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The evolution of (inter-organizational) projects to (micro-) ecosystem

An ecosystem emergence

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Executive Summary

This thesis is an exploratory case study on how projects evolve to ecosystems. The research study is demonstrated by two empirical cases provided by Telenor in a context of smart city; namely water infrastructure and air quality projects. In order for the inductive observations to be analysed and discussed, existing theories on the ecosystem concept are critically reviewed and employed to construct a temporary working definition, as well as ecosystem emergence and inter-organizational theories are presented. Project managers and senior managers within the projects are targeted as interview samples as they can provide valuable information.

Firstly, the two study cases are analysed according to the working definition and the absence of interdependency and loosely coupled relationship characteristic is identified. We then discovered the two important elements, trust and relationship, in the project setting, which also have implications on the project transformation to ecosystem. We argued that personal trust is strongly presented in the current inter-organizational project setting. However, it is necessary for this personal trust to evolve into impersonal, or system trust for a project to expand, and eventually reach a critical number of participants.

The second element we would like to highlight is relationships. We found that the existing relationship serves as the foundation of the project emergence. In this thesis, relationships are also discussed in respect to interactions among project participants. We argued that the interactions are influenced by the resources each actor brings into the project. This also implies the interdependency displayed in the project. It can be observed that, in the setting where asymmetric dependency is presented, the player, who is least dependent on other players, may take a keystone position in the project. However, it can also be the case that the keystone position is assigned to an actor, who possesses the relationship, which is also a valuable resource. In addition, we also touched upon the possible tensions that may cause the negative outcomes in this relationship setting if it is not well managed.

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Introduction

It has been discussed that a central theme in the field of strategy is related to creating sustained competitive advantage and value creation in firms and industries (Lien et al., 2016). However, the business battlefield can be seen as changing. In this dynamic environment driven by digitization, the ecosystem concept emerged and popped up everywhere in diverse industries. When discussing ecosystems, people normally think of and are interested in the very dominant and successful ones, such as Apple ecosystem, Android ecosystem or Alibaba ecosystem. It is also reasonable to say many companies are aiming to become one. However, even though dominant ecosystems have been in the spotlight for sometimes already, the birth or their first step of becoming ecosystems is still a mystery. Although the ecosystems have been studied by multiple researchers from different fields, there is no concrete instruction of 'how to become a dominant ecosystem' published. Just like that, the ecosystem concept is still vaguely understood regardless of how compelling it is.

The ecosystem concept has been introduced, at latest, since 1993 by Moore, and discussed in diverse fields of studies ever since. Moreover, the term 'ecosystem' has been scatteringly cited in various contexts, such as the technology field (Appio et al., 2019), politics and culture field (Kreutzer, 2018), sustainability field (Evensen & Kähler, 2014), and business field (Eaton et al., 2014). On the contrary, the number of researches in business and strategy field is still limited considering the prevalence of the phenomenon. On top of that, the theory built within the ecosystem regime is relatively ambiguous since there is no apparent grounded theory commonly affirmed so far. However, the limitation in the number of ecosystem studies does not mean that the importance of the understanding of this concept is diluted. Contrarily, as mentioned earlier that the ecosystem is dominating the business world, the shift in business competition, value creation and capture are observed (Birkinshaw, 2019). Thus, understanding the ecosystem is very important not just for the preparation for the ecosystem fight, but also for the survival in the dynamic environment.

In Norway, ecosystems have been presented in many industries for several years. The examples can be named as the Banking ecosystem (Eaton et al., 2014), IT-start-ups ecosystems (Tatar, 2014) and smart city ecosystem (Ahlers et al., 2019). Additionally, smart cities ecosystems are launched in many cities such as Oslo and Stavanger. In Trondheim, the smart city project is also initiated by the municipality together with Telenor, who plays a key role. Telenor, as the

central player, brings in partners from its partner bank to create the water infrastructure project and air quality project, which are focal study cases in this thesis. Both cases are one of several projects within the Trondheim smart cities.

The supremacy of ecosystem concept is resilient; however, our interest lies in its emergence process where the research studies are still lacking, implying also the broad areas to be explored. Some argue that the business ecosystem emerges throughout the business landscape and across industries, having the Internet of Things (IoT) with the shifting in customer's demand and other changing technologies (Lang et al., 2019). This argument is generally lacking the supporting empirical evidence. Thus, in this paper, the emerging phrase of the two study cases is the objective of the study. Moreover, considering the fact that the two projects are still in the early phase, we find it supportive to our thesis purpose.

In this paper, a critical review of current literature on ecosystem phenomenon is presented first, including the ecosystem life cycle theory proposed by Moore (1993), and inter-organizational project theory is also discussed in this section. Then, we moved over to the research methodology discussing the multiple case study, semi-structured interview approach adopted to fulfil the exploratory research purpose. Here, the methodology limitation and ethical concerns are addressed accordingly. Next, the Findings and Discussion section will start with the analysis on each case regarding the ecosystem characteristics based on current working definition. Moreover, key observations like trust and network relationship will be examined thoroughly. Finally, limitations of the paper and areas for future research are considered before the conclusion is casted. Again, the case study method adopted in this thesis hinders the generalizability of findings and the novelty of the phenomenon contributes greatly to the scarcity in the literature. This study is still another step towards the discovery of this emerging phenomenon as the existing theory is challenged and the areas for future research are highlighted.

The research question for this paper is wrapping around the ecosystem emergence as the main theme and we are focusing on

"the evolution of (inter-organizational) projects to (micro-) ecosystem."

Theory

The literature on ecosystem phenomenon spanned out into multiple fields of study, from technology, to legal, and business. In this thesis, the major theme lies within the implication of ecosystem emergence in the business field, more explicitly in the scope of strategy and management. The research papers within such fields are growing in numbers but still lack the central theme. Despite the absence of a fundamental framework, a working definition must be developed, in order to conduct the research thesis. Thus, from our literature search and discussion within the research group, the main literatures are selected based on what we found most relevant, frequently cited and in which the arguments are solid. Moreover, we ensure the completeness and timeliness of the literature as we looked up the publication in the year the ecosystem was first mentioned, in 1993, until the year this thesis is written. From these literatures, we built up a common grounded working definition, which serves as the temporary definition of ecosystem.

The ecosystem concept may be simply manifested with the assistance of an ecology metaphor. However, its emergence process which we aim to explore is more difficult to observe. Thus, we suggest that the emergence processes are illustrated as the roadmap towards becoming the ecosystem. Subsequently, we look at the ecosystem as the destination of the roadmap, then identify and observe the process and components along the way. Without an appropriate definition, the observation of the emergence is not reasonable as there is no clear direction where the ecosystem is moving towards. Hence, in this section, first, we introduced the current working definition of the ecosystem characteristics as the main theory of this thesis. Secondly, the business ecosystem life cycle is included to fill in the gap in the existing studies. Lastly, the inter-organizational project theory is added to elaborate the work in this thesis.

Ecosystem Theory

The concept of ‘ecosystem’ has entered business domain since 1993 (Moore, 1993) and been discussed extensively in both academic and management perspective over the past decades (Iansiti & Levien, 2004; Boley & Chang, 2007; Jacobides et al., 2016; Cennamo, 2019; Thomas & Autio, 2020). However, the increasing numbers of research articles and growing attention about the ecosystem metaphor do not directly contribute to its lucidity.

Even though current academic literature regarding the ecosystem concept lacks its lucidity and grounded understanding, there are common characteristics of the ecosystem that were broadly described. Foremost, the ecosystems emerge as the doing of *heterogeneous actors*. After the concept of ecosystem was introduced by Moore in 1993, the term 'Business ecosystem' was again discussed by Iansiti and Levien (2004) in the sense of business structure that goes beyond traditional value chain and emphasizes the coordination in more expanded boundaries and involves more immense sets of participants. Many researchers supported this underscoring on relationships, boundary, and interdependence and added up ecosystem insight in this context (Iansiti & Levien, 2004; Boley & Chang, 2007; Thomas & Autio, 2020) as categorized by Adner (2017) as 'Ecosystem-as-affiliate' perspective. The source of the heterogeneity characteristic was often posited as a spread of a business boundary which allows the entrance of the new players from diversified industries, sectors, and geographic locations (Iansiti & Levien, 2004) and/or the ease of communication and coordination promoted by the digitalization (Thomas & Autio, 2020).

The second commonly agreed characteristic was that the relationships rested in an ecosystem setting are *non-hierarchical* and can be in a formal or informal manner. Even though the ecosystem relationship is fluid and seemingly in the independent form, some formal mechanisms and traditional relationships such as contractual relationships and platform governance could often be found in various scenarios (Jacobides et al, 2016). The ecosystem in more recent articles transcended to more digitalized ambiance. Boley and Chang (2007) introduced the added element of shared explicit formal semantics that transformed the business ecosystems to digital ecosystems. The shared explicit formal semantics expedites the high-quality communication and automation among broad areas of involved entities. Moreover, Thomas and Autio (2020) aggregate insight on participant interdependence as it resides in technology as one of the focal aspects.

Furthermore, the interaction is often *loosely coupled* with *economic complementary*. Iansiti and Levien (2004) previously mentioned that the business ecosystem entailed complementarity. Then, complementarity was further discovered by Jacobides et al. in 2016 where the ecosystem is defined as *'a set of actors with varying degrees of multilateral, non-generic complementarities that are not fully hierarchically controlled.'* The generic complementarity is ruled out from the driver of ecosystem emergence due to a limited degree of economic impact. Hence, the complementarity found in the ecosystem setting is arguably super-modular

or ‘Edgeworth’ type and complement relationship can also be one- or two-way (co-specialization). Moreover, the authors also highlighted that within the modular structure of the ecosystem, the standardized formal or informal relationships are established with limited coordination required.

Lastly, one commonly agreed characteristic of an ecosystem is the *ecosystem-level output*. Iansiti and Levien (2004) demonstrated that the business ecosystem concept of formerly new business structure emerged because the success of one business is dependent or influenced by surrounding businesses as well. This statement exhibits the characteristic of the ecosystem-level output. On the other hand, the ecosystem-level output can be encountered in the ecosystem definition posited by Adner (2017) as *‘the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize’* where the *‘a focal value proposition’* equals the ecosystem-level output. The author also accentuated that the multilateral relationships underlying the ecosystem are indecomposable to multiple relationships.

In short, the ecosystem can be temporarily defined as *‘loosely-coupled complementary economic agents carrying the heterogeneous and non-hierarchical nature interact with the non-contractual governance mechanisms to produce a common ecosystem-level output.’*

The theory on ecosystem emergence took off by Moore (1993) when the four-stage evolutionary model of ecosystem creation was proposed. However, the theory on ecosystem emergence was later developed and discussed in the more modern setting of platform economy. Yet, it is still broadly controversial. Apart from the undiscovered emergence of ecosystem concept, other aspects like competition, resilience and coevolution are presently unclear and allot so much room for researchers to discover.

Even though the concept of ecosystem has come into some commonly agreed characteristics, the digital ecosystem has not. It is still ambiguous whether the ‘digital ecosystem’ has its particular definition, or it is intrinsically just the ecosystem that has been digitized. In the specific setting of this research, the focus will not be on the degree of digitization as we look at it as the ecosystem with digital infrastructure.

Based on the novelty of this concept, there are several interesting areas for researchers. However, in this thesis, due to the resource restriction in both time and manpower, we scope down our focus to the relationship aspect among ecosystem participants, where we will also

touch upon the interdependency characteristic. In this paper, we will base our work on this current theoretical ecosystem framework, however, it does not imply that this working concept is finalized. Contrarily, we would like to depose the current status aiming to strengthen the argument or broaden the perspective. Claiming so, we will later bring in the ecosystem emergence theory, posited by Moore (1993) to address the absence of the discussion regarding the emergence in the literature included in this section. Afterwards, the inter-organizational project theory will also be introduced to supplement the missing point in the existing theory.

Ecosystem emergence

After examining the ecosystem's characteristics, we can now identify interesting components of an ecosystem. Furthermore, in order to achieve the purpose of becoming an ecosystem, the first step is to understand how an ecosystem occurs. The existing research often deals with an already existed business ecosystem, but few studies discuss how it all started, or the emergence of an ecosystem.

The term *'ecosystem'* is not just widely cited in diverse contexts as mentioned earlier, but it is also endorsed with different prefixes in different domains, such as business ecosystem, platform ecosystem, or digital ecosystem. However, after carefully reviewing the literature discussed in this thesis, we found that the authors seem to point out to the same *'ecosystem'*. To avoid confusion, we consequently decided to use the theory of *'business ecosystem life cycle'* proposed by James Moore's (1993), who is the originator of the concept and is among one of the most recognized in this field. By using this terminology, we want to give the ecosystem a starting point that we can further develop.

Ecosystem life cycle

Moore (1993) proposed a theory of four stages of business ecosystem life cycle; birth, expansion, leadership, self-renewal or death. In reality, the stage is more indistinct, and we will only emphasize the very first phase of the life cycle, birth, as we aim to study the emergence. His business ecosystem consists of *'a network of organizations and individuals that co-evolve their capabilities and roles and align their investment to create additional value or/and improve efficiency'*. Moore (1993) explains that a business ecosystem starts out as *'a random collection of elements that then changes into a more structured community where the*

interconnection of capital, consumer interest and innovation opens up opportunities for a new ecosystem'.

Moore (1993) pointed out two important elements in this first stage of an ecosystem life cycle, birth. The first is *'best define and implement customer value proposition'*, and the second is *'the innovation seed that the ecosystem will be built around'*. Moore (1993) also emphasizes the importance of ecosystem keystone position. In addition, he points out that firms must protect ideas and innovations from potential competitors.

The mapping of shift in customer needs and change in products to services and/or solutions provides the new basis of doing business and opens room for multi-party collaboration and integrated solutions. Normally, firms possess local market knowledge within their own field, but with increasing demand for integrated and seamless solutions, demand and transaction uncertainties arise (Jones & Lichtenstein, 2007). Thus, companies resort to external expertise to uncover the risk factor and define new value propositions (Moore, 1993). This points out the correspondence with the complementarity and value co-creation of ecosystem output discussed in the working definition of ecosystem in our thesis project.

The ecosystem *'leader(s)'* position must be able to plan and spread investments around the *'innovation seed'*. An idea of building the ecosystem around the seed is to invite more actors into the ecosystem, and together allow the whole ecosystem to work, then improve the product system. For example, the innovation seed can take form as a significant system that has the potential to achieve economy of scale and scope, or the technology that is easily *'plug and play'* to reduce the barrier for multiple players to enter the ecosystem. Inviting additional 'follower' companies into the ecosystem is enhancing the ecosystem complementarity and fulfilling the product system, plus it is advantageous in stopping these actors from contributing to other ecosystem emergences (Moore, 1993).

Moore's theory provides an overview of important observations, specifically, when an ecosystem is born and functioning, but still lacks supporting details about the mechanisms that must be in place to achieve the goal of becoming an ecosystem. Additionally, the theory does not include the process before *'birth'*, i.e. the *'pre-birth'* stage. To better understand ecosystem emergence, it is particularly interesting to study how firms and organizations connect and collaborate in the so-called *'random'* manner before becoming more harmonized and structured. To uncover this issue, we want to explore the birth of the ecosystem at project level,

because this is where inter-organizational collaboration and coordination usually starts. Eventually, we will also be in need of understanding inter-organizational project-based theory.

Inter-organizational projects

The inter-organizational projects, discussed by Jones and Lichtenstein (2007), demonstrated two or more organizational actors from distinct organizations working jointly to create a tangible product/service to solve the uncertainty in demand and in transaction in a limited period of time. The inter-organizational project is distinct in its temporary nature, yet range can be from a few weeks to several years. However, the key for this type of project is coordination and collaboration among actors to succeed the project, where individual goals can be disparate and actors' profile, such as expertise and responsibility, are normally diverse.

There are two important aspects discussed in this literature; the temporal embeddedness, referring to time-oriented project organization, and *social embeddedness*, which is the focal aspect in this paper.

The term *'Social embeddedness'* is proposed as *'the frequency, duration, and pattern of dyadic interactions for an individual or organization'* (Granovetter, 1985). From this, Jones and Lichtenstein (2007) defined social embeddedness in terms of '*inter-actors ties and how economic action and outcomes are affected by actors'* (Jones & Lichtenstein, 2007). The social embeddedness is illustrated in two aspects; relational embeddedness and structural embeddedness. The social embeddedness demonstrates the quality of mutual exchange, where the knowledge and consideration of other actors' needs and goals are reflected (Granovetter, 1992), and the behaviour of exchange, where trust, confiding and information-sharing are exhibited (Uzzi, 1997).

The structural embeddedness is the extent to which dyad mutual contacts are connected to one another (Granovetter, 1992). The interactions are influenced by the complexity of tasks (Jones et al., 1997), discussion among organizational actors and anticipation about future interactions. The interactions also allow actors to learn each other's system (Eccles, 1981; Faulkner & Anderson, 1987), and to develop communication tools or work routines (Bryman et al., 1987). Jones and Lichtenstein (2007) argue that the structural embeddedness facilitates shared understanding and collaboration rules, and coordination.

Moreover, trust can also be created and evolved. Trust is a basic fundamental in order for projects to function. Luhmann (1999) divided trust into two types; *personal trust* and *impersonal trust*, which the first one applies to trust between people, while the last is about trust to a system or institution. Both personal and impersonal trust are experience-based (Myerson et al., 1996), which can be implied that it is dependent on the reliability of the person or system as the inconsistency will result in the weakening of trust. Many actors are entering a project with trust in their partners, and trust is needed because it is a mechanism that reduces the complexity (Luhmann, 1999) within projects. Trust allows us to lower our guards down and reduces the necessity of control in every process. Since trust is developed from prior experience and prerequisite for the project participation, it is implicit and occasionally taken for granted (Berger and Luckmann, 1967). Trust can also be based on the degree of rational reasoning, such as risk assessment and project evaluation. A higher degree of rational reasoning is necessary in the project associated with higher risk (Grimen, 2009). Grimen (2009) also presented the term *'chain of trust'* in which he explains that trust can arise between different links in a chain, referring to *'A trusts B, who trusts C, who in turn trusts D. Actor A has depended on actor D'* (Grimen, 2009). In the project setting that involves several actors, chains of trust can compensate for the process where trust is built between two actors. Consequently, it takes less time for the project to emerge and is more flexible for the actors to enter and leave the project. Thus, this is needed in order to invite more actors in projects, and we believe it is also important in the transition from project into an ecosystem.

On the other hand, it is also important to discuss the potential concern regarding embeddedness or relationship. Tension in the network of actors has been under the spotlight for decades. Since 1984, Gaski has posited that the actors' perception regarding other actors impeding their goals may cause tension in the network. In the more contemporary setting of the inter-organizational network, Johnston and Pongatichat (2008) posited that the hindrance of alignment of actors' objectives and interaction practices can be the cause of tensions. Tension can be caused by the imbalance between actors (Hummon & Doreian, 2003). Moreover, the inter-firm contractual relationship presented in this project constituted the risk to tension as well (Rese & Roemer, 2004). Three types of tensions that can be presented: structural tension, related to the governance and control mechanisms, psychological tension, related to actors' attitude, and behavioural tension, related to actual practices and actions (Tóth & Shan, 2018).

The pattern in relational and structural embeddedness has implications on the coordination mechanisms and management of the project. This embeddedness, on the other hand, can be seen as the interaction or relationship discussed above in the ecosystem theory. The social embeddedness is closely linked to the interdependency characteristic of ecosystem, while its sub-element of relational embeddedness and structural embeddedness collude with the goal or incentives and governance mechanisms of the ecosystem. Thus, the theory of inter-organizational projects is believed to contribute to the study of such characteristics of ecosystems in the pre-birth phase where the project setting is more strongly presented than the ecosystem setting.

Empirical setting

As we are writing this thesis, we are participating in the Digital Innovation Growth (DIG) research program, aiming to discover the digital ecosystem concept, with collaboration from several public and private participants. Telenor, one of the program participants has agreed on being the corporate case study for several theses in this program because they are currently working on several projects where air quality and water infrastructure cases are among these.

Telenor has been in the Norwegian telecommunication market for decades with its strong market position. The telecommunication industry is showing signs of saturation with characteristics of high degree of standardized products and intense price competition (Elter et al.,2018). Moreover, the market outlook signals shift in focus from the standardized product itself to products or services built up on technology like connectivity (Deloitte, 2019). This implies that the value of the telecommunication products is migrating or shifting away from Telenor to other companies. Thus, Telenor is now working on enhancing the value of its existing core product portfolio; connectivity and platform. One of the action plans is to explore the new market opportunities in providing integrated solution products through use cases in several promising areas. In this paper, the focus is on the water infrastructure and air quality cases lying as parts of the smart cities project.

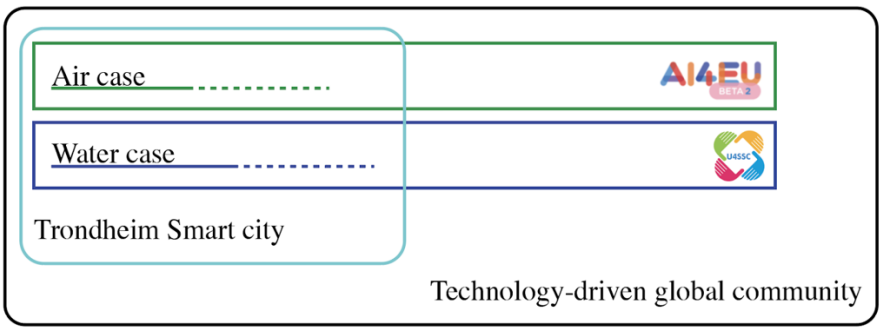
Different units in Telenor structure

In this thesis, there are two main internal units involved, which are Telenor Norway, also called Business unit, and Telenor Research unit. These two units both operate independently but occasionally cooperatively. Each internal unit has distinct roles and responsibilities, which will lead to different implications when the data analysis is performed, especially in the areas such as incentives to join or collaboration mechanism. Generally, the business unit plays a key role in the business and commercialization cases, while the research unit is responsible for the technology development process. It is often the case that the technology products are handed on from the research unit to the business unit after the technology development is completed and the products are ready to commercialize.

The strategy of use cases and scale up

To carry on the research and development on new technology obviously requires vast amounts of upfront investment and is resource intensive. Even though Telenor may have the capacity to do so, it is considerably too risky. Instead, Telenor chose to participate in the global research programs to gain access to valuable resources both in monetary and non-monetary forms. However, to develop integrated solution products requires particular knowledge and expertise that could not be gained just by participating in the programs, Telenor then turned to one of its key resources, its relationship with partners.

In this paper, the scope is limited to two cases of water infrastructure and air quality, involving two global programs of U4SSC and AI4EU, respectively. Under the U4SSC program, Telenor business unit is currently building the *'smart'* water infrastructure for Trondheim Smart city. In the meantime, Telenor research unit is experimenting with the air quality monitoring dashboard as part of the AI4EU protocol and obliquely connected to the 'smart city ecosystem'. In the smaller scale as a project, Telenor still adopts the use case strategy to experiment the technology before scaling up when the potentiality is promising. The technological experiment is accountable by the exploratory unit.



Even though both water infrastructure and air quality projects are operating simultaneously within the same Trondheim smart city ecosystem, they are independent from each other. They serve as the use cases for technological advancement, but the success or failure of each project does not affect one another. To put in other words, they do not present any complementarity. However, it can be assumed that the terminal of these two projects is the (micro-) ecosystem nested together within the comprehensive smart city ecosystem. The nested ecosystem is explained by Christensen & Rosenbloom (1995) as *'Business ecosystems are nested commercial systems where each player contributes a specific component of an overarching solution.'* Nevertheless, Telenor aims that the business model employed in the water

infrastructure case will be replicable in the air quality project as well as other use cases. Anyway, this is yet to be explored further.

Furthermore, Telenor also scales on its partner network (Elter et al., 2018), which is relevant to this thesis, in two ways. First, Telenor advances its technological experiment engaging the collaboration with its research partners, for instance Norwegian University of Science and Technology (NTNU). Second, Telenor collaborates with its partners to co-create value to the customers and to offer the integrated solutions where Telenor's existing products are put in the new setting or combined with the additional features to offer extra value.

The smart city ecosystem

There is no sole definition of smart city both practically and academically (Díaz-Díaz et al., 2017; Letaifa, 2015). However, in this research, a smart city ecosystem is presented as the holistic ecosystem where several ecosystems are underlyingly embedded. The smart city ecosystem is initiated based on the collaboration across and between public and private sectors aiming to achieve the public benefit (Díaz-Díaz et al., 2017; Boes et al., 2015).

In both practical and academic setting, the smart city incorporates various technology, such as Internet of Things (IoT) (Díaz-Díaz et al., 2017) where technology is identified as one of the key aspects in smart city ecosystem (Díaz-Díaz et al., 2017; Khomsi, 2016; Letaifa, 2015). The International Telecommunication Union (ITU) defines the Internet of Things as *'a global infrastructure for the Information Society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies'* (ITU, 2012) where IoT solution may involve Artificial Intelligence (AI) and cloud services. AI is the study and implementation of techniques that allow actions requiring intelligence on the part of a human, to be performed on computational devices (Plant, 2011).

In this case, the Trondheim smart city project comprises several aspects; water, air, traffic, flood, and many more. However, Telenor, as an agent, is currently working on the smart water solution for its principal, Trondheim municipality, in collaboration with many key stakeholders. The project was initiated by the municipality of Trondheim as the customer, yet, the keystone position in this project is taken by Telenor. The objective of this project is aligned

with the United Nations Sustainable Development Goals (UNSDGs) and the United for Smart Sustainable Cities Implementation Program (U4SSC IP) which are at global level.

The water infrastructure case

Having a product portfolio limited to connectivity and platform, Telenor needs ecosystem partnership to build up this smart city ecosystem. In the water infrastructure case, the problem to be solved lies in the city water infrastructure that is handled manually without advanced assisting tools and sufficient professional insight. The damage is costly considering the fact that the water supply is although abundant yet limited. Moreover, the absence of detection and sufficient information may lead to inadequate water production decision and leakage monitoring activity. Likewise, the municipality, as a public player, also faces the social expectation and pressure concerning the service quality, as well as the formal evaluation by the government and other authorities, such as the United Nations. Lastly, this problem opposes the investment challenge for the municipality as well because the water infrastructure itself is expensive and pipelines are less invisible compared to other investments such as healthcare and education.

Consequently, Telenor partnered up with Pipelife, which is one of the major partners, who is greatly competent in the water infrastructure industry, with the leading market position and long history of success. Another partner is Webstep, which is the one with the expertise in data visualization and application. Webstep is relatively young, yet in a promising position in market and size. Together with close collaboration with the municipality, the water infrastructure project is constructed. For all the independent entities to coordinate, the relationship structure must be decided and agreed upon. From Telenor's perspective, this collaboration and construct can be considered as the value-enhancing activities to its existing product portfolio. Additionally, such a pioneer water infrastructure project could also serve as the use case for its advancing technology. Telenor also expects scalability in this evolving project in the fairly young market.

The project participants on the supplier side have been working together to solve the water leakage in the water infrastructure since 2018. The project is currently in the early phase where the technology is being developed by each responsible party. At the time this thesis is written, the integrated solution product is not yet finalized and delivered. In our perspective, the project

is in the transition phase to the ecosystem emergence. However, this aspect will be more thoroughly discussed later on in this paper.

The air quality case

Starting in 2017, Telenor research unit has been experimenting with IoT technology. In April 2018, they applied to participate in AI4EU project, which is a part of Horizon 2020, a European research program. The AI4EU project started in January 2019 and will last until December 2021, totalling to 3 years. At the time this thesis is written, the technology in this project is still in the development phase. The project objective is claimed to be mainly to mobilize the European AI community and respond to the U.S. and Asia initiative. However, for Telenor itself, the decision to participate in this AI4EU project is more for strategic positioning rather than for monetary profit. The project experiment could also be the use case for Telenor on their existing and developing sensor and connectivity technology. Moreover, this could also create a good public relation and assist the business unit to enhance the company's product portfolio.

The project is focusing on building a tool to collect, analyse and visualize air quality data. The significant components here are the data gathering tool and analysing tool. The analytical tool is AI, Machine Learning (ML) data-driven model using a set of admissible data to predict the air quality. For the ML analytic to develop its accuracy, the sufficient amount of relevant data is essential. Consequently, Telenor gains access to needed information through open-API from several entities. They obtain the weather data from Methodological Institute (Yr), traffic data from National Road Authority of Norway, and air quality data from industrial sensors from Norwegian Institute of Air Research (NILU). Regardless of which, Telenor does not so far own any of this data stated above. Moreover, they also obtain the estimated number of populations from the number of its users connecting to its base stations in each specific area.

Furthermore, Telenor together with the student groups from NTNU, are currently experimenting in small sensors that are adherable to vehicles to collect air quality data in the larger area. They also supervise the student work on the visualization dashboard and application. However, for these small sensors to transfer the data they collected, the connectivity is needed, which is the gap Telenor bridges. With more amount of sufficient data, it is believed that the analytical tool will come up with a more accurate forecast. Presently, the degree of the forecast accuracy is still under research and experiment. At the end of the project, the data visualisation application is expected to serve as the final product, which would be

owned by Trondheim municipality as the customer along with the visualized data. Nevertheless, the technology and insight developed throughout this project can be reused or further developed by any involving partners. Subsequently, the ecosystem components and the relationship structure will be later investigated in the ‘Findings and Discussion’ section.

Methodology

This section describes the methodology employed to construct the study in this thesis. Firstly, the research purpose will be affirmed along with the basis for the methodology selection. Secondly, the solid action plan underpinning how this thesis is undertaken will be detailed in the research strategy. After that, the data collection procedure will be discussed, also with the types of data to be gathered and the method to be applied. Next, the data analysis will be presented, specifying how the data is transcribed, coded and evaluated. This also concerns the quality appraisal of the data utilized in this thesis. The methodology section will be concluded with the reflection on limitation in this research and the ethical concerns.

Research purpose

We can often identify an ecosystem when it is up and running, but it is more difficult to observe in its early stage. Often, an ecosystem just exists unintentionally, rather than as a product of a long-term strategic planning (Lang et al., 2019). Among other factors, we believe one of the reasons may be due to lack of theoretical grounding and understanding of ecosystem emergence. This thesis will follow an inductive reasoning, meaning that we will try to find out more by collecting data and observations to supplement empirical evidence. Furthermore, the findings will be used to identify patterns to build up tentative hypotheses, then lay theoretical fundamentals of the ecosystem concept. The main purpose of this paper is to explore more about the ecosystem emergence phenomenon and dig into detail of how collaborative projects between inter-organizations evolve into micro-ecosystems. By focusing on the transition process from projects to ecosystems, we aim to reveal some of the mechanisms that facilitate the emergence of ecosystems.

Choice of methodology

Our starting point is the two case studies provided by Telenor concerning smart city; water infrastructure and air quality. The two cases also come with three contact persons from Telenor. These contacts are intended to be resource people who will bring in information about these cases. The participants have the roles as project managers and are responsible for the projects. They possess important data, such as information about internal processes, routines and interactions within the project group. In addition to the project managers, we also get in touch

with a senior researcher who will give us an insight in the technologies Telenor uses in their projects.

Additionally, based on Dubois and Gadde (2002), the interaction between a phenomenon and its context is best understood through in-depth case studies. As this research focuses on the emergence attribute of the ecosystem phenomenon, the inductive case study research design is adopted (Ridder et al., 2014). According to the case presented in the previous section, the air quality project and water infrastructure project are nested within the smart city ecosystem. To best understand the emergence and interaction within and between each project setting, the multiple case study method is most suitable. The focal case presented the embedded setting of the ecosystem (Yin, 2014). Hence, the multiple embedded case study method is used in this research. To obtain the most relevant information, we decide to collect two types of data; primary and secondary data, in addition to using the research group as a discussion forum.

With the resources mentioned above, the structure of our research design will follow the nature of the qualitative approach where the interview participants' answers will be the main source for the primary data collection. Building the thesis on a qualitative method will also give us access to a large amount of data through interviews, discussions and information exchanges which we plan to implement during the data collection process. Given the limited research on the topic and the opportunity to obtain rich information from the participants, it complements the exploratory research approach. The value of an exploratory study is to ask open questions to discover what is happening and gain insight on a topic of interest (Saunders et al., 2016). By using this approach, we can gain valuable data and clarify our understanding through interviews and discussions with the participants within the project. The methodology will allow us to exchange ideas and thoughts about the topic. We hope this method will continually provide us new information and insight along the way. Exploratory study will also give us more flexibility to adjust our understanding to new information throughout the process (Saunders et al., 2016).

At the same time, we will use secondary data sources and literature review to lay the theoretical foundation for the interview guide. However, we are aware that the nature of this approach will make the interview process unstructured, and the quality of the research will rely on the answers of the participants (Saunders et al., 2016). Therefore, we will need to conduct a clear preparation guideline for the interview and be flexible to new information to limit the errors along the process.

Research strategy

In this section, the research strategy will be presented where the concrete action plan to answer the research question (Saunder et al., 2016) is detailed by linking between the research philosophy, methodology choice and the data collection (Denzin & Lincoln, 2011).

In the first instance, we will use secondary data collection to gather relevant information. The secondary data may be pre-existing information located on the Internet or in the database of the Norwegian School of Economics. In addition, we can ask the informants for relevant project-specific documents. For example, this data may be basic information related to the relevant actors and project, or it may be theories of the ecosystem theme. We can then use this information to generate ideas and overviews about the specific project and ecosystem concept. Utilizing secondary data is a very useful and effective method (Saunders et al., 2016), since the information already exists, which means that we can save time and resources on the data collection process. Assumedly the secondary data does not cover all the problem specific matter, we then resort to primary data collection. Secondary data should give us basic understanding and knowledge which we can use as a foundation to design primary data collection. The primary data collection is the data collection method linked directly to the ecosystem theme and cases that we ourselves are studying.

We find the semi-structured interview approach most appropriate for several reasons. First, this type of interview can give us opportunities not only to explore the topic in question, but also at the same time gives us opportunities to angle the interview in the direction that we think is relevant to our problem statement. Moreover, it allows us to establish a connection with the interview participants, who are our primary data sources, to create trust and flow in the interview process. Then, we can discuss the schedule based on the time constraints of this thesis. The first interview guide will be designed for the interview to provide us an overview of the topic as we want to explore and map our understanding of the ecosystem. It includes gaining an insight of the participants' understanding and their perspective of an ecosystem. In addition, we want to chart their attitudes towards the ecosystem, specifically incentives and coordination. The question will likely be formulated as open questions such as:

"Can you explain us about ecosystem in your understanding"

In total, we plan to conduct approximately three interview rounds. After the first interview round, we scope our topic of interest into ecosystem emergence. We can use information from the first interview and supplement with additional secondary data to form the second interview guide. Later, the second and third rounds of interviews will be scoping down and focused on the work process in project coordination mechanism along with other factors concerning the issues of ecosystem emergence.

We will decode and place the data collected in the interview processes into categories. We assume that there will be a lack of comprehensive data after the first interview round since it is not specifically addressed to our problem statement. After each interview round, the answers will be transcribed, and the findings will be sorted. Subsequently, the findings will later be categorized to facilitate coherence with the theories. For example, all the answers that relate to ecosystem characteristics will be put into one category, and project collaboration will be put into another category. Thus, we will use the findings of the first interview round to look for areas where there is missing or unclear information. Furthermore, in the second interview round, we want to delve deeper into the process of ecosystem emergence from projects. If there is still a lack of data, we will conduct another round of interviews to clarify and cover the errors.

Working within a research project also gives us opportunities to share and compare information and discuss with other research fellows about the topic. This also allows us to generate ideas across the groups, and to create a deeper and broader understanding of the ecosystem phenomenon.

Data Collection

Throughout the research program, there has been ongoing collaboration among student groups as the questions, findings and insight have been shared and discussed. Most importantly, the collaboration with case representatives, who are the personnel from Telenor, allows us to gain and develop insight through a set of interviews, internal documents, and internet-mediated communications. Associating with our research objective to explore the ecosystem phenomenon, the qualitative data is used to provide a deeper understanding and to develop in-depth insight about the ecosystem emergence. In this section, the data collection method will be discussed, inclusive of its characteristics and evaluation.

In this thesis, both the secondary and primary data are collected. The secondary data is obtained both in form of publicly available data from the external sources and internal project documents from Telenor. In addition to that, the primary data is obtained through the semi-structured interviews and is a main source for the analysis.

Internet-mediated communication to obtain secondary data

Prior to the interviews, the secondary data is obtained from the case representatives through internet-mediated, or email communication. Since both cases are part of a global program, there are two types of documents involved. The general information about the U4SSC and AI4EU research program is obtained from the external websites, as well as the framework about smart cities ecosystem, to gain the fundamental understanding and overview of the cases and the programs. Moreover, the specific case information is given via the project descriptions and the project presentations, which are the internal document within the projects. The information obtained from the secondary data is not only used to build grounded understanding, but also used to triangulate with the insight we gained from the interview in the later stage.

To gain better understanding over the data we obtained, the explanations of some specific points have been clarified through the email communications with the case representatives. Developing based on the secondary data and further explanations we received, the interview theme is prepared, incorporating the aspects of the ecosystem emergence we aimed to explore. This interview theme is also prepared with guidance from the supervisors and the discussion with the student groups in the research program as the comments are given and exchanged. The interview theme can be found in the Appendix I.

The information obtained from the secondary data is thoroughly studied and elaborated against another set of secondary data we obtained from external websites, both suggested by the Telenor representatives and researched by ourselves.

Semi-structured in-depth interviews

The suitability of the qualitative interview is evaluated in accordance with the four aspects of advantageous data collection (Saunders et al., 2016). First, the purpose of the research regarding exploring and understanding the emerging ecosystem phenomenon would make the qualitative interview beneficial. The nature of the qualitative interview will allow us and the informants to explore and investigate the newness of the ecosystem concept. Second, the

informants' senior to manager position are more likely to prefer an interview to a questionnaire, especially when they think the topic is interesting (Saunders et al., 2016). Since the informants are specifically selected as the case responsibles and participating in the projects for some time, it is fairly believed that they have solid interest in ecosystem concept as well as sufficient knowledge about the topic. Third, the nature of questions to be asked are basically open-ended, and the logic or order may need to be varied (Saunders et al., 2016; Easterby-Smith et al., 2008; Jankowicz, 2005). We believe the combination of these question types will help us get the most out of the interviews. Moreover, since both the ecosystem concept as well as the project and the technology setting are complex, it is fairly difficult to set up the fixated interview guide. Thus, it makes more sense to just have the interview setting as the semi-structured and let the informants lead the interview. Last, the time needed for the participants to complete the questions is more suitable to adopt the interview rather than other methods, considering the amount of information we plan to seize in this ground-breaking ecosystem concept. Summing up, the qualitative interview will be the main tool to collect data in this research.

To explore this ecosystem concept, the qualitative research interview (King, 2004) method is adopted, in other words, the interview method is semi-structure, in-depth and non-standardized (Saunders et al., 2016). In the semi-structured interview, a set of interview questions are prepared in accordance with the prepared interview theme (Saunders et al., 2016). The interview theme is initially set as: first, Incentive to join, second, coordination and collaboration mechanisms, third, technology, and lastly, specific project information.

The interview guide consists of open questions, probing questions and specific questions. The open questions are used to encourage the interviewees to provide an extensive and developmental answer so the researchers can observe and extract as much relevant data as possible (Saunders et al., 2016). In the interview, we plan to start with the open questions to let the informants express their interest and thoughts as well as their knowledge on the case.

One example of the open questions used to ask about the incentive to join is *'What are the criteria you use to choose the partners?'*. Moreover, the coordination and collaboration mechanisms can be discovered by asking *'What are your main coordination tools used to communicate with other participants in the project?'*

Then, the probing questions are asked to dig deeper in the aspects that are relevant to our research objective. The probing question like *'Can you explain more about the agreement?'*

can elaborate on the topic of coordination and collaboration while '*What technology do you already have in-house and what technology do you need to develop further to fit the project?'* can interrogate more about the technology in the projects.

Lastly, specific or close questions are asked sometimes to confirm the fact and obtain specific points. The example of a specific question asking about the specific project is *'Who is the end customer in this case?'* and '*In this team, do you have a team leader?'* can be asked to learn both about the collaboration structure in the project setting. At last, the questions such as 'Is there anything that we have not asked you about that you think we should know?' are asked to allow the informants to give more opinion or information that the discussion during the interview does not cover.

Prior to the interview, the interview theme with the concise description is sent to the participants allowing them to prepare on the topics so that the better quality of data can be gathered from the interview.

Since this thesis is part of the DIG research program, the selection of informants is decided in advance by the coordinators from NHH and Telenor. The informants are in a head and a senior executive position in Telenor business unit for water infrastructure case and a senior research scientist position in Telenor research unit for air quality case. In addition, all informants are directly responsible for each case. Hence, the informants' competency, knowledge and understanding can be ensured.

The conduct of the interview is two-to-two basis with two researchers and two Telenor participants for water infrastructure case and two-to-one basis with two researchers and one Telenor participant for air quality case. The internet-mediated interviews are held through Skype video conference with the informant from the research unit and through the virtual meeting room, initiated by Telenor participants from the business unit. The setting of each round of interviews for the researchers are quiet and calm with no connection and other disruptions experienced, hence there is no material issue in regard to concentration and distraction. The interviews start with a brief explanation about the purpose and scope of the thesis as the informants already acknowledged some background from email communications prior to the interviews. The informed consent regarding the audio recording is obtained at the very beginning of the interview. In addition, according to the NSD's confidentiality rules, the information sheet is electronically directed to all participants, then the consent forms are subsequently signed.

The first round of interview is mainly to explore the ecosystem phenomenon as well as the informants' perspective. With adaptable guidelines, the first-round responses allow the researchers to refine the topic of interest and a research question. At this point, we can scope down our areas of interest into ecosystem emergence, which later specify into topic of trust and relationship in the projects. Consequently, the second-round interview theme is developed based on the information collected so far. In the second interviews, the discussions are more focused, hence the more in-depth information can be obtained. Throughout the interview process, supporting information is obtained and discussed through email communications for clarification and better understanding about the topic.

While the interviews are held following the interview theme, the interview questions alter since these are informant's interviews where the researchers let the interviewees' perception and response flow freely and guide the conduct of the interview (Saunders et al., 2016). This will allow the researchers to examine the respondents' perspective and to explore the context of the ecosystem metaphor. Furthermore, this is expected to assist in refining our research ideas where the research question is not fully formulated (Saunders et al., 2016).

Data Analysis

Transcript and Coding

The interview records have been transcribed by the researchers without any assisting tools. The transcribing process typically allows us to reflect and recap the content extracted from the interview. Because the researchers already have background and understanding regarding the context and concept, the misconception and errors can be minimized. The interview transcripts are cross reviewed within the team to enhance the reliability of the data before the coding process is done. Additionally, the ambiguous points in the transcript are examined and clarified with the informants directly through the follow-up interview and email communications. Subsequently, the interview transcript has been line-by-line coded by the researchers together by going through the complete transcript sentence-by-sentence. The context and background are taken into account when the transcript was coded to enhance the quality of the findings extracted. In this process, the non-verbal responses and body language, such as pause, hitch and laugh, from the informants are interpreted and taken into consideration. For example, a pause during the response may imply that some information cannot be given due to business confidentiality.

Evaluation of the interview data

The data quality issues in relation to the semi-structure in-depth interview are reliability, forms of biases, and validity and generalizability (Saunders et al., 2016). Due to the non-standardization in the in-depth interview, the reliability issue arises concerning whether alternative researchers would reveal similar information (Easterby-Smith et al., 2008; Silverman, 2007). In this case, the informants from Telenor are specifically selected by the management, which implies the suitability of the informant selection, consequently the reliability of the data. This concern also relates to form of biases. One form of biases is interviewer bias where the non-verbal behaviours of the interviewer may influence the respondent's answer. Another form of biases is the interviewee bias, or respondent bias, which may be from the interviewee's perception with or without connection to the interviewer's influence. The validity of the in-depth interview refers to the extent to which the researchers gain access and are able to infer from the respondent's knowledge and experience.

These issues can be addressed by the researchers' careful preparation in respect to the informants' and case background, understanding of the ecosystem phenomenon, and the interview guide. With the insight regarding the interviewees' background we gained through internet search prior to the interview, the questions can be prepared in the meaningful and structured way using the understandable and suitable language level, where technical and academic terms are attentively applied and clarified. Most especially, our comprehensive understanding over the ecosystem phenomenon and relevant theory allows us to enhance the validity of the interview data as well as to build researchers' credibility towards respondents to reduce interviewee bias in such a way. Before the interview started, we thoroughly introduced ourselves and explained the thesis detail to build trust and credibility. Moreover, throughout the interviews, we attempt to maintain the neutral tone of voice, gesture, and behaviour simultaneously to prevent any interviewee's perception that might lead to any bias. Nevertheless, the interviews are still going in the pleasant atmosphere where the interviewees are encouraged to tell about their experience. During the interviews, Telenor representatives are highly willing to share their experience and project detail with us. The interviewer's understanding is continuously confirmed with the informants to ensure the accuracy of the data. The questions are asked in respect of the informant's experience where abstract and vague concepts are precluded. The discussions are carried based on real situations, while the

theoretical topic is assisted with the framework and presentation. Summing all up, the data quality is believed to be fairly sufficient.

Lastly, the generalizability of the qualitative research using non-standardized interviews is not statistically transferable to the whole population (Saunders et al., 2016; Yin, 2003). Both the case study and the research insight are based on a small and unrepresentative sample. Nevertheless, the value of the research relies upon the possibility for the findings and insights to be applicable and replicable in the way that the diverse context and setting is taken into consideration.

Analysing process

The data analysis process initially began since the coding step. The transcript for each interview is coded line-by-line by the researchers, which serves as the initial step for the data analysis to provide the comprehensive view of the case setting. The transcripts of the water infrastructure and air quality case are coded separately. The coding process is firstly to broadly categorise the information into many focal topics based on the interview theme. This process allows the researchers to focus better on the meaning of the transcript since the context is reduced into the most relevant setting. Afterwards, the categorized transcripts are read through again to find the most emphasized topic. Subsequently, the categorized data in each broad category is evaluated and the distinct points are noted, then, ulterior ranked based on the frequency and emphasis when they were mentioned. By that, the main attributes extracted from the interviews are acknowledged. The most prominent aspects we extracted from the coded transcript are *'Trust'* and *'Relationship'*, which will be elaborated and analysed afterward in the 'Findings and Discussion' section to answer the research question. In the 'Findings and Discussion' section, the current theoretical framework we built in the 'Theory' section will serve as the foundation for the analysis of each study case. Additionally, some further theory and literature will be incorporated to enhance the discussion.

At this point, the research question is determined based on the data presented. Here, the relevant existing theory and previous research works are introduced and discussed to support the main argument of this thesis. The theory and articles will be both in the contradicting and supporting perspective to the researchers' argument to mitigate the confirmation bias. Moreover, some predictions and concerns will be indicated when they are deemed significant.

Limitations

During the literature review, we notice the limited access to ecosystem and ecosystem emergence studies, which became the starting point for our exploration on the topic. Choosing a case study approach as the methodology is favourable for these types of research settings, as case study is frequently used for exploratory purpose. However, every study case is unique, where several factors may occur and influence the case setting, thus the findings could not be generalized.

Another limitation with case-study method is the difficulties in controlling the variables in a real world setting and may lead to lack of accuracy (Saunders et al., 2016). The quality of the findings will highly depend on the answers from the participants. If participants' willingness to disclose information is high, the research quality will be correlated and vice versa. However, we understand that not all information can be released due to the business confidentiality. Taken into account that the interview theme is sent in advance, it may have a negative effect that the interview subjects know the purpose of the interviews beforehand. Some specific questions may be less weighted by the informants based on their interest and restriction. Also, there might be some factors that are highly industry specific and difficult to translate, and some information may get lost in translations even though the informants are knowledgeable in the field.

In addition, data collection is mainly based on semi-structured interviews, and the interpretation will be based on our understanding of the topic. The analysis may be affected by our subjective background and experience. Other possible errors that may come from the researchers may be determined by the inexperience and limited training as interviewers. For example, we may have asked leading questions despite the attempt to avoid them. The online-conducted interviews pose the limitation to observe the behaviours of participants, such as the inability to make eye contact. Also, the time frame of the interview is limited, hence we could not explore all aspects of the ecosystem emerging phenomenon.

Besides, we have a small selection of primary data sources with few interview participants. It is reasonable to think that the breadth of interview objects can give a distorted picture of the topic, which may affect our analysis and/or the direction of the analysis. We have therefore chosen to mainly focus on Telenor's role and perspective in this ecosystem to mitigate errors. In addition, with a limited time frame of this thesis, it is a challenge to get a complete overview

of the entire smart city ecosystem, hence, we choose to narrow down the scope of the thesis. So, we can dig deeper into the topics of interest, which are trust and relationship in projects, bearing in mind that we exclude the opportunity to see coherence in the entire perspective of the ecosystem. In reality, there may be several actors involved in the projects which may have other significant implications in the analysis.

Ethical concerns

We have been concerned about the research ethics since the research design phrase bearing in mind the impact on research quality (Saunders et al., 2016). When undertaking a research of Telenor, we will need to find the middle ground between the organization's expectation and our right not to be coerced (Saunders et al., 2016). Throughout the processes, especially when the research question is defined, the researchers have the autonomy to work on the interested topic while the research objectives are fulfilled at the same time the interest of Telenor, as the representative firm, is satisfied.

Initially, the research objectives and practices are communicated to the informants both verbally prior to the interviews and written via the information sheet. Then, the informants are completely voluntarily as they are informed that they could withdraw anytime. The informants' personal information has been held anonymously and confidentially and will be deleted at the end of the research. The writing of this thesis is done in a way that ensures the anonymity of the informants so that the identity of the informants could not both be identified or referred to.

The interview themes and questions are prepared in the non-manipulative manner to avoid bias in the response. During the interview, the body language, gesture, and tone of voice are attempted to be maintained in a neutral manner. Moreover, the interviews were carried on with respect to the informants, the firm and the case. The transcript, coding and interpretation of the data are also performed straightforwardly and without bias. The information that was not directly stated is interpreted with the presentation of the original sentences.

Lastly, the research practices are documented in detail and in the traceable and repeatable way. Hence, the research can be replicated to ensure the validity.

Findings and Discussion

Since the main objective of this thesis is to study the emergence of ecosystems in the setting of inter-organizational projects in the transitioning process. Thus, in this Findings and Discussion section, the argument will be starting with the analysis of case setting with respect to the ecosystem definition to identify the current position or progress of the case, then followed by the in-depth discussion regarding trust and relationship which are the key points extracted from the semi-structured interview we conducted. Then, the perspective on the evolution direction from the current project standpoint will be discussed.

As explained earlier in the Empirical setting section, the water infrastructure and air quality projects are two independent projects within the same Trondheim smart city ecosystem. It is true that they both have Telenor and Trondheim Municipality as the key players on the supplier and customer side, respectively, still they are considered as standalone cases with limited to none connection between each other. Thus, it deems appropriate to analyse each case separately.

Analysis on Air quality case

For the air quality case, we are told that the project started as a strategic move. Telenor is pointing at a strategy where the company wants to show its position in the telecommunication market. Telenor also says that the project is to explore areas of potential usage and add more value to existing products. This focuses on making its products more attractive to both customers and partners. One way to do that is by collaborating with its partners in diverse use cases, which will allow the company to develop new types of services. In these collaborations, they are developing and testing generic components. The generic component developed here can also be tested and transferred to other use cases. Thus, value can be created and added up in other market settings and for other types of customers. At the same time, the UN's sustainable development goals (UN SDG) and society's concern open the door for Telenor to apply its generic component and explore its application more to help solving the complicated problems and environmental issues. This will direct Telenor to a socially responsible company, which creates a good reputation for the company.

In the early phase of innovation and technological development, the project consists of a few actors. There are informal discussions around the topic, but no formal contracts are attached

with parties, namely Norwegian Institute of Air Research (NILU), Norwegian Road Authority, and Norwegian Meteorological Institute (Yr). However, the actors mentioned are only providing an open-API which allows the access and usage of their non-specific or general data. Therefore, we can only confidently identify two economic actors who are the formal partners in this project, which are Telenor and NTNU. In this project, Telenor is represented through 'Telenor Research', a research unit within Telenor Group and is responsible for knowledge and expertise to be used throughout Telenor units.

We envision Telenor Group as an independent economic agent, and NTNU as an agent with non-profit interest. NTNU, which is the other formal partner, is an educational institution, does not operate in the same way as other private actors in the market. Unlike Telenor, NTNU does not have to create returns in a form of profit. However, NTNU still needs to maintain its position and size in order to receive financial support from the government. Also, in competition for the students, NTNU needs to continuously take action in innovation of new technologies. In short, Telenor unit and NTNU are two different actors that do not have a direct dependency, as they are loosely coupled through research collaborations. Telenor's core business will not directly affect NTNU's operations and vice versa. However, at a project level, students and supervisors are not accordingly independent. The students are highly dependent on the guidance to accomplish their thesis tasks, while the supervisors will need the students to do well in order to push the technology further.

As the technological research in the student thesis is the link between actors, the relationship between these two actors is seen as complementarities. The cooperation is developed in the form of supervision guidance and advice. Here, a representative from Telenor Research gets to act as a supervisor for NTNU' students in bachelor's and master's theses. Altogether, the students and researchers will explore and develop the technologies. The technology output is not wholly owned by either party as it can be used and further developed by all parties. Here, to a certain extent, Telenor can guide and set the framework for research on innovation and technology in the direction they want. Telenor can utilize output in its operations and generate potential profits, while NTNU gains insight and expertise in new technology. Therefore, it may be attractive for both parties to cooperate.

This also means that this collaboration consists of various small projects within. The projects within are bachelor's and master's theses that only last for a period of one or two semesters. The actors are students at the university and researchers from NTNU and Telenor. There is no

written agreement between the students and the supervisor, however, the formal contract is signed between Telenor and NTNU. This type of contractual relationship is flexible, however if students do poorly on the project, it is not possible to call off, but the student will face the consequences in their gradings. Even though students who have completed their thesis will leave the project, the technology that is created in AI-lab will still remain at NTNU for the next student groups to take over and continue on the research and development. Although there is no hierarchical structure between the students and the supervisors, the thesis output is still directed by and a result of a working collaboration between both parties.

The actors are heterogeneous by operating in different areas and are not directly related to each other. Cross-sector collaboration reduces the industry boundary and opens up the new areas for research. NTNU will gain greater insight into new territory that Telenor is operating, and vice versa. Telenor operates in the commercial market and has Telenor Research as a link point to NTNU. Although both actors, as mentioned earlier, join in the same research project, they have different goals and purposes in this collaboration. Telenor and NTNU have different risk profiles related to incentives, coordination and goals for the collaboration. The main intention for Telenor Research is to explore the emerging technology to support the business unit, while the main purpose of NTNU, a non-profit oriented institute, is to excel their research to support their educational activities.

AI-lab is a collaboration initiated by both Telenor and NTNU. Telenor provides financial support for the research operations, as they also provide NTNU with supervision activity. The actors involved in the project aim to develop the best version of air quality prediction dashboard and application using different types of data. In short, we can say that in this project, they have a common goal for technology output.

Based on the ecosystem characteristic listed above, the project is yet to become a full-fledged ecosystem. Although the project met many of the criteria, it still lacks independence and loosely coupled components, which are the important parts of becoming an ecosystem according to our current working definition. The absence can be explained by that the collaboration is still at the project level as well as other mechanisms, such as trust and relationship, hinder the independence between the actors. However, the air quality project is at a very early stage of the research and can be further developed. If the project will be commercialized in the future, it will need to involve more actors with common interests. Then, it will require a new analysis that is adapted to the changes.

Analysis on the water infrastructure case

The water infrastructure project was initiated by Trondheim municipality, which is a customer as well as a principal based on the agent-principal theory. As previously mentioned, the incentives for Trondheim municipality are, first, its lack of advanced tools and insight regarding water and water infrastructure, second, the social expectation and pressure it is facing as a public player, and third, even though abundant, limited water supply, which makes water production and management costly. The first incentive ties most closely to the municipality itself and dissolves with the later incentives. Summing these all up, Trondheim municipality approached Telenor to carry out the integrated product.

Telenor's incentives to join this water infrastructure project are rich in dimensions too. Firstly, Telenor wants to secure its market positioning in the intensifying competition by enhancing the value of its existing products and services by offering the integrated solution bundle. The second incentive is for Telenor to gain access to use cases and develop its narrowband IoT technology as well as other advanced technology, such as Machine learning (ML) and Artificial Intelligence (AI). The third incentive can be named as the strategic movement to raise awareness in the more international setting since it also joined the U4SSC research program.

Even though Telenor is big in size and has sufficient available resources, it is considered as excessively resource demanding in many aspects, such as financial, human capital, and technological, to invest in the pioneer project in a fairly young market. Thus, this is one of the reasons that Telenor decided to collaborate with its partners instead of producing the integrated solution product itself. Moreover, since the technology involved in this project is also relatively new, a certain level of risk and uncertainty is presented. Telenor appraised this situation as too risky to put a large amount of upfront investment into it and it would rather utilize the established resource it has in hand instead. One of Telenor's valuable assets is the relationship with its business partners. It is observable that Telenor treasures this relationship as it has a particular 'Partner Department' taking care of the relationship management specifically to secure this durable advantage (Hutt & Speh, 2010). Telenor's partners are in various industries and in different sizes. Thus, to select the particular partners to join as one of the solution builders, Telenor considered, first, the expertise required for this product solution to succeed, second, the company size, and, lastly, the market position. However, Telenor does not solely

decide the partners itself since the municipality can also provide opinion in this selection process as well.

The water infrastructure project consists of three key independent actors: Telenor, Pipelife, and Webstep, on the supplier side. On the customer side, Trondheim municipality is the main actor, who is the initiator as well as closely involved in this customer-centric setting as the sensor and data visualization technology need to fit into its legacy system. In the partner selection process, the partner companies are considered based on, but not limited to, the scalability. Telenor expected to scale this water infrastructure project to other cities within Norway, as well as internationally, for example, in Sweden and some countries in Asia where Telenor is currently operating. Nevertheless, the international scalability must be carefully evaluated considering the specific local context.

All three suppliers are 'loosely coupled complementary economic agents carrying the heterogeneous nature' in this water infrastructure project. Telenor, Pipelife, and Webstep are from different industries, namely telecommunication, water infrastructure, and application and data visualization providers, respectively. While Telenor and Pipelife are in the mature stage of the business life cycle, Webstep is still in the growing phase compared to other two actors. At this point, it is apparent that these project participants are heterogenous. However, this heterogeneity in the characteristics also has implications in the company profile in several ways. Consequently, apart from the difference in industry and life cycle, it is reasonable to assume that the companies also have the different risk profiles, management styles, and many more. Then, they are the co-suppliers, or within the common supplier network, who come together in order to co-create the ecosystem output and gain economic benefit when the output is commercialized, which represents the attribute of the economic agents.

A diverse set of activities and resources is needed to develop technology and technology-based solutions (Möller & Svahn, 2009; Lundgren, 1995), hence the actors seek a new way of acquiring essential resources. The fact that they need to join forces manifests the complementarity nature among the participants. Each actor brings their products to the project or network, then binds those together to enhance the value of both their products and companies. However, the presence of complementarity does not always imply the interdependency among suppliers in developing the technology needed for this integrated solution. When it comes to the technological development process, all three actors are independently responsible for each specific part of the technological components of the

products according to their expertise. We are informed that *"one is responsible for the product; one is responsible for communication and one is responsible for the application communication layer. So, it's quite simple."* Here, Telenor is responsible for the connectivity and communication while Pipelife utilized its expertise in water pipes to develop sensors and collect the data which will later be analysed and visualized in the application or dashboard created by Webstep. These can be seen as the chain of usage of resources.

However, the analysis and visualization of water infrastructure data requires particular knowledge in respect to the water infrastructure. That is to say, this illustrates that Webstep is dependent on Pipelife and there is the asymmetry in the dependency presented in this setting. Moreover, because of the resilience presented here, it suggests that the loosely coupled relationship, which is one of the ecosystem characteristics, is missing.

Moreover, the interactions among actors are limited to the scheduled meetings, physically once a month and virtually twice a month. Even though the interdependency is set as one of the ecosystem characteristics, there is no rule about a certain degree yet. Thus, with this sparse presence of the interdependency, it is reasonable to argue that the project lacks this characteristic as the ecosystem.

Considering this point, it leads us to one of the important ecosystem characteristics which is 'the non-hierarchical actors interact with the non-contractual governance mechanisms.' The three actors interact and work together, but there is no clearly defined project leader or keystone player. Each actor works independently on the responsible part of technology. However, in this setting, Telenor acts as the project manager, as claimed *"you can call us the product manager, to put all these pieces together"*, but it yet has the complete authority to finalize the key decision as the project representative or leader. What is interesting here is that Telenor takes the keystone position without the outstanding superiority in technological contribution, except being the one who brought all partners together.

Noticeably, the relationships among project participants are still traditional contract-based both to the customer and supplier side, where the tasks are divided into multiple projects to mitigate risk and uncertainty underlying the project setting and output. The option to replace any partner in case the development in one's accountability fails is also written in the contract which could mitigate the risk of project failure caused by one actor's deficiency. The risk is considered as prevalent to all project participants, including the customers. Nevertheless, this project-based

relationship allows the actors to have fluid interaction that is promptly adaptable to respond to any possible uncertainty. The definite separation of responsibility can reduce friction in output and interaction among partners, even though there is no standardized interface developed for this focal project yet. The modularity comes in the form of the possibility that the players can be switched or shifted out if the technology development fails and the new player is allowed to replace the spot to make the project goal successful. Hence, this particular type of contractual relationship might still be able to maintain the characteristics of the non-contractual relationship in its adaptability, frictionless and modularity.

Lastly, the utmost objective of the ecosystem is to create and produce 'a common ecosystem-level output.' For this specific project, the ecosystem level output is the application or dashboard that visualizes the data regarding water infrastructure of the city of Trondheim. The features of the application are tailored to the requirements from the municipality, for example the leakage spots and water pressure. The product is currently in the development process with a certain level of uncertainty regarding both the technology and the suppliers. Based on the ecosystem characteristics discussed in the Theory section above, this project is short in this component as well. With the absence of both the interdependency and the loosely coupled relationship as well as the output in development, the water infrastructure project therefore is yet a full-scale ecosystem.

Apart from providing insight to the analysis on the ecosystem characteristic in the project setting, the collected data also highlighted two prominent elements of the cases that the informants strongly emphasized; trust and relationship. Referring to the analysis above, both the air quality and water infrastructure projects are yet to be a complete ecosystem based on the definition. Thus, we would take one step back and analyse the study cases in the inter-organizational project context (Jones & Lichtenstein, 2007). By doing so, we aim to cast light on the two prominent elements, trust and relationship, in the inter-organizational project setting and provide the perspective of ecosystem emergence at the same time. We believe that trust and relationship that incorporated in the project setting closely relate to the interdependency and loosely coupled interaction discussed in the ecosystem definition. Thus, we expect that this in-depth discussion will discover the way to facilitate the evolution from project setting to ecosystem emergence.

As mentioned in the Theory section, even though the 'ecosystem' has been discussed widely in academic papers, little has touched upon the emergence part. Thus, to better manifest the

process of ecosystem emergence, we borrow the theory of 'business ecosystem life cycle' proposed by Moore (1993). It is true that Moore's business ecosystem description does not exactly correspond with our working definition, still the similarities and overlapping lead to the belief that Moore looked at the same phenomenon from a different angle, thus describing it differently. From this point, we believed that borrowing the remark on the birth stage of Moore's ecosystem life cycle is fairly reasonable and would provide us with the insightful guideline for our analysis focusing on the birth phase of the ecosystem.

Trust in project settings

It is hard to put words on the concept of *'trust'*, however, the representatives from Telenor confirm that they have trust in their partners. They expressed:

"We are honest guys - and we trust each other. And doing business is easy because we trust."

From Jones and Lichtenstein (2007) studies show that trust arises through repetitive interactions during social embeddedness. Structural embeddedness creates a shared understanding of collaboration. Thus, trust will rest on this common understanding, and often it can be taken for granted, and makes trust difficult to explain (Berger & Luckmann, 1967). We assume that there must be a sufficient degree of trust within the project, resulting in the actors agreeing to join and enter the project. This may imply that trust is an important foundation for starting a collaborative project. Trust is experience-based (Myerson et al., 1996), and Telenor's representatives had previously experienced project-based collaboration, hence they can easily develop a common understanding and rules of working conditions in project collaboration (Jones & Lichtenstein, 2007).

"We have quite long experience working together with partners. Normally it works quite well."

Our assumption is, trust within the project starts from rational reasoning, exemplified by Telenor' selection of the partners from its partner bank, which are based on market size and potentiality. According to Grimen (2009), a high-risk project necessitates a high degree of rational reasoning. This implies that Telenor has done research on its partners, and based on this information, it is reasonable to assume that Telenor has performed the risk assessments. Thus, Webstep is recruited into the team, taking its market size and potentiality into consideration since Telenor representatives do not have direct work experience with this

company themselves. Pipelife is already chosen by the municipality, but they are in the leading position of the water market. Telenor representatives explained.

"When it comes to hardware partners, (...) we are using the partner department (...) We normally do not have any partnership program with the application partners. So, this is the totally new partnership for us."

Trust can be shaped by cultural norms and experience, and Norway is at the top of the world in terms of trust (Cappelen, 2014). Having a high degree of trust makes it easier for actors to come together to form a project, which subsequently makes it more promising to create value. The representatives from Telenor say:

'Trust is important (...) Trust, you will get with time. Trust is not something you will have before you work - it's something you build up.'

Nevertheless, trust must exist and is important for both at the start of the project and throughout every process within the project. In an inter-organizational collaboration, two or more actors are involved (Jones & Lichtenstein, 2007), which can reduce demand and transaction uncertainty. On the other hand, this type of collaboration also signifies that the companies must sacrifice parts of the control to other actors, thus creating a new type of risk factor. However, as argued by Luhmann (1999) that trust can also be a complexity reducing mechanism, Telenor has chosen to trust its partners in safeguarding its interests when it allows partners to access its technology. Trust is illustrated again as Telenor believes that its partners would not leave the project and produce the integrated solution by themselves without setting up any policy or procedure to prevent this from happening. It can be also implied that Telenor trusts its partners to a certain degree to forfeit the opportunity to gain advantages as a keystone player to prevent its partners from potential contribution to other ecosystems, as argued by Moore (1993).

"The risk is, (...), because we don't control the whole value chain. So, we are depending on having good partners (...) So that's the risk: If no one want to develop devices, we don't have any business"

However, they believe that the project will fail if one party believes they can do the whole project by themselves. This emphasizes the great level of trust Telenor has in its partners.

In order to move forward from a project to an ecosystem, according to Moore's (1993) theory of the ecosystem emergence, the random collection of partners needs to be more structured for the ecosystem to emerge. However, it does not provide details around this process. The limitation in the theory lacks a description of trust mechanisms, which we believe must be in place in order for the system to emerge and grow. This implies that the participants' trust must be shifted from individual trust to trust in the system. System trust is necessary for the actors to dare to invest in the project and around the innovation seed. Therefore, Telenor and the main players must create sustainable trust in the system and around the 'connectivity technology' as it is their seedling technology.

Moore (1993) also explained that for an ecosystem to expand, it needs to reach a critical number of participants. To attract promising actors into the ecosystem, a high degree of system trust must be in place to build the creditworthiness that subsequently encourages the investment around innovation seed, which in turn facilitates the ecosystem expansion and enhances the value of the technology.

On the other hand, in the project setting, *'chain of trust'* must be present when several actors are involved. The new players must trust in the leading actor(s) regarding the quality and sufficiency of the previous participant's contribution as the new players need to take over and carry on the technology development after they join the project. New players who want to join the project do not necessarily need to be in contact with previous partners since they trust in Telenor to maintain the quality of the product. For instance, in these projects the municipality is trusting Telenor will deliver the best solution.

> *"The customers don't really care too much about who is providing the underlying technology, they trust in Telenor putting together the best possible solution for them"*

It is reasonable to believe that personal trust, or chain of trust, must be transformed to system trust for the ecosystem to emerge from the project setting. In addition to establishing trust, the maintenance of trust is also essential to achieve sustainability within the system. Luhmann (1999) argued that trust in a system depends partly on the time aspect because time allows the system to function and prove itself. Contrarily to personal trust, the interactions that can help facilitate system trust are limited because actors can rarely monitor and control all parts of a system. Actors do not have the opportunity to gain full insight into the system, so they must choose to trust that the system works (Thyssen, 2002). Telenor and other leading actors who

control the system should continue to maintain the quality of the system and sustain the good reputation for the audience so both the end-customers and complementarity actors can continue trusting and associating with the system.

Trust is important, and without trust there not be any form of cooperation. Trust must be present for different actors to join and invest in a project, especially in high risk projects. Moore's (1993) theory states that an ecosystem becomes an ecosystem through *'gradually moving from a random collection of elements to a more structured community',* without adding more details about the process, and excludes key factors such as trust in project and ecosystem. In this specific project setting, the project will not exist without personal trust, both from the customer and supplier side. However, this personal trust must be transformed to system trust for an ecosystem to emerge and expand in the later stage.

Relationship network

Another prominent aspect highlighted in our collected data is relationship. In addition, relationships also play an important part in the inter-organizational project theory. In this case, we discuss relationships as the interaction among project actors. Besides, relationship or interaction is also key in the ecosystem regime we aim to explore. Thus, in this section, we examine relationships in deeper detail.

Both the air quality and water infrastructure cases emerged from the established relationship Telenor has with its partners. All the project participants, both on the customer side and supplier side, have previous history with Telenor. Informed by the interviewee that *"They have signed an agreement with Telenor to do a joint project where we work together and where we also drag in relevant ecosystem partners that can provide specific services to the project."* and *"In this project, there is a customer, and there is Telenor and we include relevant partners in the specific project."*, it is obvious that Telenor took a central position in the project and brought its partners in. This is also emphasized several times in the interviews as quoted below.

"Well, team and team leader, we find the roles quite simple, we try to solve this problem as a team, and we have some clear roles. What I showed you, one is responsible for the product, one is responsible for communication and one is responsible for the application communication layer. So, it's quite simple."

"From our point of view, it is easy to make an agreement on."

"We go open in the project and say we spend some time together with you and invest in the market together with you. if we fail -we fail, but we take our risk everybody. It's simple as that."

In the inter-organizational project field, relationships can be seen as the structural embeddedness, which is an element of social embeddedness. This interaction also relates to another social embeddedness' element, the relational embeddedness, which manifests how the actors perceive and consider each other's goals and needs. This also involves the incentive to join the project, which is also a crucial aspect in the ecosystem theory.

Regarding relationship networks, the air quality case has less to discuss as the project is quite straightforward with the framing of thesis supervision project, involving two parties within two layers of relationship. On the most superficial layer, the formal relationship between Telenor and NTNU as two independent entities is constructed. Then, there exists the more individual relationship between Telenor's research personnel and NTNU bachelor and master students. Here, the teams of students change more frequently because the bachelor and master theses are normally done within one or two semesters while Telenor personnel is more likely to repeat this supervision activity several times. This foregoes the chance to develop relational embeddedness that helps enhance the knowledge exchange among parties. However, since Telenor can utilize the insight and technology developed in the project in other use cases too, Telenor can still benefit more from joining this project than other traditional business development projects, which might incur higher costs.

At this point of considering the issue of relationship, interdependency cannot be avoided. This implies the structural embeddedness in the inter-organizational project theory since it discusses the extent actors interact. The interdependency between the supervisor and the students presented here is mutually but not equally weighted. Some may argue that the students carry more pressure and expectation in succeeding the projects since it determines the completion of their degree. On the contrary, the supervisor, who is also dependent on the project success, has less pressure since the personnel, including Telenor, has less to lose, taking into consideration that the air quality project is not yet in the commercialization phase. They are not going to face difficulties afterwards.

However, that is only partially true since during the supervising period, Telenor still incurred costs, monetary and non-monetary such as opportunity costs. Moreover, since this project also

serves as the use cases for Telenor's technology development as a whole, there is a chance that the personnel may also face some feedback from failing this supervision too. Thus, Telenor's dependency on this air quality project may be in more dimensions than that of NTNU and its students.

Another key factor to consider for this air quality project is that if the objective here is to become an ecosystem, some anticipations must be made. To discuss this, we borrow the birth of ecosystem from Moore (1993), where the seeding innovation and the keystone player are key. It can be seen that the seeding innovation for this air quality project is the connectivity, however the add-on technology is still in the development process, where uncertainty is relatively high. Moreover, there is no clear project leader defined because the participants will be considered and dragged in when the technology is materialized and more stable. With this in mind, the air quality project is several steps away from becoming the ecosystem.

Turning to discuss the relationship in the water infrastructure project, there are several interesting points. Firstly, in the relational embeddedness sense, the project actors have common goals to succeed in technological development and to be able to deliver product to the end customer as *"That's each partner sees each other as equal partners to have success."* and *"To have a good partnership model, it's very important."* are claimed during the interviews. However, the key distinction here is what each actor brings into the project, which are totally different and hard to measure. The other side of the resources they bring in is the resources they need to complete this development of integrated solutions. Thus, it is difficult to justify how each actor perceives each other's goals and needs.

Moreover, the structural embeddedness should involve more closely tied interaction when the products are complex (Jones & Lichtenstein, 2007), yet this specific project does not seem to be the case. The interactions here are simple and quite straightforward where each actor has separate responsibility and interacts directly with the end customers. In addition, the scheduled meeting is set to be once and twice a month, physically and virtually.

"Pipelife, they normally have a contact with the technical department - the responsible for water in the municipality. Telenor have been in dialog with the communication manager in the municipality - and Webstep they are normally in dialog with the IT manager. So, we have 3 different contact people in a municipality."

"Let's say once a month we meet up physically and every two weeks we have skype meeting part - web meeting like we have now. so, we have meetings every second week. the reason why this is not a product you can take off the shelf - it is under development."

This may be a result of the fact that the complexity lies in the particular technology rather than the linkage among each technology. To put this another way, the sensor technology is complicated while the data analysis and visualization is too, but the integration process of putting every piece together is a lot less complicated and does not require much of the resources or expertise.

Then again, this leads to doubt in the interdependency that all actors have in this water infrastructure project. One way to look at this interdependency is through the technological resources and usage. Telenor brings in connectivity technology, which does not depend on others' resources since it serves as the infrastructure of the project, which is more integrated with work of Pipelife and less with that of Webstep. Next, Pipelife uses Narrowband IoT connectivity provided by Telenor to further develop its sensor and data collection tools, and Webstep builds up the analysis and visualization technology on the water data collected by and forwarded from Pipelife. Yet, Pipelife does not need the analysis and visualization technology for its sensor technology to work. Here, the dependency is one way as only Webstep depends on Pipelife while Pipelife relies on Telenor.

According to the most straightforward definition of 'interdependency', the dependence should be two-way, however, the question lies in whether the mutual dependency should be equally weighted among actors. As claimed in the interview that if one partner fails, "Then, it will fail the whole system. The whole concept will fail." Even though all actors depend on the success of the end product, the interdependency is lightly presented. To look at this another way, there is the asymmetry in the interdependency. In this specific setting, the interdependency can be defined that Webstep depends on Pipelife, who depends on Telenor, who does not depend on anyone, in the technological sense. Telenor does not depend on any actor in this project, yet it provides the underlying technology that triggers the chain of production. Thus, the interdependency is not presented here. Additionally, Telenor also carries the valuable resources in forms of its established relationship that allows it to gather all actors together.

"We will select our partners."

"We have quite a long experience working together with partners. normally it works quite well."

"You can call us the product manager, to put all these pieces together."

"Then based on what we agree we pick the relevant partner on the device and the application side and then we kick off the project to implement this and we are the product manager in this case."

"We have more than a hundred partners - that are partners of Telenor - we don't use all hundreds in one project. we pick the most relevant specific for each project."

Referring to the quotes from the interviews, Telenor takes a huge part in the process involving partnership building. It can be said that Pipelife, Webstep, and Trondheim municipality rely on Telenor and its partner bank to bring together the actors and create the project or the ecosystem setting. In short, based on the evidence we found, the two possible reasons for Telenor to be able to take the keystone position can be either the independent position in the relationship, or the possession of the relationship as the more superior resources. However, one question is, still, whether a relationship is considered as more valuable than the technological and knowledge resource since it allows Telenor to take the keystone position.

At this point, we bring in Moore's (1993) theory regarding the birth of ecosystems. The seeding innovation and the spin-off innovation in this project are quite clear as the integrated solution of water data analysis and visualization application that is built on-top of connectivity. Hence, the seeding innovation does not seem to be the struggle for this project to transform into the ecosystems. However, Moore (1993) also points out the role of keystone player as a crucial part of ecosystem birth. The importance of the keystone player in the birth of ecosystem is the responsibility on the value creation based on the seeding innovation to attract new joiners and the management of the value appropriation or value sharing among the joined actors.

For the water infrastructure case, the activity to bring in new actors seems to be difficult, at least in the project setting in Trondheim as the actors are relatively fixed since the actors do not plan to include other players anytime soon. The additional players give the ecosystem the resource advantages, as well as other benefits coming from the diversity. As argued by William and De Meyer (2012), a vibrant ecosystem can enable activities, assets, and capabilities to be flexible and constantly reconfigured in response to the unexpected. Moreover, it can also enable

a diversity of tacit knowledge to be mobilized and help speed up innovation and improve customer service. Moreover, as the interdependency is weak among all actors, without the satisfying reward from joining this project, or ecosystem-to-be, it is likely that some actors may leave. In addition, since the actors are fixed as they join the team with the proposal to scale, at least domestically, the relationship here cannot be considered as loosely coupled. To put in other words, the project does not carry one key ecosystem characteristic as well as its flexibility. As the project is also aimed to scale internationally, the fact that the project may need local players, apart from Telenor, from the targeted countries also indicates the absence of flexibility, or loose-coupled characteristic in the relationship. However, the question remains here is whether this water project will be able to transform into an ecosystem.

Additionally, this implies the interaction is inevitable. In this setting, the deployment of incentive structure, governance mechanisms, actors' attitude and culture must be carefully managed otherwise the ecosystem may be exposed to tension. As discussed earlier in the Theory section, tension may be displayed in some relationship networks and may lead to damage in the relationship as well as the drawback in the project progress and output.

In the water infrastructure case context, the actors are exposed to the risk of tension in the network for many reasons. To begin with, the contractual relationship among project participants can be the cause of tension unless it is appropriately managed. However, since the project is still in the birth phase and the output is not yet finalized, there is the possibility that the contracts may have to be fixed to fit with respect to technological uncertainty or the variance in customer requirement. The contract or clause modification may harm the relationship stability in the project or ecosystem.

Second, since each actor brings in their distinctive technology and expertise which cannot be directly measured, there might be ambiguity in the other actors' perception. As mentioned by Kondo et al. (1998) and Gronroos (2011), the value created in the relationship is typically perceived differently. This perception is crucial since it influences their expectation in terms of anticipating benefits, roles, and responsibilities. The actors' altered perceptions of the value they bring and the benefit they will gain might also be the cause of tension. In this project, Telenor brings in the platform and connectivity, which are its existing products and it does not have to work on technological adaptation or implementation. The other two players do not only have to work on technological development, they also need to plug and play to Telenor's technology. However, Telenor takes a project manager role in this project as it is the project

initiator, being approached by the municipality, and the project has emerged from Telenor's established partner bank. It is possible that the other actors may see this situation as the asymmetry in input, contribution, role, and benefit. Moreover, because the solution package will be charged as the bundle, there is the risk of customer's doubt in price transparency (Jaakkola & Hakanen, 2013), which may tense up the pricing decision among the project actors on the supplier side.

This ecosystem is in the emergence or birth phase; to some degree, the uncertainty is significant. However, when the project becomes more mature, the information asymmetry among actors will be reduced and the opportunity may widen. Even though there is no problem noted at the time this thesis is written or in the short run, the imbalance in actors' activity may cause tension in the longer run.

The impact of tension has also been explored by many researchers. Tension can be the source of the relational intimacy destruction (Wuyts & Geyskens, 2005) and destabilization of relationship development (Fang et al., 2011). Moreover, Kumar et al. (2006) mentioned that tension can cause actors to withdraw from the interaction as well as related emotions such as frustration and disappointment while Johnson and Lacoste (2016) claimed the inter-organizational distrust as one of the consequences of tension as well.

As interaction and value co-creation is crucial in an ecosystem setting, the effects of undergoing tension presented are likely to be stronger and cause more unexpected damage. Hence, it is worth concerning the tension triggers/drivers to avert the unfortunate consequences.

To sum up, from the analysis we performed, it can be concluded that both the air quality and water infrastructure projects were initiated by Trondheim municipality and emerged basically from trust and relationship, originated from Telenor. Even though the water infrastructure case is ahead of the air quality case, however, they both are yet to become the ecosystem because of the absence of several characteristics of the ecosystem; loosely coupled and interdependency. The loosely coupled characteristic contributes to the flexibility of the ecosystem, which allows the ecosystem to invite more promising players and benefit from the resources and technology they would bring. The asymmetric interdependency will result in the unequal in bargaining power, then affect the value appropriation among actors and sustainability of the ecosystem. In this case, if Telenor plans to scale with more players, it needs to take these two elements into consideration to expand the ecosystem in the sustainable

manner. While the benefit of becoming an ecosystem still could not be clearly estimated, the decision of becoming an ecosystem will affect their trust and relationship network they have built so far. There is high uncertainty involved, and the winner-take-it-all scenario is generally overstated. So, it is up to Telenor and their partners how far they would push the vision of becoming the ecosystem.

Limitation of the paper

The concept of ecosystems is comprehensive and complex. The main limitation of this paper is a lack of existing research and literature available on the topic. With no definite grounded theory, it is also difficult to set clear boundaries for our analysis regarding the ecosystem and ecosystem emergence. Furthermore, the theory on the birth phase is limited and vague and lacks detailed elements around the process. It is worth noting that although the ecosystem concept was introduced decades ago, the research and empirical studies on this concept are relatively new, and the term is widely cited and applied in diverse settings. This might as well contribute to the limitation discussed above.

It is important to point out that we only observe project-based inter-organizational collaboration, which may or may not evolve into an ecosystem at all. It should be highlighted that each project and ecosystem may have originated in different ways and such processes may not be replicable. This is to say that ecosystems may transform from a project, materialized from the inter-organization collaboration in this study, but it may as well emerge from a project, developed from other drivers or foundations, or, in the extreme, from other forms of collaboration that are off the scope of a project setting. However, given the time and resource restriction in this thesis, we are unable to observe all possible scenarios and capture every circumstance. Our objective of this paper is to explore the phenomenon and contribute to the advance of theoretical framework, but the insight generated from the study cases cannot be statistically generalized to all ecosystems and ecosystem emergence exploration. Therefore, the purpose of this paper is to invite readers to a journey to explore the ecosystem together.

In addition, the term ‘ecosystem’ is widely used, which can create confusion around the theme. Our thesis is based on a common working definition that is agreed within the research group. Due to the ecosystem being a relatively new field of research, we ask for understanding that not all knowledge of the concept has fully developed. The working definition is just preliminarily set and can therefore change with new information. As the working definition is

still fluid and adaptive, the findings and analysis in this thesis can as well be changed accordingly.

There might also be a limitation according to the characteristic of the sampling unit as one of our main findings, trust, is highly dependent on cultural context. Thus, the fact that Norway is ranked as a country with a high degree of trust, may pose a significant impact on the characteristics of the informants. This, in turn, affects the findings extracted in this paper and must be taken into consideration in the future application.

Another source of challenge is concerning the high degree of uncertainty because both cases are in the development phase as Telenor has no concrete commercialization plan for the cases. Internal and external factors can affect these projects and will determine whether these projects will have the opportunity to evolve into ecosystems in the future, and the outcome may therefore shift.

Future research

The Findings and Discussion presented in this paper are based on existing theories, current empirical evidence, as well as our own working definition. It can be foreseen that the theoretical framework and empirical evidence will be further developed and explored. Thus, we firmly believe that there are many more areas within this concept that will be uncovered with the upcoming research. Hence, the future research will be correlated with the supplemental theories incrementally developed along the way.

First of all, future research may be to cover a larger proportion of interview samples and it may be a possibility to find other significant factors and viewpoints regarding this topic. In addition, it can be interesting to explore other types of projects with other settings to gain more insight.

Secondly, if the concepts of ecosystem and ecosystem emergence are more clarified and solid, it would become easier for management and businesspeople to understand the phenomenon. This will lead to a better strategic decision making, raise more awareness of ecosystem advantages, and eventually stimulate the emergence of ecosystems. With this, there will be greater opportunity for the researchers to discover the concept with broader dimensions.

In addition, at present, Telenor is working on many projects at the same time, which have the potential to connect or merge into a larger project or ecosystem. This more comprehensive

ecosystem comes with increasing complexity; however, it also expands the scope of possible research, from a standalone project or ecosystem to embedded ecosystem. Moreover, it is also interesting to study specifically about the boundary of the ecosystem as the current theoretical framework does not allow us to set a clear line yet. We believe that a clear boundary will make the future research on this concept less chaotic and lead to more meaningful observations.

Lastly, as our study cases are still at an early stage, there are many possible scenarios that could happen. It is purposeful to follow the project's development and observe the change in elements discovered in this thesis, for instance incentive structure, project structure, trust and relationship. It is possible that the change in project setting will shift the findings we found in this paper or the discussion we argued. Moreover, it is also compelling to observe how each actor would react when the project grows, and the ecosystem concept is more understandable. It is true that the question here is how far each actor, or more specifically Telenor, should go to become an ecosystem. However, it must be noted that such questions can be answered only when the ecosystem concept and setting are firmly described and explained. Anyways, as we pointed out that the interdependency and loosely coupled interaction are absent in these project settings, we did not address the possible way to overcome such deficiency. This is also one area that could further be explored.

Conclusion

The objective of this thesis is to discover the emerging phenomenon of ecosystem. The study cases allow us to approach the research question regarding the process of evolution from the inter-organizational project to a potential ecosystem. To answer the research question, we performed a semi-structured interview method on two study cases; air quality and water infrastructure, to fulfil the exploratory research purpose. The two study cases incorporate the inter-organizational project setting, involving both public and private actors with different profiles and incentives. We have informants in a senior researcher to manager position from Telenor providing the information on the study cases as they also act as the case responsibles.

The analysis and discussion in this thesis are based on the working definition developed upon the currently available literatures we accessed during the literature review procedure. This working definition is yet definite and subject to change according to the new information to be discovered at the later stage. The definition of ecosystem can be temporarily described as *'loosely-coupled complementary economic agents carrying the heterogeneous and non-hierarchical nature interact with the non-contractual governance mechanisms to produce a common ecosystem-level output.'* Moreover, the theory of business ecosystem life cycle and inter-organizational projects are associated to supplement the deficiency in the current ecosystem framework.

The two study cases are analysed according to the characteristics defined in the working definition. Based on ecosystem characteristic analysis, the current setting of both water infrastructure and air quality projects still lack the elements of interdependency and loosely coupled, which are the main characteristics of ecosystems. Thus, we brought in the theory of inter-organization projects to focus on these two aspects, specifically in this transformation or emergence phase.

The findings highlighted trust and relationship as important factors for project emergence, as the project collaborations are based on trust and relationship network Telenor has with their partners and customers. Trust discussed here is personal trust Telenor established with each actor. However, we argued that it is important for Telenor to be able to transform this personal trust to impersonal trust, or system trust, to facilitate flexibility in the project setting and reap the future benefits that additional actors may bring in. Additionally, system trust is necessary for the project to expand and for the ecosystem to emerge and reach the critical mass. Moreover,

trust in the project also put an ease to the collaboration among actors as a complexity reducing mechanism.

In addition, there are several observations regarding relationships in this inter-organizational project setting. It is worth noting that the relationship discussed here also includes interactions among project participants. We found that the established relationship that Telenor has with its partners plays a key role as a foundation to the project emergence. Moreover, the relationships and interactions are also related to each actor's incentives and contributions in the project. Each project participant brings distinct resources into the project, which are perceived differently by each actor. We noticed the asymmetry in the resource dependency during the technological development process. It is reasonable to believe that this asymmetric dependency may have an impact on the fact that Telenor is currently taking the keystone position in the project. However, it is also possible that the keystone position is a result from the established relationship that Telenor has with all project actors. In this case, the implication could be that relationship can be seen as a more valuable resource even in this technology-advanced project setting. Furthermore, it is worth noting that relationships must be appropriately managed to avoid tensions among project participants as tensions may lead to unfavourable scenarios and cause damages to the relationship and/or project outcome.

Nevertheless, the main limitation of this thesis is that the case study approach we employed hinders the statistical generalization of the findings as they are specific only to these study cases. Future application and replication must take the contextual setting into consideration to avoid any errors. However, we aim that the work in this thesis would contribute to the current theoretical framework in some way as well as shed the light to the areas where the future research is compelling.

Bibliography

Adner, R. (2017). *Ecosystem as structure: An actionable construct for strategy*. Journal of management, 43(1), 39-58.

Ahlers D., Wienhofen L.W.M., Petersen S.A., Anvaari M. (2019) *A Smart City Ecosystem Enabling Open Innovation*. In: Lüke KH., Eichler G., Erfurth C., Fahrnberger G. (eds) Innovations for Community Services. I4CS 2019. Communications in Computer and Information Science, vol 1041. Springer, Cham

Appio, Francesco & Lima, Marcos & Paroutis, Sotirios. (2019). *Understanding Smart Cities: Innovation Ecosystems, Technological Advancements, and Societal Challenges.* Technological Forecasting and Social Change. 142. 1-14. 10.1016/j.techfore.2018.12.018.

Autio, E., & Thomas, L. (2014*). Innovation ecosystems.* The Oxford handbook of innovation management, 204-288.

Berger, P., & Luckmann, T. (1967). *The Social Construction of Reality: A Treatise in the Sociology of Knowledge.* Garden City. NY. Doubleday.

Birkinshaw, J. (2019). *Ecosystem Businesses Are Changing the Rules of Strategy.* Retrieved from:https://hbr.org/2019/08/ecosystem-businesses-are-changing-the-rules-of-strategy

Boes, K., & Buhalis, D. (2015*). Conceptualising smart tourism destination dimensions.* In I. Tussyadiah and A. Inversini (Eds.), Information and communication technologies in tourism.

Boley, H., & Chang, E. (2007, February). *Digital ecosystems: Principles and semantics.* In 2007 Inaugural IEEE-IES Digital EcoSystems and Technologies Conference (pp. 398-403). IEEE.

Bryman, A., Bresnen, M., Beardsworth, A. D., Ford, J., & Keil, E. T. (1987). *The concept of the temporary system: the case of the construction project.* Research in the Sociology of Organizations, 5(1), 253-283.

Cappelen, A. (2014). *Høy tillit er god økonomi. Aftenposten.* [Online] 1. June 2020. Retrieve from: http://www.aftenposten.no/okonomi/Hoy-tillit-er-god-okonomi-7706517.html [Tilgang: 17. februar 2015]

Cennamo, C. (2019). *Competing in digital markets: A platform-based perspective.* Academy of Management Perspectives.

Christensen, C. M., & Rosenbloom, R. S. (1995). *Explaining the attacker's advantage: Technological paradigms, organizational dynamics, and the value network.* Research policy, 24(2), 233-257.

Deloitte. (2019). *'2020 Telecommunications, media, and entertainment outlook'.* Retrieved fromhttps://www2.deloitte.com/us/en/pages/technology-media-and-telecommunications/articles/telecommunications-industry-outlook.html

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2011). *The Sage handbook of qualitative research. Sage.*

Díaz-Díaz, R., Muñoz, L., & Pérez-González, D. (2017). *Business model analysis of public services operating in the smart city ecosystem: The case of SmartSantander.* Future Generation Computer Systems, 76, 198-214.

Dubois, A., & Gadde, L. E. (2002). *Systematic combining: an abductive approach to case research.* Journal of business research, 55(7), 553-560.

Easterby-Smith, M., Golden-Biddle, K., & Locke, K. (2008). *Working with pluralism: Determining quality in qualitative research.* Organizational Research Methods, 11(3), 419-429.

Eaton, Ben & Hallingby, Hanne & Nesse, Per & Hanseth, Ole. (2014). *Achieving Payoffs from an Industry Cloud Ecosystem at BankID.* MIS Quarterly Executive. 13. 223-235.

Eccles, R. G. (1981*). The quasifirm in the construction industry.* Journal of Economic Behavior & Organization, 2(4), 335-357.

Elter, F., Gooderham, P.N., Dasi, A., and Pedersen, T. (2018). *The digital future of Telcos: Dumb pipes or crucial partners in innovation of new business models?* Beta, 32, 131-147.

Evensen, E.G., & Kähler, J. (2014*). Analysis of the Norwegian NFC Mobile Payment Business Ecosystem.*

Faulkner, R. R., & Anderson, A. B. (1987). *Short-term projects and emergent careers: Evidence from Hollywood.* American journal of sociology, 92(4), 879-909.

Gaski, J. F. (1984). *The theory of power and conflict in channels of distribution.* Journal of marketing, 48(3), 9-29.

Giddens, A. (1991*). Modernity and Self-Identity, Self and Society in the Late Modern Ag*e. Cambridge. Polity Press.

Granovetter, M. (1985). *Economic action and social structure: The problem of embeddedness.* American journal of sociology, 91(3), 481-510.

Granovetter, M. (1992). *Economic institutions as social constructions: a framework for analysis.* Acta sociologica, 35(1), 3-11.

Grimen, H. (2009). *Hva er tillit.* Oslo. Universitetsforlaget.

Grönroos, C. (2011*). Value co-creation in service logic: A critical analysis.* Marketing theory, 11(3), 279-301.

Hummon, N. P., & Doreian, P. (2003). *Some dynamics of social balance processes: bringing Heider back into balance theory.* Social Networks, 25(1), 17-49.

Hutt, M., & Speh, T. (2010). *B2B business marketing management.* South Western.

Iansiti, M., & Levien, R. (2004*). Strategy as ecology.* Harvard business review, 82(3), 68-78.

ITU. (2012). *Internet of Things Global Standards Initiative*. Retrieved from https://www.itu.int/en/ITU-T/gsi/iot/Pages/default.aspx

Jaakkola, E., & Hakanen, T. (2013*). Value co-creation in solution networks*. Industrial Marketing Management, 42(1), 47-58.

Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). *Towards a theory of ecosystems.* Strategic Management Journal, 39(8), 2255-2276.

Jankowicz, A. D. (2005). *Business research projects.* Cengage Learning EMEA.

Johnston, R., & Pongatichat, P. (2008). *Managing the tension between performance measurement and strategy: coping strategies.* International Journal of Operations & Production Management.

Jones, C. and Lichtenstein, B. (2007). *Types of Inter-organizational Projects: Managing Uncertainty through Temporal and Social Embeddedness.* In book: Handbook of Interorganizational Relations, 231-255 . Oxford University Press.

Khomsi, M. R. (2016*). The smart city ecosystem as an innovation model: lessons from Montreal.* Technology Innovation Management Review, 6(11).

King, N. (2004). *Using interviews in qualitative research.* Sage.

Kondo, H., Matsuda, T., Hashiba, M., & Baba, S. (1998*). A study of the relationship between the T&T olfactometer and the University of Pennsylvania Smell Identification Test in a Japanese population.* American journal of rhinology, 12(5), 353-358.

Kreutzer, I. (2018*) An integrated and effective Nordic ecosystem for innovation and green growth.* Retrieved from https://www.norwayhealthtech.com/content/uploads/2018/11/nordic-ecosystem-from-nordic-innovation.pdf

Kumar, A., Ouyang, M., Van den Dries, K., McGhee, E. J., Tanaka, K., Anderson, M. D., ... & Schwartz, M. A. (2016). *Talin tension sensor reveals novel features of focal adhesion force transmission and mechanosensitivity.* Journal of Cell Biology, 213(3), 371-383

Lang, N., von Szczepanski, K. and Wurzer, W. (2019). *The Emerging Art of Ecosystem Management. Boston consulting Group.* [Online]. 15.May 2020. Retrieved from: https://www.bcg.com/publications/2019/emerging-art-ecosystem-management.aspx

Lefaucheur, J. P., André-Obadia, N., Antal, A., Ayache, S. S., Baeken, C., Benninger, D. H., ... & Devanne, H. (2014). *Evidence-based guidelines on the therapeutic use of repetitive transcranial magnetic stimulation (rTMS).* Clinical Neurophysiology, 125(11), 2150-2206.

Letaifa, S. B. (2015). *How to strategize smart cities: Revealing the SMART model.* Journal of business research, 68(7), 1414-1419.

Lien, L. B., Knudsen, E. S. & Baardsen, T. Ø. (2016). *Strategiboken.* 1st edition. Bergen. Vigmostad & Bjørke AS.

Lundgren, U. P. (1995). *Att organisera omvärlden.* Liber. Stockholm.

Luhmann, N. (1999). *Tillid : en mekanisme til reduktion af social kompleksitet.* Copenhagen. Hans Reitzels Forlag.

Mayer, R.C., Davis, J.H. and Schoorman, F.D. (1995). *An Integrative Model of Organizational Trust.* Academy of Management Review, 20(3): 709–734.

Meyerson, D., K.E. Weick & R.M. Kramer. (1996). *Swift trust and temporary groups* in R.M. Kramer og T.R. Tyler, Trust in Organizations – Frontiers of Theory and Research. (166–195). Thousand Oaks. Beverly Hills. Sage Publications.

Moore, James F.(1993) *Predators and Prey: a new ecology of competition.* Harvard Business Review, May-June, 1993, 71(3), p.75(12).

Möller, K., & Svahn, S. (2009). *How to influence the birth of new business fields—Network perspective.* Industrial Marketing Management, 38(4), 450-458.

Pais, I., & Jones Jr, J. B. (1997). *The handbook of trace elements.* CRC Press.

Peng, S., Chen, A., Xu, L., Cao, C., Fang, J., Myneni, R. B., ... & Piao, S. (2011). *Recent change of vegetation growth trend in China.* Environmental research letters, 6(4), 044027.

Plant, R. (2011, March). *An introduction to artificial intelligence.* In the 32nd Aerospace Sciences Meeting and Exhibit (p. 294). https://arc.aiaa.org/doi/abs/10.2514/6.1994-294

Ramsay, J. O., & Silverman, B. W. (2007). *Applied functional data analysis: methods and case studies.* Springer.

Rese, M., & Roemer, E. (2004). *Managing commitments and flexibility by real options.* Industrial Marketing Management, 33(6), 501-512.

R.E. Johnsen, S. Lacoste. (2016). *An exploration of the 'dark side' – Associations of conflict, power and dependence in customer-supplier relationships.* Industrial Marketing Management, 59 (2016), pp. 76-95

Saunders, M., Lewin, P., & Thornhill, A. (2016). *Research Methods for Business Students (Seventh ed.).* Harlow. Pearson.

Shan, J., & Toth, C. K. (2018). *Topographic laser ranging and scanning: principles and processing.* CRC press.

Tatar, G. A. (2014). *How are entrepreneurial competence and dynamic capabilities of the Norwegian IT Start-ups related to performance* (Master's thesis).

Uzzi, B. (1997). *Social structure and competition in interfirm networks: The paradox of embeddedness.* Administrative science quarterly, 35-67.

Vandenberghe, W. G., Verhulst, A. S., Kao, K. H., Meyer, K. D., Sorée, B., Magnus, W., & Groeseneken, G. (2012). *A model determining optimal doping concentration and material's band gap of tunnel field-effect transistors.* Applied Physics Letters, 100(19), 193509.

Wuyts, S., & Geyskens, I. (2005). *The formation of buyer–supplier relationships: detailed contract drafting and close partner selection.* Journal of Marketing, 69(4), 103-117.

Yin, R. K. (1984). *Case Study Research. Design and Methods.* Beverly Hills. Sage Publications.

Yin, R. K. (2003). *Case study research: design and methods (ed.)*. Thousand Oaks.

Yin, R. K. (2014*). Case study research: Design and methods (applied social research methods).* Thousand Oaks, CA: Sage publications.

Appendix I

Interview Theme

Opening:

- Introduce ourselves
- Explain about the master thesis (purpose, time frame, area of interest)
- Explain about how the information will be stored and used
- Ask for permission for audio recording
- Ask the interviewee to introduce themselves

Topic 1: Incentives to join

- Who is taking the initiative for the starting of this project? - and how?
- What is the main purpose of joining the project?
- What do you expect from this project?
- How do you initially plan to accomplish your expectation?
- How did you build trust with other actors to participate in and throughout the project?
- Why did you choose to collaborate rather than doing it by yourself?
- How do all the partners come together?
- Who are the target users or potential users for this project?
- Who are the owners of the final output?
- Who will it be available for?

Topic 2: Coordination and collaboration mechanisms

- Who are the leading actor(s) in the project?
- How do you choose the leader? (formal agreement? Or informal discussion/meeting?)
- What is the structure of all the actors involved (i.e. hierarchy, flat structure?)
- What are the roles and responsibilities of each player?
- What are your main coordination tools used to communicate with other participants in the project? (i.e. scheduled meeting, slack, other channels)

- What was your expectation concerning inter-organization collaboration in the project?
- How does the collaboration and coordination work in the project? (i.e. fixed or flexible representatives from each firm meet - how often)
- What part of the collaboration went according to your expectation and what did not?
- What are the main struggles/constraints/challenges in terms of communication and collaboration during the project?
- How do you address the struggles/constraints/challenges you mentioned?
- Do you work on this project 100% of your time or how do you manage the workload?

Topic 3: Technology

- What are the main technologies in this project? Who are the owners of such technology?
- What technology do you already have in-house and what technology do you need to develop further to fit the project?
- Who is responsible for the development? (i.e. Technology from Telenor but is developed by other players)
- What are the strengths of the technology you own?
- What are missing in this technology and how do you plan to solve this?
- How do all technologies work together? (within Telenor's technology and with other players' technology)
- What kind of data is shared?
- How do you share the data?

Topic 4: Project progress

- How do you appraise the progress of the project?
- How is the progress of the project? (on-time, delay)
- How do you follow up the progress of the project?
- How do you feel satisfied with the progress of the project?

Topic 5: Project appraisal

- What do you find the biggest benefit gained from joining the project?
- What do you think is the strong point of this project?
- Why do you think the point you mentioned is the strong point?
- What do you think is the source of the strength of the project?
- What do you think is the weakness of the project?
- How do you deal with it?
- What is the future of this project? (i.e. financial wise, technology wise, and joint venture, collaboration)
- What are the risks and uncertainties in this project (project level → team level → individual level? (i.e. what kind of risks)

Ending questions

- Is there anything that we have not asked you about that you think we should know?
- Is there any other person that you think we should talk to concerning this project?