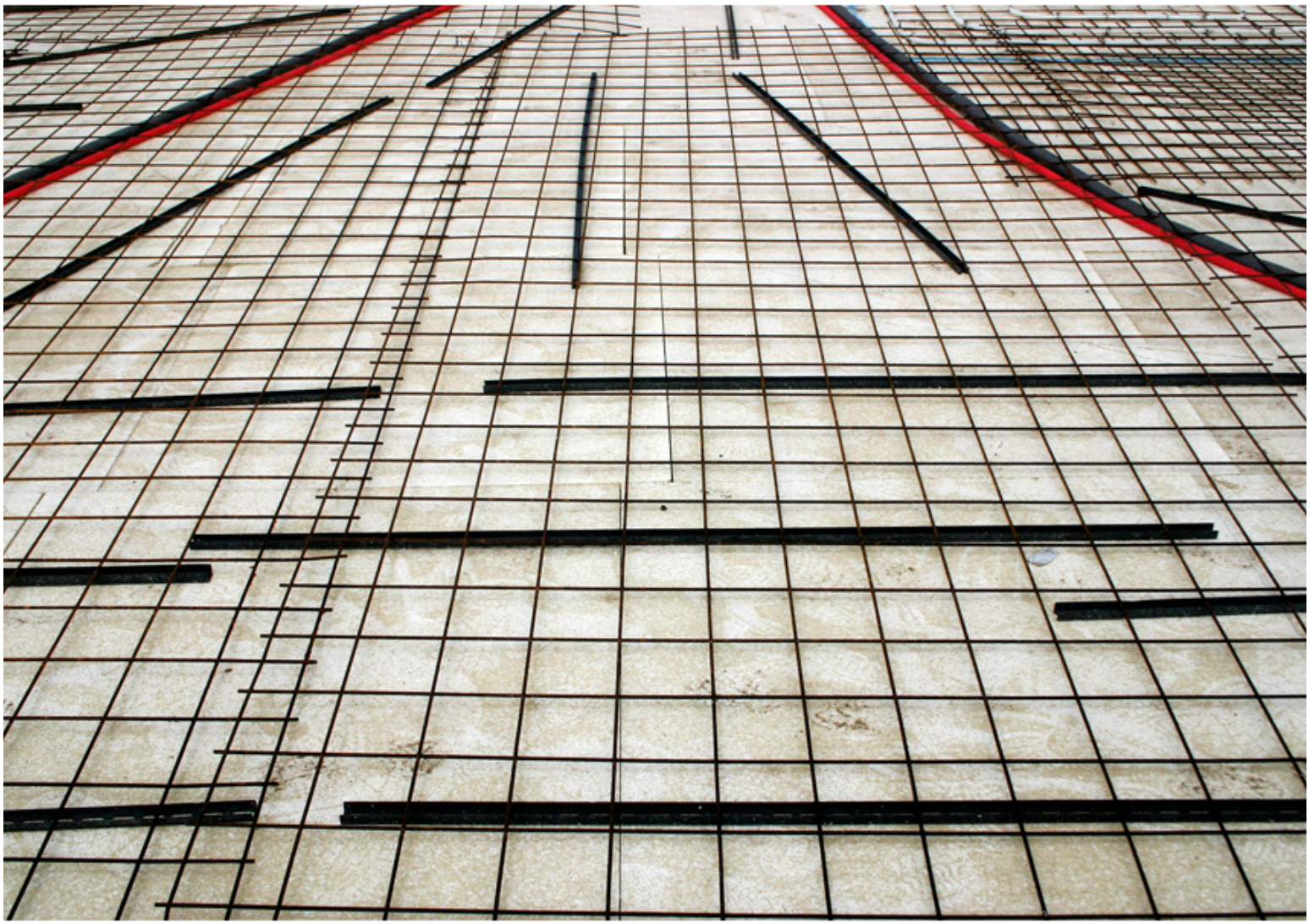
# THE EMPOWERMENT OF THE UNDERGROUND:

## 'A SOCIO-MATERIAL APPROACH TOWARDS THE UNDERGROUND INFRASTRUCTURE SECTOR'



MATTHIJS BREEUWSMA

MASTER THESIS

# THE EMPOWERMENT OF THE UNDERGROUND:

## 'A SOCIO-MATERIAL APPROACH TOWARDS THE UNDERGROUND INFRASTRUCTURE SECTOR'


by

**M. Breeuwsma**

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**Student number**: 2563487

**Supervisor:** Prof.dr. A.H. van Marrewijk

**Co-reader:** Dr.ir. F.K. Boersma


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# PREFACE

For the past six months, I had the opportunity to study the underground infrastructure sector. On beforehand, I had absolutely no idea about this sector. But in the end, I can say it is a fascinating world full of interesting organisations. The past months had its ups-and-downs, but I proudly present you the final result '*The Empowerment of the Underground*'. However, I could not have done this without support.

First of all, I would like to thank my supervisor Van Marrewijk for the support and insights he has given me during this period. He thought me to look critically to the underground infrastructure sector and not everything has to be taken for granted. I even ended up writing a letter to my mother explaining the findings of my research. Anyway, I would also like to thank my fellow thesis colleague Oscar van der Wiele for the debating about this difficult to grasp sector and the mental support. And, of course, I would like to thank the COB, in particular van Ravesteijn, for the guidance throughout the process. Without them, I would not have been able to find a project for the case study. And lastly, I would like thank all the respondents of the study, because without their participations and in particular their stories I would not have anything to write about.

I hope you will enjoy reading,

Matthijs Breeuwsma,
Amsterdam, 30th of June 2017

# ABSTRACT

Over the last twenty years, there has been a tremendous development in the use of the underground. A growing number of organisations and industries such as network administrators, contractors and municipalities use the space below the ground level. The nature of these projects is complex and requires an extraordinary degree of structure, collaboration, and governance. This paper aims to gain insight into how an inter-organisational project in the underground infrastructure sector, with multiple stakeholders, is governed from an actor-network perspective. The qualitative case study conducted in this research is the renewal of the Amstelveenline (AVL). By applying the translation model of Callon (1986), the entanglement of the social and the material within the project AVL is studied. It shows that several notions are necessary to govern the fragmented and risky process, but it also sheds light on the importance of the underground and materiality within an underground infrastructure project. The results are somewhat consistent with earlier studies. However, more research is needed to get a better understanding of the governance in underground infrastructure projects.



**Keywords:** Inter-organisational Project, Temporary Organisation, Governance, Actor-Network Theory, Translation.

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| | |
|---|---|
| ANT……. | Actor-Network Theory |
| AVL……. | Renewal Amstelveenline |
| C&P……. | Cables & Pipelines |
| COB……. | Centre for Underground Building |
| D&C……. | Design & Construct |
| IOP……... | Inter-Organisational Project |
| OPP……. | Obligatory Passage Points |
| TMO……. | Temporary Multi Organisation |
| TO……. | Temporary Organisation |
| KLIC……. | Cable and Pipeline Information Centre |

# 1. INTRODUCTION

*"The world is not a solid continent of facts sprinkled by a few lakes of uncertainties, but a vast ocean of uncertainties speckled by a few islands of calibrated and stabilized forms"* – Bruno Latour

In the Netherlands, approximately 1.7 million kilometres of cables and pipelines are located in the underground with a high density in urban areas. According to Lerner (2011) 70% of the world population will live in urban areas by 2050. Consequently, over the last twenty years, there has been a tremendous development in the use of the underground to facilitate the foreseen growth figures of Lerner. A growing number of organisations and industries such as network administrators, contractors and municipalities use the space below the ground level. It is becoming increasingly difficult to ignore the fact that space is becoming scarce. Consequently, it affects the networks of cables and pipelines in the underground, as the functioning of society depends on the power and utilities provided by these cables and pipelines. The society is entirely connected to these networks and they provide almost all households and organisations with basic needs. They are, so to say, the nerve and blood vessels of the society. As a consequence, there are high risks of disruptions, crucial for the wellbeing of modern citizens. Hence, the underground empowers projects that have to deal with issues of cables and pipelines. Within underground infrastructure projects the ordinances, regulations, and consultations procedures do not guarantee the smooth operation of cooperation between the many organisations involved in the design, construction and management of cables and pipelines (Ravesteijn et al., 2014). These projects, which involve multiple projects for a limited period of time, can be called inter-organisational projects. According to Van Marrewijk et al. (2008) these projects are often a fleeting constellation of multiple subprojects and different stakeholders that collaborate in shifting alliances.

Governance in underground infrastructure projects is necessary, as the underground is an environment that consists of many uncertainties. Similar to the aforementioned quote of Bruno Latour, the underground is also a vast ocean of uncertainties speckled by a few islands of calibrated and stabilized forms. It addresses many disciplines such as archaeology, different soil types, urban areas, and even unexploded bombs. According to Van den Ende et al. (2015) the underground causes many risks for network administrators through, for example, unknown cables and pipelines or instable subsoil. The underground construction of the so-called North-South metro line in Amsterdam has caused seven historical buildings to prolapse (Berkhout & Rosenberg, 2008). However, the prolapsing of the underground can also cause risks for the pipelines located in the subsoil. These are not always resistant to bending by, for example, strong sagging soil and possible damage of gas pipelines can be catastrophic for the environment. The use of the underground requires an integral approach in underground infrastructure projects. However, according to Taselaar (2009), this implies three obstacles. The first obstacle is the fact that the underground is the field

of specialists who do not always understand each other's work and do not find it interesting either. Secondly, there is a lack of exchanging the data, such as the locations of cables and pipelines. And lastly, construction, energy networks and space are treated as separate areas within a project. The governance of these underground infrastructure projects involves a high degree of uncertainties and includes a large number of organisations, i.e. network administrators, municipalities, contractors. The organisations involved are interested in an insightful situation under the ground level. However, various aspects have significant influence in underground infrastructure projects, such as conflicting interests (Clegg et al., 2002) or the temporary collaboration amongst multiple organisations (Van Marrewijk et al., 2016). Several scholars studied the temporary organisational forms across different organisational settings – for example film crews (Beckhy, 2006) and SWAT teams (Okhuysen & Beckhy, 2009), but also construction (Eccles, 1981). According to Bechky (2006) temporary organisations are set through structured role systems whose nuances depend on the situation. Within these temporary organisations, organisational actors are constantly seeking for order, continuity and consensus out of the chaos. In general, the nature of these projects is complex and requires an extraordinary degree of structure, collaboration, and governance. The ability to stabilize these projects often requires allies. Additionally, understanding what goes through the minds of the other organisations is commonly the key. The aim of this study is to explore the inter-organisational collaboration in the governance of underground infrastructure projects.

It can be argued that the uncertain and temporary character of underground infrastructure projects asks for an approach that captures every aspect of the entity, including the underground and material. One school of thought that deals with this is the socio-material perspective. According to Orlikowski (2007), the social and the material are constitutively entangled in the everyday life of projects. Latour (1992) argues that agency is not something that inheres only humans, but is relational to the actions of actors, either human or non-human. This philosophy triggered three scholars (Callon, Latour and Law) to introduce the actor-network theory in the 1980s. To understand the actor-network theory, it is important to know that the actor-network theory is not a theory, but rather a descriptive approach in sociological studies. It tells stories about how relations and uncertain processes are assembled in specific situations (Law, 2009). According to Law (2009, p. 141), the actor network theory describes the "*enactment of materially and discursively heterogeneous relations that produce and reshuffle all kinds of actors including objects, subjects, human beings, machines, animals, nature, ideas, organisations, inequalities, scale and sizes, and geographical arrangements*". An interesting framework within the actor-network theory philosophy that maps these interests and obstacles of an underground infrastructure project is the translation model of Callon (1986). By applying the translation model to explore the inter-organisational collaboration in the governance of underground infrastructure projects, it provides an insight in the ambiguity amongst the multiple stakeholders involved,

including the underground and material of the cables and pipelines. This study will go into the complex environment of these projects where the underground shapes the processes from a socio-material perspective. To explore the complex environment of underground infrastructure networks and the inter-organisational collaboration in the governance of these projects, the following research question will be answered in this thesis: *"How is an inter-organisational project with multiple stakeholders governed in subsurface utility projects from an actor-network perspective?"*

This question is subdivided into sub questions, consisting of one theoretical question, a methodological question, and two empirical questions, in that order:

1. What is written about inter-organisational projects from the perspective of a temporary organisation?
2. How can the actor-network theory be used to study a temporary organisation such as an inter-organisational project?
3. What factors influence the temporary organisation of underground infrastructure projects?
4. How are uncertainties that occur in underground infrastructure projects governed from the actor-network perspective?

The research questions will be answered by conducting a qualitative case study of an inter-organisational project within the underground infrastructure sector, which is the renewal of the Amstelveenline (AVL). This is a project with multiple organisations involved, such as network administrators like KPN, Gasunie, Liandon, but also the contractor VITAL, a consortium of different organisations.

## 1.1 Scientific and Societal Relevance

This study aims to contribute to the discussion on the governance of inter-organisational projects to further develop the concept of temporary organisation involving multiple stakeholders, conducted in the underground infrastructure sector. Studying the governance of such projects tells us more about the complexity of uncertainties and temporality, as this sector is contumacious in its character with different interests of the organisations involved. It provides a great opportunity to contribute more interesting insights in the construction sector as in the characteristics of a temporary organisation.

This thesis makes three theoretical contributions. Firstly, it contributes to the debate of governing projects with a multiplicity of organisations involved in a complex environment and examines the origin of the problems that occur (Clegg et al., 2002; Van Marrewijk et al., 2008; Klijn & Koppenjan, 2016). It shows what risks, uncertainties and conflicting interests are part of an underground infrastructure project and how

and by whom these conflicts can be solved through governance. Second, this study will contribute to the on-going debate of temporary organisations, where several different stakeholders are involved for a limited period of time (Goodman & Goodman, 1976; Lundin & Soderholm, 1995; Van Marrewijk et al., 2016). This temporality causes tension within the organisation and this study shows how these organisations deal with the time pressure and constraints (Dille & Söderlund, 2011; Bakker et al., 2016). Lastly, the findings contribute to the academic debate of the socio-material perspective (Orlikwoski, 2007), as the underground and materiality of the cables and pipelines is taken into account as an actor who has agency within the network. The insights gathered can be helpful to support the entanglement of the social and material aspects in everyday life. It helps to gain a better understanding of the actor-network theory by applying the translation model of Callon (1986). The findings create the opportunity to see how the role of non-human actors influence a (construction) project in the underground infrastructure sector and provides a practical insight in the multi-layered characteristic of the different actors involved a project. It therefore contributes to the debate of the actor-network theory (Law, 2009, Latour, 2008 Callon, 1990) within organisational settings.

The societal relevance of this study is to prevent as many unasked situations and problems within the underground infrastructure sector, which includes the environment of the projects. Despite the obligation to register the (re)locations of cables and pipelines, there are still many unknown cables and pipelines in the underground. By conducting professional governance many problems can be avoided. Necessary activities remain adaptable and citizens do not experience any obstacles due to, for example, road maintenance, plans of the project and organisations involved do not get delayed. According to Van Marrewijk (2016) there is potential in the joint decision-making over subsurface projects that are dealing with scarce public space, synergy between infrastructures, reducing costs and, eventually, more satisfied citizens. The findings also contribute to a project of the Centre for Underground Building (COB), who launched a project that provides insight into how cable and pipeline issues are managed in large infrastructure projects. The goal of this project is to create more consensus between the interests of the multiple organisations (e.g. project initiator, the network administrators and the contractors) involved. The sector of underground infrastructure is ambiguous in its character and sometimes difficult to grasp. However, by developing the awareness of the uncertainties and conflicts that occur, it creates solid ground for possible solutions.

## 1.2 Core Concepts

Before elaborating on the theory in the next chapter, it is useful to briefly explain certain concepts that are used in this thesis. This provides context for a better understanding of the theory and results. In this thesis, the following core concepts will be used: 1) inter-organisational projects, and 2) temporary organisations.

*Inter-Organisational Projects*

Hobday (2000) defines a project as "*any activity with a defined set of resources, goals, and time limit*". However, in this thesis the definition by Jones and Lichtenstein (2008) will be used, who state that a project is "*a nexus of activity that allows multiple organisations to collaborate to achieve their individual and collective goals*." This definition sheds light on the multiple organisations that are involved in the project, which also can be understood as an inter-organisational project (IOP). In inter-organisational projects, two or more organisations collaborate by sharing their processes, information systems and knowledge. Each organisation can focus on its own core business, but benefits from the core business of other organisations involved to achieve the same goal (Fenema & Loebbecke, 2014). Thus, these organisations temporarily work together with each other. This temporality within the projects can also be viewed from a different perspective.

*Temporary Organisations*

As the name suggests, temporality plays an important role in the aforementioned projects. In literature, there are different definitions for temporary organisations (TO). For example, Morley and Silver (1977) call it a "temporary system" and define these systems based on their time-limited duration and membership where people come together to create something and then disband again. This is acknowledged by Grabher (2004), who sees temporary organisations as transient, inter-disciplinary institutions that perform a particular task together. However, Beckhy (2006) sheds light on the unfamiliarity between the members involved, where each member has its own skill, but must work independently on the, often complex, task.

## 1.3 Structure of the Research

In this chapter, a brief introduction is provided about the main topics that will be discussed in this thesis, as well as the academic and societal relevance. The following chapter deals with the theoretical background of inter-organisational projects and temporary organisations, but also the actor-network theory method will be explained. Chapter 3 explains how this research is conducted in the context of the methodology. On this basis, findings were obtained, which are discussed in chapter 4 (organisational context) and chapter 5 (the translation of the underground infrastructure sector). In the last chapters, these findings will be processed into a discussion and the final conclusion.

# 2. THEORETICAL FRAMEWORK

This section describes the theoretical framework for the thesis. The first part will explain the perspective of a temporary organisation to study inter-organisational projects. It describes what is meant with temporary organisations and to what extent it relates to inter-organisational projects. In addition, the factors that influence the process of temporary organisations will be addressed. The second section will explain the actor-network theory, which is an approach that can be used to study the temporary organisation of inter-organisational projects.

## 2.1 Inter-organisational Projects as Temporary Organisations

Even though the number of organisations involved may vary, the temporarily collaboration between organisations can be referred to as inter-organisational projects, according to Jones and Lichtenstein (2008). Jones and Lichtenstein (2008) define inter-organisational projects as projects where "*multiple organisations work jointly on a shared activity for a limited period of time and are increasingly used to coordinate complex products/services in uncertain and competitive environments*". Several key characteristics stand out in this definition, which characterizes these projects. Firstly, the multiple organisation that must collaborate for a particular activity. This could be challenging as the different organisations involved have, for example, different organisational structures. Secondly, it is apparent that these organisations must collaborate for a limited period of time, which can cause tensions due to time pressure in the project. Lastly, such projects are often located in an uncertain and competitive environment. This is acknowledged by Van Marrewijk et al. (2016) who define these inter-organisational projects as a group of organisations that temporarily work together to coordinate a complex service or product, often without any clear hierarchical structure amongst the involved organisations.

Another similar approach as the inter-organisational project is the temporary multi-organisation (TMO) being described by Cherns & Bryant (1984). They apply their perspective to the construction sector and come up with three characteristics to which such projects must comply: 1) a construction project is the temporary commitment of different and separate organisations, such as client, consultants, contractors, subcontractors and suppliers, for a limited timeframe to design and construct. 2) The management of such construction projects is called a temporary multi-organisation, which consists of several organisations with the same purpose that remain together from the beginning to the completion of the project. Once the project is completed, the organisations separate again to form a new temporary multi-organisation somewhere else. 3) In these construction projects, a complex organisational system evolves with different interests of each participating organisation, some congruent and some conflicting. Diverse influences within the group can affect the performance of the temporary multi-organisation. These so-called temporary multi-organisations

occur in several forms and depend on the nature of the construction project to the contract chosen. It can influence the performance of the TMO seriously during the completion of the construction project (Osborne, 2004). In short, within both perspectives (IOP and TMO) it depends on the inter-organisational relationship between the participating organisations.

What stands out is that both perspectives have a one similar aspect, namely temporality. Based on Cherns & Bryant (1984) and Van Marrewijk et al. (2016) it can be argued that in both concepts the temporary cooperation between different organisations with the same purpose or problem is essential. Once this goal is achieved, the organisations reassign and form a new project somewhere else. So, this temporality gives projects an interesting and challenging dimension. The nature of the environment and organisations is always changing, so temporality becomes an important aspect in organisational studies. Bakker et al. (2016) argue that inter-organisational projects can be seen as a temporary organisation, focusing on those forms and structures. From this angle, the temporary organizing leads to formal organisations or other types of social systems, which are invented to deal with a limited time frame. In this thesis, inter-organisational projects are studied from the perspective of the temporary organisation.

Many studies (Kenis et al, 2009; Van Marrewijk et al., 2016) about temporary organisations as a form often emphasise on actors who are intertwined in establishing, maintaining and discontinuing temporary structures such as projects in permanent systems like inter-organisational networks. These structures are reproduced or transformed by individual or collective agents participating in such a project or system (Bakker, 2010). According to Goodman and Goodman (1976) temporary organisations are a "*set of diversely skilled people working together on a complex task over a limited period of time*". Thus, temporary organisations can be characterized by time, (skilled) people, and a collective goal. These aspects lead to uncertainty and time constraints, which stresses the importance of coordination mechanisms (Menger, 1999). With the focus on temporary organisations, Grabher (2004a, p. 1492) claims that this form of organisation is "*inextricably interwoven with an organisational and social context which provides key resources of expertise, reputation, and legitimization*". In his paper, Bakker (2010) applies four themes to study these temporary organisations: time, team, task and context. These four themes are often central to this form of organisation. Obviously, time is important, as temporary organisations are often linked to a certain time limit, which puts pressure on the organisation. The second theme is about the composition of the team in the organisation. Different (skilled) people come together in the temporary organisation to achieve the (same) goal. This goal also brings us to the third theme, which is about the team's task. Together they will have to solve a particular problem or achieve a certain purpose, depending on the situation. The last theme emphasizes the context of the temporary organisation. It focuses not only on the organisational context and structure, but also on the social context that influences these forms within the organisation. Lundin & Söderholm (1995) add one

more theme to it: transition. According to them the temporary organisation has a specific purpose where elements of change are intertwined. Change is necessary and the temporary organisation is there to achieve this change. Therefore, a clear 'before' and 'after' situation is expected. This change is called the transition of the temporary organisation.

The temporality within these organisations has to do with the element of time. However, time can be broad and vaguely understood. In any organisation time is scarce and a 'time is money' attitude often occurs in the organisational environment (Lundin & Söderholm, 1995). The way someone organises time and tempo can differ, but also the several phases (i.e. start-to-finish phase) within a project differs. How to manage these differences can contribute to the governance of a temporary organisation, argue Dille & Söderlund (2011). They come up with a conceptual framework to analyse the aspect time in projects: 1) isochronism, 2) timing norms, and 3) temporal fit/misfits. The notion of isochronism is about the fact that organisations who share the same environment, tend to adapt the same time orientation. As a result, they get temporarily aligned in terms of when things need to happen, but also how fast things should happen (i.e. control processes, duration of work practices).

The second concept is timing norms, which stresses the importance of the shared rules and expectations of behaviour among the actors involved in the same sector or organisation. These standards are about the pattern of how things should go and how the different actors should handle them (i.e. delay policies, deadlines, competitive bidding deadlines). According to Krohwinkel-Karlsson (2008), the elements within the (temporal) structure of an organisation, such as schedules, sequencing patterns, and deadlines, contributes to how time is understood by the actors. In short, these norms are important in governing the activities within a project. The last notion of temporal fit/misfits is about how the timing norms within a project affect the processes. In the temporal fit (i.e. mutual understanding of the decision process), the perceptions of time and timing are aligned and synchronized within the project. However, when this is not the case, a temporal misfit (i.e. different perception of time within the project) can cause collaboration and synchronization problems, as the perception is different (Dille & Söderlund, 2011). In other words, there is a difference in 'time' and 'timing', when we study temporary organisations. Both aspects or notions could lead to uncertainties, conflicts and time pressure within a project. To deal with these problems, organisations must first get an insight in these problems to, eventually, solve them.

The element of timing can be linked to different phases in which a project can proceed. The actions that should be taken in a particular phase are not fixed and can differ per project. However, it provides insight into when and how certain actions are undertaken in the "life cycle" of a temporary organisation. In addition, it deals with the temporality an organisation has to deal with, from phases as the preparation and

the realisation phase. To gain a better understanding of the phases within these organisations, Lundin & Söderholm (1995) came up with the following figure about the four phases of a project's life cycle, depicted from the Project Management Body of Knowledge (2008). In this figure, the four basic phases of a project are visible. These are useful to capture the aspects, such as costs, staffing level and time. Additionally, the different phases can be applied to study the conception of time and timing within a (temporary) project. The phases can be divided into the initial, preparation, realisation and closing phase:

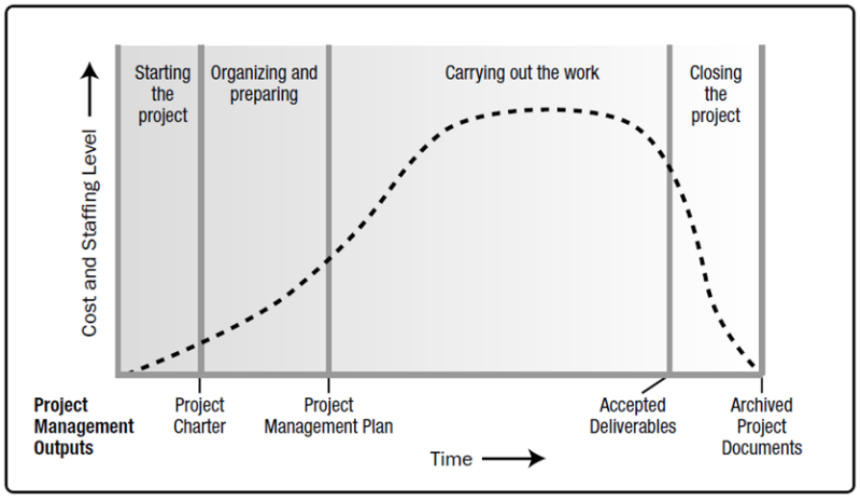


*Figure 1*. Four basic phases of a project's life cycle (Source: PMI, 2008, p. 39)

An inter-organisational project can be studied through the perspective of temporary organisation. However, certain aspects that could influence the project are important. For example, Van Marrewijk et al. (2016), shows that the agreement of roles, relations and collaborating philosophy is essential in the tender phase of a construction project. This fragmented process shows that difficulties can and may arise in controlling the outcome due to the increasingly diverse organisations involved. In the construction sector, they divided two phases: design and construct. Nevertheless, this could result into barriers for the entire process, project duration and time-related risks, as it has become a fragmented and risky process. The 'Design & Construct' was introduced to create a single point of responsibility between the client and contractor. Despite this, managing the conflicting risks during the construction continues to have an impact on business viability and life-cycle costs. It remains difficult, due to the many uncertainties interwoven in the fragmented and complex nature of many organisational resources within infrastructure projects. Managing the process, costs and schedule planning remains the main tool. However, the short-term interest of the contractor still conflicts with the long-term interests of the client and end user (Clegg et al., 2002). Therefore, the coordination of the process within projects remains an important aspect in the construction sector.

In sum, within the construction sector, work is often being done on project base and can be called inter-organisational projects. These projects can be approached through the perspective of temporary organisations. However, the above has shown that there are many aspects that influence these forms. The question that occurs is how these apply to reality. Therefore, this thesis will examine organisational processes, social interactions and factors that influence a temporary organisation in the underground infrastructure sector. One approach that can be used to study this is the actor-network theory (ANT).

## 2.2 The Actor-Network Theory (ANT)

To understand the actor-network theory, some context must be given about the origin of the philosophy. In organisational studies, a distinction is often made between the material (e.g. Barley, 1998; Orlikowski, 1992) and the social aspect in organisations (Grabher, 2004; Tsoukas & Chia, 2002). However, it is overlooked that these two aspects affect each other and the organisation. For example, Orlikowski (2007) states in her paper that it is often ignored, taken for granted or treated as a separate case when we talk about the social and material aspects. Orlikowski (2007, p.1436) describes that a "*considerable amount of materiality is entailed in every aspect of organizing, form the visible forms – such as bodies, clothes rooms, desks… to the less visible flows – such as data and voice networks, water and sewage infrastructures*". As Leonardi (2013) describes it, the material has agency in such way that objects act when humans provoke it. But the humans have agency as well, and is defined as "*the ability to form and realise one's goals*" (Leonardi, 2011, p. 147). Therefore, it is important to take this into account and perhaps even combine it. Orlikowksi (2007) argues that the material aspect should not be considered as a separate case, but as an entity in association with the organisation. Material is integrated in organizing, so the position can be taken that the social and the material are constitutively entangled in the everyday life. Now, there are various ways to apply this approach to organisation studies, such as mangle of practice (Pickering, 1995), relational materiality (Law, 2004) and the actor-network theory (Callon, 1986; Latour, 1992). In this thesis, the emphasis will be on the actor-network approach, which combines the material and human agencies within a network.

The actor-network theory (sometimes called 'the sociology of translation') is developed by the researchers Callon, Latour and Law around the 1980s. They argued that actors build networks combining the technical with the social element, and these elements are shaped within those networks (Stanforth, 2006). To explain the actor-network theory (ANT), it is important to know that the ANT is not a theory, but rather a descriptive approach in sociological studies. It tells stories about how relations and uncertain processes are assembled in specific situations. According to Law (2009, p. 141), the actor network theory describes the "*enactment of materially and discursively heterogeneous relations that produce and reshuffle all kinds of actors including objects, subjects, human beings, machines, animals, nature, ideas, organisations, inequalities, scale and sizes, and geographical arrangements*". In addition, Latour (1996, p. 373) states that "*an actor in ANT is a*

*semiotic definition – an actant – that is something that acts or to which activity is granted by another*". Actors have the ability to change their environment and have a mutual influence on each other, which can be described as 'agency'. According to Law (2009), there are three elements that are important in the actor-network theory. Firstly, there must be semiotic relationality, which is the network where actors influence each other. Secondly, there must be heterogeneity in the network, which means that the actors involved differ. Lastly there is materiality, which is the aspect where material influences the social aspect. So, in the ANT all humans are equal to each other, but non-humans are equal to the humans as well. It does not distinguish between human and object. Actors could be humans, but also machines, cars, and so on. In the ANT, even objects have the ability to influence a network (Latour, 2008). All these actors together can be defined as a network and, as Callon (1990, p. 142) states, they *"identify and define other groups, actors, and intermediaries, together with the relationships that brings these together"*. Within a network, there is a continuous interaction between people and objects to ensure consensus, rather than disorder. When a new actor, or actant, becomes part of an existing network, both the new actor and the actors in the network must change to restore or maintain the stability (Callon, 1990). The process of organizing this consensus is also called 'translation'.

### 2.2.1 The Translation Model of Callon

The best way to explain the translation philosophy is 'A translates B', where it does not matter if B is human or non-human, an individual or a collectivity. Both A and B are endowed with interests, projects, desires, strategies, reflexes or afterthoughts. According to Callon (1990), the nature of relationships between actor and network is never fully resolved as two translations link together and generate a third one, which creates a new network. The process of translation consists of different complex dynamics, as the actor and their intermediaries weave themselves together in a network. To get a better grasp of this process, Callon (1990) describes how convergence is essential within the network. Convergence is described as the process of translation that leads to an agreement and is a combination of two dimensions: alignment and co-ordination. Alignment generates a shared space and equivalence between different actors and co-ordination highlights the aspect of rules or conventions to secure stability in the process. Actors in these networks favour certain kinds of solutions or interests and contest these by enrolling with allies. A powerfully coordinated and aligned network could be compared with the Tower of Babel:

> "*Everyone would speak their own language, but everyone else would understand them. Each would have specific skills, but everyone else would know how to use them. It would be particularly efficient, for it would draw on both the force of the collective and the synthetic capacity of the individual*" (Callon, 1990)

In order to understand the process of translation, Callon (1986) has developed four moments of translation: problematization, interessement, enrolment and mobilisation. Within this model, the chain of different actors and their actions are studied, each of which translates and shapes it to their own goals.

The following four phases are conceptualized in the famous paper 'Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay' of Callon (1986). The first phase is 'problematization', where the problem and solution of the project is formulated. In addition, a set of actors is determined by defining their identities. To define their problems and obstacles an important step has to be taken by setting up the Obligatory Passage Points (OPP). The OPP implies that all actors must pass certain obstacles to ensure the network in which they are involved can truly succeed. In the previous phase, the identity of the actors has been established. This determines what interests' other actors may have and are integrated in the initial plan. Therefore, the identities, goals, projects, orientations, motivations, or interests are refused in another way through their actions. This second phase of 'interessement' shows the group of actions by actors who attempt to impose and stabilize the identity of the other actors. In short, 'interessement' entails the process in which the actors must be convinced that their interests are being ensured in the solution of the project. This creates mutual relations and involvement of the different actors. If the previous moment is organised well, the next phase, 'enrolment', is achieved. In the 'enrolment' phase the roles of the actors are defined and coordinated. As Callon (1986) states, it is *"to describe the group of multilateral negotiations, trials of strength and tricks that accompany the interessements and enable them to succeed*". The enrolment phase consists of describing the process in which the actors are attempting to make certain statements. Whether the actors in question represent their backbone is being discussed in the final phase: 'mobilization'. If this succeeds, the initiator needs to mobilise and stabilise the network and the 'new' identities of the actors. It is a set of methods that is used to ensure the representative role of the spokesmen (Callon, 1986). Thus, translation is an on-going process in which the various actors are part of a network. With the collaboration between the actors, a specific goal is achieved within the network.

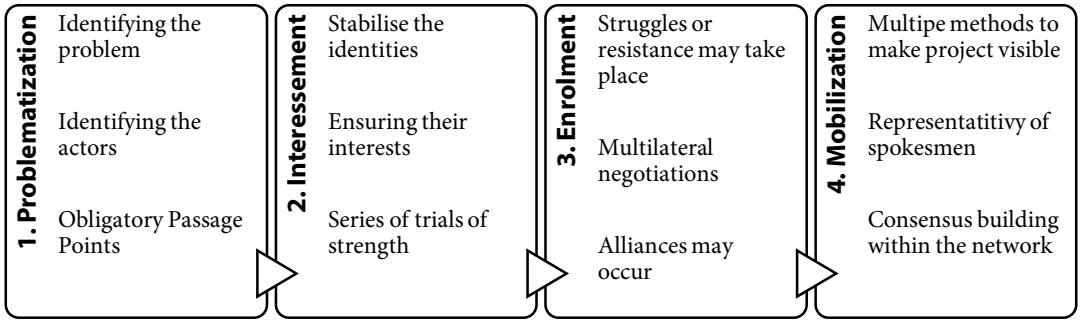


*Figure 2. The Translation Model of Callon (1986)*

By applying the ANT to the process of governance in underground infrastructure projects, it is possible to study how the various actors position themselves in the network. Through the ANT, the uncertainties of the underground that may occur in projects are being captured. In this thesis, the ANT is used as a framework to study the network of actors in an underground infrastructure project. The underground is taken into consideration to find out how it is connected to the system and how it affects the network. The OPP implies that all actors must overcome certain obstacles to ensure that the network in which they are involved can actually achieve their (common) goal.

# 3. METHODOLOGY

In this chapter, the methodology used in this thesis will be elaborated upon. Firstly, the research design will be described, explaining the chosen starting point. Also, the choice of the case will briefly be discussed. Secondly, in order to gather the data, certain research instruments have been used. How these results have been analysed is explained in section 3.3. Finally, the position of the researcher in the field will be explained through a reflection on the fieldwork.

## 3.1 Research Design

The starting point of this thesis will be a qualitative study to get insight in the governance of inter-organisational projects in the underground infrastructure sector and the factors that influence these projects. When research is used to get insight into new 'ground' (or underground in this case), it is often referred to as 'descriptive research'. The goal of a descriptive research is to get a better understanding of events, persons or situations (Saunders et al., 2009). Additionally, an (epistemological) interpretivist perspective will be applied, where social realities are socially constructed by the researcher, who is fully part of these constructivist processes (Ybema et al., 2009). To answer the research question, a qualitative case study approach has been chosen with the focus on a single case. A single case study provides a clear insight into the governance of an inter-organisational project (Yin, 2014). It allows the researcher to gain a better understanding on how the governance is structured within an underground infrastructure project.

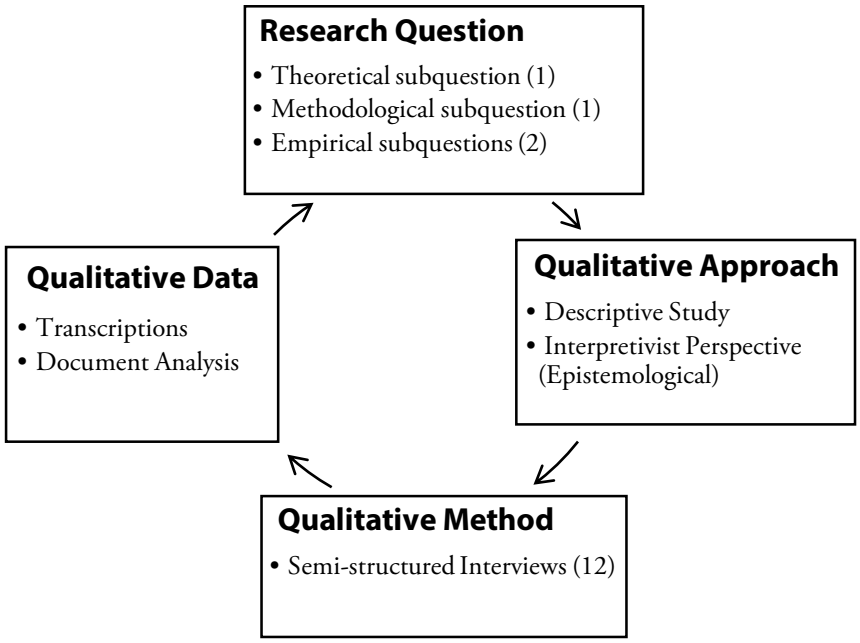


*Figure 3. Methodological Framework: Qualitative Research in Inter-organisational Projects*

*Case Selection*

The choice of a case and the boundaries of the study is key in defining the case study (Flyvberg, 2011). The selection of the case is based on certain requirements. Firstly, the thesis is focused on underground infrastructure projects involving cables and pipelines. It is part of a larger research from the Centre for Underground Building (COB). The COB organised a conference in 2016 initiating a new study to better understand how large infrastructure projects can manage cable and pipeline issues. The purpose of the study is to align the different interests of the project initiator, network administrators and the contractor. Together with the COB, the criteria of the project were discussed. Therefore, the project must be in an urban area and the realisation budget for cables and pipelines are at least 50 million euros. In addition, at least four network administrators must be involved, the client and contractor excluded. It also important to create diversity between the projects studied, i.e. type of project such as road or rail and the different stages of the project such as planning phase, preparation phase and realisation phase. These criteria have led this study to the renewal of the Amstelveenline, which is between the preparation and realisation phase.

## 3.2 Data Collection

The aforementioned research design will be conducted with various research instruments. In this case, a qualitative approach indicates only non-numerical data was generated (Saunders et al., 2009). A qualitative fieldwork method has a number of attractive features to get a better and more in-depth view of underground infrastructure projects. For example, a combined set of different instruments can be used, such as participant observations, semi-structured interviews, informal talks and document analysis (Ybema et al., 2009). For this thesis, the semi-structured interviews and document analysis were chosen to generate a reliable outlook on these complex projects. Between these interviews, there have been several informal talks about the underground infrastructure sector in general during conferences or meetings of the COB.

*Semi-structured Interviews*

The method that was used to gather most information was semi-structured interviews, meaning the interviews were not completely structured with questions (Saunders et al., 2009). In advance, the information needed to be gathered to answer the research question was prepared. Different topics have been conceptualised with questions that could be asked per topic. The order of the questions, but also the topics, can differ per interview. For example, some topics may not apply to a particular respondent, as they were not involved in the process at that time. This gives the researcher room and opportunities to modify the questions in order to obtain the right information. Through the COB, the Cable and Pipeline (C&P) Coordinator of the AVL has been contacted to find out which organisations are involved and agreed to this study. Subsequently, invitations were sent containing a brief introduction of the thesis attached with a request for an appointment. Every type of actor, i.e. client, network administrators and contractor, is

interviewed (see table 1). The researcher went to these organisations to interview them in their own business environment. As can be seen in table 1, the project managers involved in the AVL were interviewed during the research. This implies different levels of the organisations, such as management or implementation level, have not been interviewed. This would be useful for further research. All conducted interviews were recorded, so all information gathered is retraceable. The interviews were held in the native language of the respondents, which is Dutch. The topic list of the semi-structured interviews can be found in the appendices.

| # | Organisation | Type of Organisation | Position |
|---|---|---|---|
| 1 | Bouwend Nederland | Branch organisation for construction and underground infrastructure | Policy Adviser Market Issues |
| 2 | Aveco de Bondt | Engineering Office | Senior Project Manager Cables & Pipelines |
| 3 | Municipality Amsterdam | Engineering Office – Municipality Amsterdam | C&P Coordinator AVL |
| 4 | Gasunie | Network Administrator (Gas) | Project Manager |
| 5 | Nuon Warmte | Network Administrator (District Heating) | Project Manager |
| 6 | Liandon | Network Administrator (Electricity) | Project Manager |
| 7 | Stedin | Network Administrator (Gas) | Engineer (Project Manager) |
| 8 | KPN | Network Administrator (Telecom) | Project Manager and Liaison Manager |
| 9 | Project Organisation AVL | Client | Project Manager |
| 10 | Municipality Amstelveen | Government | Specialist District Management |
| 11 | Municipality Amsterdam | Government | Policy Officer |
| 12 | Project Organisation AVL | Client | Environment Manager and Technical Manager AVL |
| 13 | VITAL | Contractor | Integral Realisation Manager |

***Table 1**. List of Respondents*

### *Document Analysis*

Another method applied is the analysis of different documents. Before the interviews were held, knowledge about the field is necessary. Through the COB, documents have been provided to create context about the underground infrastructure projects, such as preliminary research on collaboration. These documents used for the study can be considered as secondary sources, as its origin was initially for a different purpose (Saunders et al, 2016). Documents about the project AVL have also been analysed, e.g. the preferred variants, action plan, financial report.

## 3.3 Data Analysis

There are different ways to analyse the data when it is gathered with the research instruments. The interviews have been transcribed, which enables the researcher to analyse them. As mentioned in the research design, this study has been conducted from an interpretative perspective. From this perspective and the context of the case, the data can be understood (LeCompte & Schensul, 2013). According to LeCompte & Schensul (2013), the data can be analysed in four steps. Firstly, the researcher must know what terms are being used in the underground infrastructure projects. This was done by analysing the documents, but also by asking general questions about the sector in the first interviews that were conducted. The second step is to analyse all the data collected by encoding it. The knowledge and information gathered with the interviews have created enough contexts to generate topics that are relevant to the research question. In this case, the following themes were used in the analysis of the interviews: the project AVL, collaboration (network), the underground, governance, interests (actors).

| The Project AVL | Collaboration (Network) | The Underground | Governance | Interests (Actor) |
|---|---|---|---|---|
| Characteristic | (Dis)advantage | Space | Knowledge | Lowest Society Costs |
| Actor | Risk | Risk | Information Provision | Individual Interest |
| Planning | Reason | Value | Environment Management | Common Interest |
| Factor | Exit Point | Trend | Process | Obstacle |
| | Contract form | | Decision | |
| | Obstacle | | | |

***Table 2.*** *List of Themes and Codes*

Based on these themes, the interviews were analysed and processed in an Excel file. These themes were subdivided into codes that are attached to the relevant quotes. This resulted in a complete overview of the quotes that can be used to support the findings, which is the third step. This analysis was also discussed with the contact person of the COB, which is simultaneously the fourth and final step of the analysis. Subsequently, the data analysis is processed into the findings and will support the answer to the research question in the conclusion.

## 3.4 Reflection on the Fieldwork

It is helpful to look back on the process of the fieldwork. This reflection positions the researcher in the context of this thesis and in the field. Throughout this process, also referred to as reflexivity, a clear insight can be provided into the role of the research and how this could influence the outcome of the research (Haynes, 2012). Since the researcher applies an interpretive perspective, a self-conscious awareness of the role of the researcher within the project is required. This creates clarity during the fieldwork, deskwork and text work about what is being studied, like a subsurface utility project (Ybema et al., 2009). Therefore, the reflection of the role as a researcher and the field will be discussed.

The world in which this study is conducted is quite complex and occasionally difficult to understand. Moreover, this thesis is written from the perspective of social science. In the beginning of the fieldwork, there was some ambiguity about the focus of the research. The reason for this was partly the unknown area of it: the underground infrastructure sector. One of the respondents made it clear in the interview that this sector is often difficult to understand for outsiders, as the only thing they see is, for example, road maintenance or a temporary power outage in the households. However, it is a challenging environment to study the social context of this sector, as it is often complex and technical. This creates a certain culture that is interesting for a social scientist. Thus, the focus in this thesis was above the ground, with projects in the underground. But what is there to study above the ground?

It is gradually being chosen to study the governance between the various organisations concerned. However, the field of governance is wide. Therefore, the question that occurs is about the focus within the governance. First of all, the focus was on inter-organisational projects and the theoretical framework has shown that this can also be seen as a temporary organisation. The combination of such projects and the temporary character makes it interesting. It raises questions such as: by whom and how is it governed? What are the factors that influence the project? It became clear that the focus of this thesis was going to be ‘governance in a temporary organisation’. The interest in the socio-material perspective has developed from one of the lectures, meaning the material aspect was also included in social science. At some point in the fieldwork, it has been proposed to use this as an approach to study this governance. As a result, the underground was taken into account as an actor. A method of studying the various actors involved is Latour’s actor-network theory. This gave the fieldwork a different turn, as the topic list had to be modified. For example, questions about the risk and the value of the underground were added. It appeared that the respondents were enthusiastic to tell about the underground and its characteristics. In this manner, an in-depth overview was developed concerning the sector, which became increasingly comprehensible to many elusive situations. Yet, it remains a very technical business environment.

As mentioned, the thesis is written from a social scientist view in a technical environment. These two aspects do not always go hand in hand, as the technical jargon is not always clear for a student in the social science. During the first interviews, this resulted in situations where the interviewer and respondent did not understand each other. When a question was asked about, for example, the culture of an organisation, it was often asked what this meant precisely. But vice versa, if the respondent was speaking about a city-heated steel-in-steel ø 400-600mm pipeline, it was not clear what this type of pipeline was. Eventually, more context was gathered each interview that could be applied in the next interview to ask the right questions and gather the right data. At some point during the fieldwork, there even was a moment of 'going native' (Powdermaker, 1967), as respondents began to ask what potential solutions could be for this difficult-to-grasp issues such as governance. Nevertheless, the world of underground infrastructure project remains a technical world, which can also be an answer to the question of why unresolved issues still occur in these types of projects.

# 4. ORGANISATIONAL CONTEXT

This chapter will provide context for the case, namely the renewal of the Amstelveenline (AVL). A brief introduction will be given about the history of the AVL and the reasons for its renewal. Also, the map of the AVL shows which intersections are being constructed into a tunnel and have interface with cables and pipelines. Finally, the timeline of the project AVL has been processed into a table to provide a clear overview of all events.

## 4.1 The Project AVL

The case study studied in this thesis is the renewal of the Amstelveenline. The Amstelveenline is primarily part of the public transport in Amstelveen, but a small part is established on Amsterdam ground. The roots of the Amstelveenline date back to 1990 with two lines, namely subway 51 and tram 5. The subway 51 runs from Central Station in Amsterdam to Amstelveen Westwijk. Tram 5 utilizes the same rail track and travels between Station Zuid and Oranjebaan in Amstelveen. Because tram 5 is a low floor city tram, the stops along this part have both a high and low platform. Two decades after the establishment of the Amstelveenline they started to think about the future of this line, as it is customary for infrastructure and materials to be replaced after 25 years. Since the start of the planning and construction of the infamous subway North-South line, there were speculations for extending the route to Amstelveen. In February 2012, it became clear that this would not be the case. However, they decided to introduce a high-quality tram link to replace the current fast-track connection. The goal of converting the Amstelveenline is to realise a cost-effective, high-quality, traffic-safe and future-fast rail link. Therefore, the Amstelveenline is an important link in the public transport of the Metropolitan Region Amsterdam (MRA). A decent accessibility is essential for further economic and spatial development. They opted for a high-quality tram rather than the subway, as there was no financial coverage for such an expensive solution. Furthermore, they calculated the growing number of travellers and in the design of the AVL, the focus is to improve safety and the flow of important intersections. It has been decided to take the following three major intersections: Kronenburg, Zonnestein and Sportlaan:

> *"And it has been a wish of the municipality to make tunnels at the intersections. There are still some accidents happening, also deadly accidents. And the Transport Region Amsterdam does not want that, they are for the safety and the accessibility"* (Specialist District Management, Municipality of Amstelveen)

Project AVL is a relatively large project for the municipality of Amstelveen with a total budget of over 225 million euro. To achieve the accessibility goals, three intersections will be constructed into a tunnel. The starting point was to apply a Design & Construct (D&C) contract with opportunities for the market organisations involved. Through a competitive dialogue as tender form, a functional specification has been put in the tender, in which minimum traffic specifications were established.

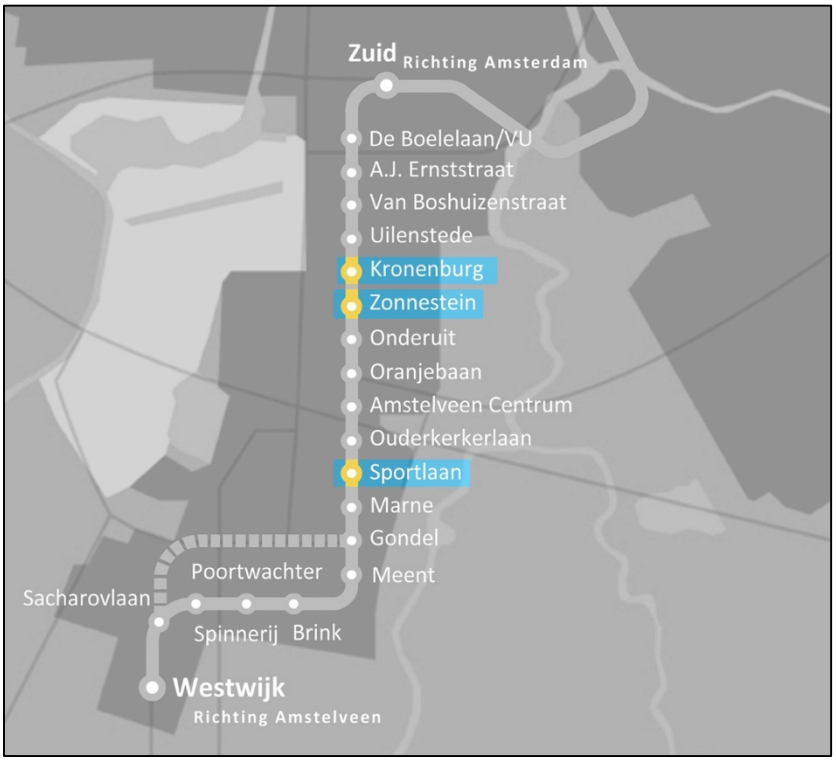


***Figure 4.*** *Situation of the Intersections*

*Timeline of the AVL*

| | |
|---|---|
| **February 2012** | City Region Amsterdam (Stadsregio Amsterdam), the municipalities of Amsterdam and Amstelveen and district South decide to invest 225 million euros in a renewed, high-quality tram link between Amsterdam Zuid and Amstelveen. |
| **December 2015** | Implementation Decision |
| **January 2016** | The beginning of the tender (announcement) |
| **January 2017** | City Region Amsterdam has become Transport Region Amsterdam (Vervoersregio Amsterdam) since January 1. |
| **April 2017** | Tender |
| **Second Quarter 2017** | Start of activities, first activities by NUON, Stedin and Gasunie |
| **March 2018** | Start Realisation Renewal AVL |
| **December 2020** | AVL Completed |

***Table 3****. Timeline of AVL*

# 5. THE TRANSLATION OF THE PROJECT AVL

In this chapter, the translation model of Callon (1986) will be applied to the project AVL. This model consists of four phases, each being processed in a subchapter. The findings are supported by the quotes from the interviews and the translated quotes can be found in the appendix. These findings focus on the governance of the inter-organisational project AVL.

## 5.1 Exploring the Field

The first phase of the translation model is 'Problematization'. Insight into the field of actors and their interests is essential to understand what and who plays an essential role in complex subsurface utility projects. For example, when finding a route for a new connection for the cable or pipeline, it is important for the project initiator to understand the driving forces behind the person who wants to establish the cable or pipeline. On the other hand, it is important for the network administrator to understand the interest(s) of the initiator. In other words, these interests are intertwined with each other. All the actors have their own goals, but they have to overcome some obstacles to reach the common goal.

### *5.1.1 Introducing the Actors of the project AVL*

The figure below shows the triangle of actors involved in the project AVL. The actor-network theory (Latour, 1992) also includes the underground as an actor in the project. The underground is where the activities and usually core business of the different organisations involved are interwoven with each other. In this thesis, these four different types of actors will be discussed to see what impact they have on each other.

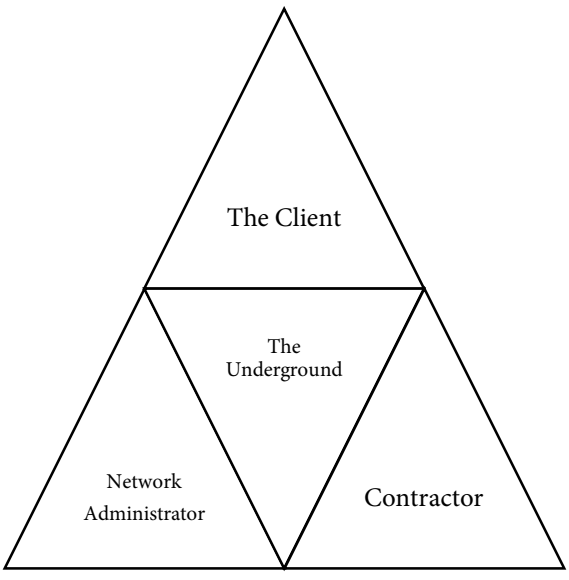


***Figure 5.*** *Triangle of Actors*

### *The Client*

In case of the AVL, there are three actors in charge: City Region Amsterdam, the municipality of Amsterdam and the municipality of Amstelveen. On the 1st of January 2017, City Region Amsterdam changed its name and role to Transport Region Amsterdam. The focus of the Transport Region Amsterdam now lays exclusively in regional traffic and transport tasks, including transport commissioning and the realisation of infrastructure for public transport. The municipality of Amsterdam and Amstelveen are the road authority, but Amstelveen lacks the expertise in complex rail projects and Amsterdam finds it difficult to carry out a project, which is not on its own territory. For these reasons, they requested the Transport Region Amsterdam to complete the role as client for the plan-making phase. Also for the realisation phase, the two municipalities indicated they did not want the role as a client. Consequently, Metro and Tram (MET) was involved in the project as Property & Management of the infrastructure. From within this organisation, they introduced a special project organisation for the realisation of the project AVL:

> *"But the client who has the final responsibility is the Transport Region Amsterdam. They have a new role. Where they were formerly subsidiary, they are now client and tenderer for the first time. And we, as the project organisation, do not decide these things. So, we need the approval of the client, Transport Region Amsterdam, but also as the project as the entity. That takes time."* (Environment Manager, Project Organisation AVL)

In short, the Transport Region Amsterdam is the client for the renewal of the Amstelveenline. Additionally, the municipality of Amstelveen and Amsterdam are shareholders and co-financers. The Project Organisation has the responsibility to realise the new AVL. The municipality as owner and manager of public space is the actor that has to allocate the route for cables and pipelines in the underground. The network administrators who need to adjust their cable or pipeline infrastructure for the renewal of AVL will have to consult with all these different actors. This means that the client AVL has to deal with all different kinds of interests. However, they have their own goals and interests as well within the project, as they are the ones that initiated the idea. Additionally, they want to accomplish a successful end to the story with a new high-quality tram. Nevertheless, if we focus on the part of cables and pipelines, which is the scope in this thesis, there are different interests. As the project is (primarily) located in Amstelveen and the municipality of Amstelveen is part of the client alliance, 1) the society plays a vital role in their interest. When operating in large and complex infrastructure projects, there will always be some kind of nuisance. However, it is the responsibility of the municipality to coordinate it to achieve as little nuisances for the neighbourhood:

> *"The municipality is an important actor, but it is also about the surroundings and environment management. Because, of course, a lot of things happen in the area. Therefore, the municipality has a destination plan, which allows them to carry out such projects. But the impact is huge. There must be temporary lanes, bike paths must be sacrificed, trees must be removed, all of it must be possible. So, the municipality must support it completely"* (Project Manager, Nuon Warmte)

Next to the responsibility for the neighbourhood and environment, the client has another role to fulfil, 2) they have to coordinate the process with the network administrators. They are required to put all the different interests in a funnel and come up with solutions that work for every actor, if possible. And, at last, 3) in the end it is always the costs that play a crucial role in projects like these.

### *The Network Administrators*

Network administrators have the responsibility to provide utility services. The nature, structure and methods of the utility organisations differ from one service to another. For example, sewerage organisations are often municipal services, while telecom organisations can be listed companies. In general, a utility organisation has a commercial attitude that includes the agreement with the customer, department that provides the network design and construction of the cable or pipeline infrastructure. In case of electricity and gas, the ownership of the cable and pipeline infrastructure and the supply of energy are separated (Taselaar, 2009). The electricity cables and gas pipelines are owned by the network administrator. In general, network administrators have common interests, but most of them contradict with each other. One common interest of all the network administrators is to secure their delivery for all its customers, with no interruptions. An aspect that differs with every network administrator yet is vital for a utility project is the turnaround time. In some cases, they have the same interest, for example the lowest costs, but the cheapest solution for network administrator A could be the most expensive solution for network administrator B:

> *"Interests are so contradictory. It is just about the money. That's it. And the person of an energy company who is at the meeting, have the responsibility to keep it cost-efficient. So, if it can stay, leave it."* (Project Manager, Nuon Warmte)

In case of the AVL, there are several network administrators involved in the project, both cable- and pipeline owners. Moreover, each organisation has a different organisational structure, but also other interests. To achieve the next step in the 'problematization' phase, a brief overview of the organisations involved and its characteristics is giving.

The first actor is Nuon, or in case of the AVL **Nuon Warmte**. Nuon is a Dutch utility organisation that produces, trades and delivers electricity, gas and heat. It is established in The Netherlands and in 2009 the Swedish energy company Vattenfall took over Nuon. One of Nuon's organisational tasks is Nuon Warmte,

which focuses on district heating (also known as Heat Networks). District Heat is a cleaner form of heating, because generating energy in power plants releases a huge amount of heat. This heat, so called 'residual heat', is used for the households in the city. Nuon Warmte has become a Business Unit within Vattenfall and is engaged in the construction of heat, district heating and junctions. They are driven and organised by the controllers, i.e. Business Managers, who mainly focus on the costs: *"The asset manager became important, within Nuon Warmte as well. Nothing wrong with that though. In this case, it is a Business Manager who monitors it. The dime is reversed a few times before it is really spent"*, responds the Project Manager of Nuon Warmte.

Nuon Warmte is one of the actors that has a long turnaround time for their activities. If Nuon Warmte is involved in a project, it means that the client has to deal with this timeframe in the project. It can have serious consequences for the progression of the project if the client does not involve Nuon Warmte at the right time. Another, very critical, interest of Nuon Warmte is the safety aspect of their activities.

Another pipeline owner involved in the AVL is **Stedin**, which is the second actor. Stedin is a regional network administrator for gas and electricity in the Netherlands that operates mostly in the Randstad. It is responsible for the transport of electricity and gas of approximately 2 million customers. One of their main interests in underground infrastructure projects is to secure the delivery of their energy to all their customers. And again, like Nuon Warmte and Gasunie, safety is a crucial aspect that influences the work practices of Stedin. Most of the time, they want to coordinate their own operation practices in the field:

> *"Working with natural gas is bounded with all kinds of rules. This also has to do with skills and capacity. Not everyone can work on the gas network. So, we have less choice between contractors, because an organisation with mantle tubes can be executed by a civil contractor. They can call steereddrill.com for example and it's done"* (Engineer, Stedin)

The location in Amsterdam mainly fulfils the role as Operation Organisation. Their asset manager is located in Rotterdam, who has the final responsibility over the region. This means that the location in Amsterdam has to discuss everything they do with the asset manager and is more focused on Operations, which creates a technical oriented working culture that differs from the corporation Stedin.

The last pipeline owner is the third actor **Gasunie**. Gasunie is an organisation owned by the government that takes care of the transport of the Dutch natural gas. They are the gas supplier for the network administrators who transport the gas to their households. In short, they transport natural gas under high pressure and supply the major distribution channels in the Netherlands. Gasunie is owner of the entire pipeline network and is responsible for all the work that needs to be done within this network. If Gasunie

has to reconstruct a pipeline, it is necessary to take their destination plan into account, which consists of a turnaround time of at least one or even two years. Compared with other actors, the financial impact is also much higher in terms of reconstructions. If Gasunie has a reconstruction project, the minimum costs start at 300 000 euro, which can escalate up to millions. Due to the fact that less natural gas is being transported because of the trend towards a sustainable world, they have recently started transporting Biogas as well, which is produced from manure. The main interest of Gasunie when reconstructing their network is safety. They are transporting natural gas under high pressure and if anything goes wrong during these constructions it would be catastrophic. Therefore, Gasunie has to manage systems and networks which consists of high risks:

> *"Yes, safety plays a very important role. We are getting managed and governed on the aspect 'safety', also with the solutions we are considering, like 'is it safe?' Look, of course, we have to make profit as well in that sense. But we are actually kind of, yes, we are semi-government, because all the shares of Gasunie is property of the Ministry of Finance"* (Project Manager, Gasunie)

Besides pipeline owners, several cable owners are also involved in the group of network administrators involved in the AVL, such as **Liandon**. Liandon is part of the utility organisation Alliander, which originated from Nuon. Alliander is split up into two organisations, Liander and Liandon. Liander is the Dutch utility organisation that manages the high voltage network up to 50 kV, medium and low voltage electricity and the gas network in some parts of the Netherlands. Liandon focuses on the construction and maintenance of complex energy infrastructure issues in the Netherlands.

The second cable owner in this project will be the **KPN.** KPN is a provider of telecommunications and ICT services and provides consumers with telephony, Internet and television. Consequently, in the world of cables, KPN has a huge amount of data cables in the underground. For the reconstructions by KPN in the Netherlands, they divided it into 15 regions. This means that if cables have to be relocated, there is an interruption of KPN's Core Business, which is securing the supply of data, according to the Liaison Manager of KPN: *"at the time of reconstruction, we have to interrupt our customers very often. And that's something we prefer not to do. Or actually not at all."*

For these reconstructions, KPN works with VolkerWessel Telecom Infra (VWTI). Within all the reconstructions in the Netherlands, there are around 2,000 reconstructions in which their contractor VolkerWessels is involved. To sum up, KPN has 50 projects a year that exceed the 100,000 euros, the renewal of AVL being one of them. Already one key interest of KPN is named above, namely to secure the supply of data for their customers. The cables they use for it separates them from the pipeline network administrators like Gasunie. A cable is much easier to reconstruct and the costs attached to it are less

compared to pipeline constructions. Still, KPN has to deal with several stakeholders who cannot go without the data, e.g. banks or government institutions. Additionally, the signal strength of the data and its consistency is important for their customers.

### *The Contractor VITAL*

The contractor VITAL is a partnership of VolkerWessel organisations Van Hattum and Blankevoort, VolkerRail and KWS. From 2017 to 2020, this consortium will realise the renewal of the Amstelveenline to a high-quality tram link between Amsterdam Zuid and Amstelveen Westwijk. Due to this collaboration, they can offer a wide range of specific and smart solutions for the project: *"we are a large contractor, with an engineering firm, with a lot of smart and creative minds, we like those tender projects"* responds the Integral Realisation Manager of VITAL.

VolkerWessels is the second largest construction organisation in the Netherlands and recently have become a publicly traded company. They work with a decentralized model, which means that around 120 operating organisations operate in the name of VolkerWessels. The contractor in many utility projects has different interests than the network administrators who are involved. This has to do with the fact that contractors tender with a cost estimation that is going to be their budget for the project. If anything unexpected occurs, for example unknown cable- or pipelines, the progression of the project can delay. Such delay can influence the estimated revenue for the project

### *The Underground*

One of the unanticipated actors in the story of AVL is the underground. All of the actors (client AVL, network administrators and contractor) have one very important common aspect that they depend on: the underground combined with the environment. Focussing on the urban areas, which the project AVL is part of, space is getting scarce, both above and below the surface. It becomes difficult to come up with traditional solutions, as cables and pipelines are everywhere. Thus, organisations in the underground infrastructure sector will have to go through several processes before starting a project. The underground combined with the cables and pipelines therefore consists of some repercussions. On the one hand, it is an important basic need of people (electricity, heat, sewage, etc.), but on the other hand, large complex infrastructure project in urban areas always obstructs the environment with the society and the outcomes are not always visible for them:

> *"What is different above the ground... A building can be engineered to the final detail. You will get things against you. But in fact, a car or a building can be completely engineered. The underground doesn't work that way, because you do not know what is in it. And yes, that makes the underground different. And there you have to operate differently."* (Project Manager, Project Organisation AVL)

It can be said that the underground is a very important actor that influences utility projects. So, this so-called stranger in the midst shapes the processes in an underground infrastructure project. If some of the actors do not fulfil the right position (or role) in this process, it results into ambiguity. Even though the underground is the common interest (or problem) for all the involved actors, it has its own interests as well. In some way, the subsurface is the most important actor for the client of the AVL. If they 'collaborate' in the right manner, they can come up with solutions that create fewer nuisances for the environment. Another significant element in underground infrastructure projects is that you have to deal with archaeology, different soil types, urban areas and even unexploded bombs:

> *"The underground consists out of much more interests, besides cables and pipelines, which are, by the way, not easy to forget. They also have their rights and duties. The water level, if that goes wrong, the building around here will collapse. It's really a wonderful world of interests"* (Policy Officer, Municipality of Amsterdam)

### *5.1.2 The Obligatory Passage Points (OPP)*

The OPP in the project of AVL is to coordinate the processes involving cable- and pipelines, including the control of nuisance and costs. By setting up the right project objectives from the interests and obstacles of the actors, the aim for the next step is created. The goal of the OPP is to understand the interests of the actors involved in the relocations and use these different needs to create several cable- and pipeline solutions. But the actors have to overcome some obstacles to reach the right solution:

*Client AVL* – They are the project initiator, so have a general interest to complete the whole project without any troubles and delays. However, projects with cable- and pipelines involved are never easy to accomplish. Therefore, the main goal of the client is to create as little nuisance as possible for the environment and society. On the other hand, they want to create alliances between the actors involved to avoid any conflicts.

*Nuon Warmte* – In the case of the AVL, the Nuon Warmte has to relocate a large heat transportation pipeline on several different locations. This large heat transportation pipeline is important for the districts Amsterdam Zuid, Zuidas, Buitenveldert and Amstelveen. All these districts, around 25,000 junctions, are connected to this pipeline. It is the backbone of the whole neighbourhood.

*Stedin* – To secure the supply of gas is one of the obstacles Stedin has to overcome in the project AVL. Another important obstacle is one of the intersections. Stedin had to decide if they are going to drill the pipeline or going to use open excavation.

*Gasunie* – The long turnaround times are the biggest obstacle the Gasunie has to deal with. They have their own destination plan, which consists of certain processes that have to be applied. Another significant obstacle with the Gasunie, which is the same for Nuon and Stedin, are the safety constrictions. The Gasunie has their own certified contractors that are allowed to work with gas pipelines.

*KPN* – The Core Business of KPN is securing a durable signal strength for its customers. They have to relocate a cable that is connected to the datacentre of the ABN AMRO, which is an important stakeholder of KPN. In addition, if they do not come up with a cost-efficient solution, the relocation of the cable will be around the 800 meters.

*Liandon* – This actor is just a fraction involved in the project AVL, as they only have one cable that needs to be relocated at the intersection Sportlaan. Their interest is to secure as little possible malfunction minutes for their customers.

*Contractor VITAL* – The contractor in the project AVL has a different perspective on cables- and pipelines than the network administrators. In general, the cables- and pipeline is something they did initially agree to, but have to cope with regardless. Their interest (and main goal) is to be as efficient as possible to decrease the costs, which means more revenue. If it is possible to leave a cable or pipeline untouched, it saves them time and, thus, money.

*The Underground* – For the underground (and environment) it is important to cause no nuisance for the society. This also means that no cable or pipeline that is already located in the underground is being damaged due to the lack of registration in the Cable and Pipeline Information Centre (KLIC)

*The Obligatory Passage Points (OPP)*

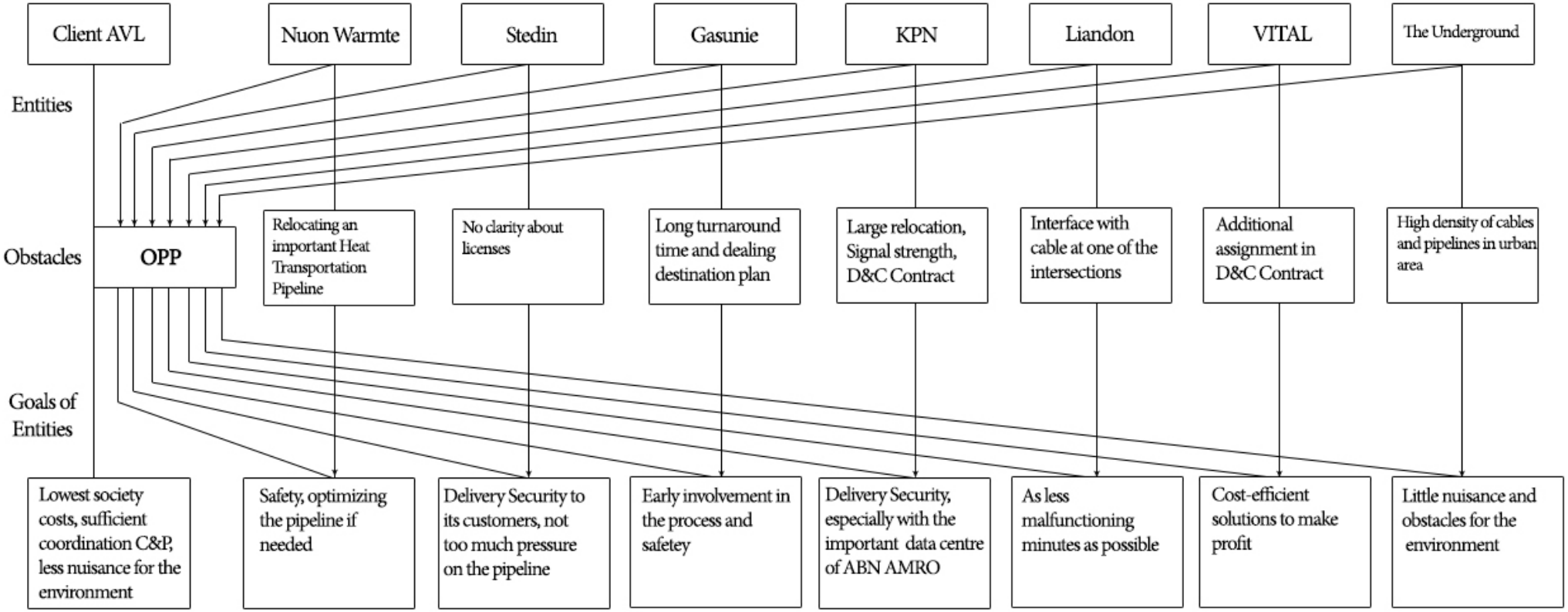


*Figure 6. The Obligatory Passage Points (OPP)*

## 5.2 Realisation of Cable- and Pipeline Networks

The second phase of the translation model is 'interessement'. The realisation of cable- and pipeline networks consists of an entire process. This process begins with searching and finding new routes for the cables and pipelines. In addition, the process involves the management of the licenses, schedule, and even dismantling or transferring (parts of) the cable or pipeline network. The following chapter briefly examines a number of aspects that are important for defining the roles of the actor in the project AVL, from design aspects to the project scope.

### *5.2.1 Project Scope and Design*

A project starts with a scope, which, in this case, began with the idea to renew the Amstelveenline. At that point, several processes have to be followed until the completion of the project. One of them is the process of cables and pipelines. It all starts with the initiatory phase, where the project initiator does a simple KLIC-notification. KLIC is the database in the Netherlands where every single cable or pipeline is registered. The KLIC-notification is the starting point of the cables and pipelines process and consists of several phases *"It is clear that when you start, you do a KLIC notification, that's the starting point. But, between that, where it is about decision-making, it is a grey unknown area. That's the challenge."* (Project Manager, Engineering Office). After the initiatory phase, the data of the cables and pipelines is gathered. Connected to this data are the different organisations that own these cables and pipelines (the network administrators), which leads us to the research phase. The project initiator contacts those network administrators to shed light on their plans. Several conversations and meetings will be organised to discuss the interests. In general, this takes place in a time period between three and six months. Within this period, the project initiator (or client) will have to come up with a VTM (Request for Action) in the case of telecom organisations and a VTA (Request for Adjustment) in the case of the regular utility organisations. This is being processed into a project agreement, i.e. POS. The project agreement serves to establish agreements with the network administrators on the project scope, planning and cost estimation. The provisional compensation is also part of it. The project agreement aims to make the relocation procedure with the network administrator run smoothly.

The design of the new cable and pipeline to be undertaken starts with defining the system requirements of the network administrator. Leading are business, capacity, security, network structure, delivery reliability, lifespan, maintenance and materials. The network administrator also strives to standardise his systems, with the aim of managing and maintaining as efficiently as possible. If the system requirements for the technical design are determined, the network administrator must find a route in the ground. To find the right location for the cable or pipeline, the network administrator is appointed to the owner of the ground. Usually it is the municipality who is the owner, but also other authorities, such as railway organisations and landowners can be partly involved. Furthermore, the other network administrators can play a part in finding the right

track, as they are the co-users of that ground as well. The network administrator uses the route selection criteria based on the functionality and maintenance of his network. This includes minimum depths, arc radiations, distance to other objects in the underground, ability to reach the networks at all times and load of ground level above the cable or pipeline. As the use of space in the underground is increasing, finding a route can be problematic and time consuming. Consequently, it can cause tensions with the wishes of the end user (ground owner), which often depends largely on time and delivery:

> *"And finally, we are also limited in the possibilities of where the pipeline could be located. Because, for example: buildings. There must be a distance between it of at least 4 meters. You cannot just build within that distance. Especially in urban areas where many houses and other cables and pipelines are located. It is often very difficult, that's what we call free trace, where you can locate your pipeline"* (Project Manager, Gasunie)

Based on the system requirements and route selection, the project can be defined technically and spatially. The first estimation of the costs and timetables can also be made. With this information, the project management can draw up a project plan and submit it to the network administrators. In such a project plan, the project is defined by topics, e.g. description of the scope, the project organisation, schedule planning, cost estimation, the main risks, and communication (internal and external)

> *"When the VTA or VTM is accomplished, they are going to prepare. When the POS is done, they will also prepare the realisation phase. Are they going to do the work separately and put it on the market to get it done? Eventually, some coordination has to be taken into account"* (C&P Coordinator, Municipality of Amsterdam)

### *5.2.2 Functions and Risks of the Underground*

The functions of the underground differ and the chance that these functions will conflict with each other increases. According to Czarniawska (2010) the underground consists of many different aspects, such as soil, machines, concrete, and tunnels. In the underground, you have to deal with geology, technology, and ecology, but above the ground it consists of laws, constructions laws and organisations. The COB has categorized the functionality of the underground as follows: 1) the underground has, for example, a carrying function of everything above the ground level, but also a 2) archive function in which archaeological discoveries are located. 3) The transport function includes the cables and pipelines, but also the tunnels. Next to this is the 4) storage function, which focuses on the parking garages, cellars and storage areas. And lastly 5) production function, which relates to the role of the underground as a feedstock for agriculture and nature. It can be concluded that the multifunctional character and the use of the underground is growing fast. In the densely populated (urban) areas these functions conflict with each other. As a consequence, many organisations have a completely different perception of the underground (Taselaar, 2009).

Because the cables and pipelines are located in the underground, it is important to understand the structure of it as well. It can have influence on the carrying function of the underground, but also on the transport function of the cables and pipelines. This interaction between the lower and upper ground affects each other. In addition, Van den Ende et al. (2015) shows in her paper the risks of the different types of subsoil. Consequently, buildings in the centre of Amsterdam have showed signs of prolapsing. It depends on the type of subsoil how much pressure it can hold due to, for example, construction work. These risks must be investigated in advance. Unlike in all other European countries, the underground in the Netherlands does not consist of rock. Cables and pipelines are always in loose soil, such as sand, clay or peat. This makes the excavating relatively easy, but the stability of the cable or pipeline vulnerable. For example, within the realisation phase of the underground infrastructure networks, the excavation work in the subsoil can increase the pressure, which has impact on the cables and pipelines. So, the underground can have consequences for the cable or pipeline. Most of the pipeline owners do not want any pressure from the subsoil on their pipeline:

> *"With pipeline owners, such as Gasunie or Stedin, they want a layer on top of the pipeline with not too much pressure. Meaning that if you are going to excavate, that there is not too much pressure of the subsoil on the pipeline. A gas pipeline is located quite tight in the underground. It can move a little, but not too much."* (Specialist District Management, Municipality of Amstelveen)

> *"Peat and clay is a bad layer. In that sense, bad in a way that geotechnical it is a difficult layer to build upon. It's not called Amstelveen for nothing. So, there is a lot of peat. The first 10 meters is just a bit less bearable ground, so we have to make a construction."* (Contractor, VITAL)

### *5.2.3 Dividing the Cables and Pipelines*

The different actors can be divided into four different categories. Following these categories, the client can get an insight in when the relocations of the cable or pipeline need to be executed in the process, e.g. before the work starts or relocations that can be taken into account by the contractor. Therefore, these categories have an influence on the decision-making of when and which cable or pipeline must be removed or replaced during the realisation phase. This subdivision of categories must be done beforehand by the client (or project initiator). They make a reference design that consists of all the cables and pipelines involved, accompanying the category label. In this way, they can gain insight on which cable or pipeline will clash within the realisation phase. The categories start with 0. Within this category the cable or pipeline has no interference with the design, so no adjustment is needed. The cables and pipelines that will definitively have a "conflict" in the implementation of the project are labelled as category 1. This category describes the relocations that must be relocated before the contractor begins with his job. This also has to do with the turnaround times

of the various actors. Actors with a long turnaround time must be involved early in the process. Category 1 is therefore facilitated and coordinated by the client of the project, in this case the project organisation AVL:

> *"Certainly, where a long turnaround time is the case, they will mitigate it. Gasunie is an organisation that has a long turnaround time, but NUON Warmte is also one. Certain telecom organisations are important, because glass fibre could have a long turnaround time, especially with all the connections in it. So, the client usually takes responsibility of these cables and pipelines."* (Contractor, VITAL)

In category 1, the client will contact the network administrators themselves with the idea and plan of the project, including the reference of their cable or pipeline. This allows the network administrators to respond with certain solutions. If the relocations of the cable or pipeline are inevitably intertwined with the contractor's execution method, then the relocations of the cable or pipeline will be labelled as category 2. This is where the contractor will take the relocations into account in his work, if the turnaround time is also less urgent. The client indicates that the contractor can coordinate these relocations of the cables and pipelines with the network administrators. In addition, the first contact has already been made, but is taken over by the contractor. At last, there is category 3, which is also known as the residual category. These cables and pipelines are in the perfidy of the work, which one actor can suffer from, but the other actor does not:

> *"This is often linked to the design of the contractor. Well, maybe some organisations may have more problems with it. Usually they say: 'you figure it out, but also take the costs for your account'. And as a contractor, you can be smart with the design, for example; if I do this, the cable or pipeline can just stay there."* (Contractor, VITAL)

In category 3, the contractor is given the possibility to carry out the relocations and thus also to take these in consideration. As a result, the contractor can decide to apply changes in his design, which makes it a little more expensive, but avoids a relocation of the cable or pipeline. On the other hand, if the contractor does not change anything in his design, the cable or pipeline has to be relocated. This relocation must be cheaper than the optimisation. This is the partition the contractor has to deal with. In short, these categories can be summarised in the following table:

| | |
|---|---|
| **Category 0** | The location of the cable or pipeline is a precondition for the D&C contractor, no adjustment to the cable or pipeline takes place |
| **Category 1** | The location of the cable or pipeline is a precondition for the D&C contractor, the relocations are being done before realisation |
| **Category 2** | The solution for the cable or pipeline is a precondition for the D&C contractor, the relocation work takes place after tender and is coordinated by the contractor |
| **Category 3** | The solution and relocation will be done after tender and will be coordinated by the contractor |

***Table 4.*** *List of Categories*

## 5.3 Enrolling the Actors

The third phase of the translation model is the 'enrolment'. If the process mentioned in the previous chapter is executed in the right manner, the actors will have to collaborate. At this point the roles of the actor are defined, but how these different actors can collaborate with each other must be investigated. What strategies, e.g. contract form, are being applied to the project AVL and in what form the starting points of all the actors will be processed. In this chapter, the focus is on the collaboration of the network.

### *5.3.1 Reasons for Collaboration*

The interests and obstacles were made visible in the Obligatory Passage Points in chapter 5.1.2. Based on this model, the network administrators can seek alliances within the project AVL to collaborate. This could be beneficial, both in the social as in the cost-efficiency perspective. They can save money if they carry out the work to, for example, the same subcontractor. However, the network administrators should be willing to collaborate, and thus also take the interest of the others into account. As someone said during a COB meeting: *'I am good in collaborating with others, if they just do what I say'*. Yet there are plenty of reasons in an underground infrastructure project to collaborate. The respondents mention the aspect that the actors even need each other in the field:

> *"You will always meet each other in the field, which has its pros and cons. The advantage is that you know each other at some point. Only if you mess it up, you also messed it up with the others involved. On the other hand, if they work against you in, for example, Alkmaar… In the end you need each other, because without it you cannot achieve a successful project.*" (C&P Coordinator, Municipality of Amsterdam)

> *"In the end, if you are involved in it together, you have all kinds of interests. The funny thing is, of course, that if you really want to achieve your goal, you will not get there, so you will have to collaborate. There is a common problem. With all the different interest, it is a game of interests and that has to be coordinated"* (Policy Officer, Municipality of Amsterdam)

As discussed, there are several categories in the cable and pipeline networks. Cables and pipelines on its own are already two totally different things. As a cable has the ability to bend and roll out easily, a pipeline has almost no possibility to bend and to get in the ground is much more difficult. In addition, the materials needed for this kind of work activities differ. Another aspect that plays a significant role is the transportation of gas, water, electricity, etc. Obviously, at every construction site safety will be important, but for transporting gas, there are stricter safety requirements. All these factors make it difficult to collaborate with each other, because as one organisation needs a preparation of three years, the other can start relocating their cable or pipeline in, for example, three weeks. They have a totally different mind-set. So, how can these organisations, or so-called actors, collaborate? First of all, the client needs to take the different turnaround times into account. Hence, the Gasunie has to deal with a destination plan and must be involved early in

the process. Due to the early involvement of the Gasunie, they have a position to influence the decision-making of certain plans, as stated by the project manager: *"Because I am involved early in the process, the scope of the project is often not entirely engineered. So, there are also possibilities to maybe change the plans a bit, so no adjustment has to be done"* (Project Manager, Gasunie)

Thus, Gasunie is an actor that does not collaborate with others very often. Even if they want to, they are involved in a different phase, which makes it difficult to collaborate. However, there are more contradictory factors involved in collaborating. If every actor would work separately from each other, it causes more nuisances for the environment. For example, one construction to the road is better than four at different times. So, from the perspective of the underground (and environment), the actors are required to work together. An important actor who has a coordinating role in this case is the client (together with the municipality). The environment forces the various actors to work together, but that is not always easy. In (almost) every project there is an environment manager involved. They focus on maintaining and creating support in the society and surrounding of the project. This includes direct stakeholder management, such as households, organisations and government stakeholders. The environment manager of the AVL indicates that this task is broad and often coincides with the different facets of the project:

> *"Sometimes the environment is a bit more in the lead and sometimes the technical aspects are a bit more in the lead. With the network administrators, it is often the other way around, it is often the technology which is in the lead and we attach the environment aspect to monitor the interfaces with other stakeholders and connect when necessary"* (Environment Manager, Project Organisation AVL)

The environment manager has become an important actor in the underground infrastructure sector. He can be seen as the one that ensures that all the stakeholders are involved, including the environment. Additionally, he keeps an overview of the entire project, not just the issues with cables and pipelines. However, his main objective and responsibility is to ensure that the environment has no annoyance of the activities during the realisation phase.

### *5.3.2 The Driving Force: Lowest Society Costs*

Within underground infrastructure projects the different categories or turnaround times are not the only reason why actors have to collaborate. Undoubtedly, every actor involved has to deal with the environment as a common interest (or problem). However, it is not always their own interest. This intertwining of interests and technology creates a paradoxical perspective that plays a major role in large infrastructure projects. One of the aspects that has a significant role in this phase is the lowest society costs. Many of the respondents spoke about the 'lowest society costs' in the interviews. This is something that plays an increasingly important role in underground infrastructure projects, especially within urban areas, as there is

less space. For these utility networks, there is public space available. At the same time, it imposes restrictions on other applications, above the ground and in the underground. Consequently, it is inevitable to get in touch with the environment if something is being changed in the underground. One of the actors that is aware of the society and environment is the municipality, as they are responsible for the citizens who may be affected by these subsurface constructions e.g. cycling paths that are inaccessible, noise or energy interruption at home. In general, these aspects are called the 'lowest society costs' and are stated in the contract. Costs such as traffic nuisance, but also social benefits such as saving trees or nature and positive environmental impacts can affect the design of the cable or pipeline network. A possible way to gain insight into social costs is the Social Cost and Benefit Analysis (MKBA in Dutch), as described by the C&P Coordinator of the municipality of Amsterdam: *"You can close down the street and get the shopkeepers against you, but those are society costs and also income, basically a detour of the road. These are basically all the costs that are included in a MKBA analysis"*

The costs incurred in a project are subdivided into investment costs, replacement costs, maintenance costs and costs associated with paving recovery. The benefits in the MKBA can be positive or negative and are formulated in terms of project effects. These are again subdivided into direct effects such as excavation damage and supply interruption, external effects such as unintended project impacts (environmental barriers) and indirect effects such as risks, safety and information provision (Taselaar, 2009). This is how the lowest society costs is build up. Municipalities need to consider these incurred external costs when deciding on spatial situations. The actual expenses for the network administrator must be divided between the network administrators and the client concerned, in order to strive for the lowest society costs. The problem here is that every actor looks at it through their own perspective, which is for their own interest, to achieve the most cost-effective solution regarding cables or pipelines. This causes certain tensions between actors. For one actor, a certain solution could be cost-effective, but for another actor this could be the most expensive solution. Thus, the lowest society costs are considered differently by each actor, as is evident from the study:

> *"Within the project boundaries, more and more is about the Lowest Society Costs, which is the sum of the costs of everyone involved. And it is a topic where, yeah, often everybody is going for his own interest, check if it is possible to make their own share as cheap as possible"* (Liaison Manager, KPN)

This perspective of the various actors involved influences the temporary organising of underground infrastructure projects. Most of the time, actors do not want to share the costs fairly, which would solve tensions between the different actors. The various network administrators exert influence on the client to choose certain alternative solutions that are beneficial for them. This also means that they come up with plans in which the actors do not have to relocate their cable or pipeline at all. Time plays a significant role. The sooner the different actors are involved, the more time they have to prepare different solutions. In this

way, it must be ensured that network administrators are already involved in the planning phase of projects and can provide alternative solutions to prevent unnecessary relocations of the cable or pipeline. The municipality has to take the lead and involve all the necessary actors in the process. Not only the lowest society costs play a role, also the contractor of the project. The client (and municipality) examines which types of relocations and categories exist in the project AVL, as previously described. What relocations do they want to see beforehand and what relocations could be included in the work for the contractor? These types of considerations must be included in the tender phase, as the contractor has to prepare its work as well. These decisions and responsibilities are processed in a contract.

### *5.3.3 Design & Construct*

In the previous chapter the scope of the project and the different categories in which the cables and pipelines are divided in underground infrastructure projects are discussed. Also, the reasons why the different actors involved in the project AVL have to collaborate with each other have been presented. And finally, the role of the contractor was described, who will continue with the realisation phase, including the cables and pipelines of the categories 1 and 2. All this information has to be incorporated into an agreement, like a contract. A contract with binding agreements between the network administrators and executive organisations is already needed in the tender. There are various contract forms that exist in the utility sector. One of them is the Design & Construct (D&C) contract. As the name suggests, there is a design but the construction is attached to it as well. It is a contract that includes the design until the realisation of the entire project, so not just cables and pipelines. However, the cables and pipelines are part of the work, as stated in the contract:

> *"I mean, cables and pipelines are just an integral part of the job. That doesn't mean that you have to take it as an integral topic in the tender or in the contract. I do not think so. My opinion is that you have figure out what is the best solution for the contract and what is not. But it does not matter how you do it, just make sure to make it an integral part of your project"* (Environment Manager, Project Organisation AVL)

In the underground infrastructure sector, there are different opinions about the D&C contract. It has its advantages but its disadvantages, too. The D&C contract is applied more and more, affecting the various actors and their work processes. One of the advantages of the D&C contract is that, as a client, you can outsource it quickly on the market. The contractor takes a lot of work regarding cables and pipelines into account. The problem is that this contractor is involved in the last phase of the process with the network administrators. When the contractor is also part of the temporary organisation, it will come up with solutions about its design, including the cables and pipelines. One of the respondents who is a project manager at Liandon indicates that this is a disadvantage of the D&C contract:

> *"That is, on the one hand, that's annoying. Because with such a D&C contract, everything is figured out in the end, at that point you are involved. They are going come up with solutions and there will always be long turnarounds and bandwidths and those sort of things"* (Project Manager, Liandon)

The study shows that there is an even bigger issue concerning the (dis)advantages of a D&C contract. Such a contract is, in fact, in the benefit of the client, as it can quickly put the tender on the market. However, there is another actor that benefits from this: the contractor. It is the contractor that can both influence the 'Design' part and the 'Construct' part of a project. Obviously, the contractor must meet certain requirements, but the D&C contract is designed to leave certain solutions to the contractor. Despite this, the contractor takes a risk, as he takes the responsibility over the cables and pipelines in category 2 and 3 as well. Through the uncertainty of the underground unknown cables or pipelines can influence or delay the process of the project. Due to these risks, the profit for the contractor can tremendously decrease. It also means that the various network administrators involved in the project due to their cable or pipeline, have less control on their network. The main interests of network administrators are, above all, to secure the supply for their customers and, of course, the dissolution of the translation as cheap as possible, in their interest as well. The research has shown that the contractor has a different interest than the network administrator:

> *"No, the contractor certainly has a different interest. 1) he has a registration price 2) he wants to make profit. So, they want to cause as less inconvenience as possible, there are requirements that needs to be followed, and the sooner he's gone, the more profit he is making. So, that's always a contradiction in the realisation phase if that's the responsibility of the contractor"* (C&P Coordinator, Municipality of Amsterdam)

This has consequences for the actors who are involved in the project AVL. And to what extent does the contractor consider the lowest society costs or the environment? The coordination of these aspects plays a significant role, which will be elaborated on in the next chapter. To prevent that the contractor loses the focus on these aspects, there are certain requirements specified in the tender on which they score credits. The project AVL was tendered on the market, in which four organisations were allowed to respond in the tender phase through a competitive dialogue. The client took the EMVI criteria into account, which stands for Economic Most Beneficial Subscription. In case of the project AVL, the client has asked all the four tendering organisations to work out three different barriers:

> *"A barrier plan for the environment, so during the construction, how do you ensure that there is no nuisance for environment and surroundings. The second was a barrier plan for the road user, especially traffic from the Beneluxlane, but also crossing traffic. How do you ensure that the traffic is not stuck every morning and evening? And third, a barrier plan for the public transport. So, for the tram and metro user*" (Contractor, VITAL)

### *5.3.4 Five Steered Drillings*

Different aspects influence the process of an underground infrastructure project. It has already been described that the lowest society costs play a significant role, but also the interests of the network administrators affect the process. These interests may be contradictory with each other, which causes tensions between the different actors. From the various categories discussed above, the project organisation AVL has investigated the different types of relocations of cables or pipelines that needed to be done. And what relocations could be done in advance and what relocations can be taken into account by the contractor? Looking at the category 3, a contractor can handle many cables and pipelines issues when needed. The problem in the project AVL was that the contractor did not know exactly what needed to be done, which resulted in: *"for the contractor it was a risk. So, we actually looked from the risk perspective: what is the best solutions right now?*" argued by the environment manager and technical manager of the project organisation AVL. Another problem that occurred was the fact that there were cables and pipelines that actually had to be relocated. If all these relocations would happen separately, it would cause nuisance for the surroundings. Without a good solution, for example, KPN had to extend 800 meters of copper cables, which has a negative effect:

> *"Copper cables of the KPN, which has to be extended by 800 meters, will lose a lot of signal strength. So that was not an option. We had to do it differently. Plus, if 800 meters of cable has to be relocated the traditional way by digging up, relocate cable, closing the gap. Yes, that causes disturbance*." (C&P Coordinator, Municipality of Amsterdam)

Thus, this issue consisted of various problems in different areas of the process. The contractor did not have enough information yet and the network administrators had to relocate many cables and pipelines if there was no other solution. From this point of view, the project organisation AVL thought about possible solutions that would be beneficial for all the actors involved regarding the lowest society costs. It is the responsibility of the client to include all aspect of the project, including the surroundings. With the traditional excavation methods, the network administrators would cause much more damage and nuisance. The Cables & Pipeline Coordinator from the municipality of Amsterdam wrote a memo stating that it is not smart to put all the cables and pipelines in category 3 for the contractor. As a consequence, looking from the time perspective, the contractor would suffer with too much work that needed to be done, which could delay the project:

> *"Within the time limit, the time that was left, is it actually enough for the contractor to contact all the cable and pipeline owners to send out the VTAs and VTMs, to set up the POS, and then give the organisations involved the time to relocate their cable or pipeline, before even starting the realisation phase"* (Environment Manager, Project Organisation AVL)

At this moment, the project organisation AVL looked into the solution to drill the relocation of the cables and pipelines. With a drilling, you go from A to B below the ground level. Such solution will cause fewer nuisances for the surrounding and for the network administrator it saves material if the relocation is a 30-metre cable instead of 800 meters. This meant that the project organisation AVL also had to scale up their capacity internally, since this problem would otherwise be the responsibility of the contractor. Hence, it has been acknowledged that a combination of drilling was possible, so each actor would not have to drill individually. With this solution, the project organisation AVL returned to the various network administrators involved. The question that occurred at that moment was: *'Who of the actors is going to take the lead and responsibility for these drills?'* It was not the situation that every actor was involved in all the five locations for the five steered drills. An actor that does not have any cable or pipeline at one drill, is not going to take the responsibility for it.

In addition, from the various network administrators the project organisation AVL received two responses during the meetings: 1) *"we know that the client coordinates a lot of these projects nowadays"* and 2) *"if we would do it ourselves, there will always be one of the actors involved that does not agree and then, the planning of the drill would be extended and delayed"* said the technical manager of the project organisation AVL. Thus, this would cause problems and eventually it would result into a delay for which the client is responsible. These responses to the solution have been discussed internally in the project organisation AVL, who decided to take the responsibility on the five steered drills. The advantage in this decision is the fact that various network administrators do not have to get together again to discuss the responsibilities. So, this solution was suitable for every actor involved. But who was going to execute these drills? There was a possibility to put it on the market separately. But eventually, the project organisation AVL decided to include these five steered drills in the specifications towards the contractor as an additional contract in the D&C contract. However, there was one crucial side note that played a significant role. The procurement procedure started in January 2016. Although the project organisation AVL already shed light on the idea of the drillings, the additional contract with the five steered drills were added to the specifications only one week before the closing date of November 2016.

## 5.4 Mobilising the Network

In the 'mobilization' phase it is time to mobilise the actors within the described network AVL. The actors are now part of a temporarily stabilised project, but who takes the lead to coordinate the project to keep it stabilised? In this chapter, the governance of the project AVL will be presented, along with the information provision during the preparations. As described in the previous chapters, there is a shift in roles when the contractor is announced. The questions that occur is about the coordination of the process; how and by whom is the project AVL governed? And what factors influences this governance?

### 5.4.1 *Time is Crucial*

During the entire process of the AVL project, someone has to take a coordinating role to guide it to the (successful) end. For example, the municipality, as landowner, licensor, road manager and responsible for the public order, has the role to coordinate these aspects in a project. These coordination activities are mainly related to the factor 'time'. Time can be understood from different angles, such as turnaround time, schedule planning, but also involving the actors at the right moment in the process. It all has to do with the temporary organising in the project AVL. If this is done in the right manner, it can make a significant contribution to the project. The project AVL started with an idea to renew the Amstelveenline. A renewal of the Amstelveenline means different things, such as new material, but also an interface with cables and pipelines. It is up to the client to involve the network administrators early in the process, at the right moment. A network administrator has little to do with the very first ideas about the renewal of the AVL. But it is too late when the network administrator gets involved when all the designs are already organised. Another aspect that has to get attention in the process is the different turnaround times of the actors. It has already been described in a previous chapter that the Gasunie is dealing with a destination plan, which means it must be involved early in the process. On the other hand, each actor is interested in being involved in time so they can have influence on the process to get the most cost-effective solution, argues the C&P Coordinator of project AVL:

> *"The moment you have that, you should start with C&P, is my opinion. Because the sooner, the better. I mean, it is better to start in the initial phase with some extra hours, which might have been possible later. But if you start too late, and you find out that you should have done it earlier, you will not regain the hours. It's easy as that. And eventually you have to spent those hours anyway"* (C&P Coordinator, Municipality of Amsterdam)

In the project AVL, the network administrators were involved in the initial and preparation phase of the project. So far, there were no big problems and the few problems with the cables and pipelines relocations were solved through, for example, the five steered drillings. This task was carried out by the C&P coordinator of the AVL, who was involved early in the project.

### 5.4.2 *Coordinating the Network*

With the construction of cables and pipelines in public space, the question that appears at the municipality is how the traffic should be redirected. Also, it is important that the different network administrators perform their work as closely as possible, so the nuisance for the surroundings remains limited. In particular, carrying out work as efficiently as possible is in practice a rewarding task. Each actor is naturally inclined to use the most efficient method for himself and to adjust it to its working rate. In addition, each network administrator has his own contractor with subcontractors. In order for the project to run smoothly, the client fulfils a coordinating role in the preparatory phase. It lists all stakeholders in the project AVL and

invites all relevant network administrators to provide enough time for their own solutions of the relocations. In addition, the client or project organisation may, in the case of AVL, consider solutions for any necessary relocations at this stage. The project AVL decided to work with one executive actor, the contractor VITAL. This contractor can be directed by a coordinator from the client (or municipality of Amsterdam), as they are still the client for the project. However, VITAL coordinates the process with the various subcontractors and occasionally the joint use of temporary facilities. A good transition of the coordination and knowledge between the client and the contractor is in interest of the entire project AVL, as this can prevent unpredictable situations. The Integral Realisation Manager of VITAL responds to it as follows:

> *"We noticed that the client has gathered a lot of information in advance, in details, with the conversations with the C&P owners. So, you felt that they worked very hard to get that information. And in the dialogue discussions we have always asked about it"* (Contractor, VITAL)

### *5.4.3 Knowledge*

An important aspect in the world of cables and pipelines is knowledge. This sector asks for a lot of knowledge if you are involved in these underground infrastructure projects. It is essential that the provision of information on the spatial planning of the area is managed, both above the ground and underground. The knowledge of the existing and possible future plans of the public space is necessary in order to determine the right route for the cable or pipeline. In addition, it is also important to understand the underground situation, especially when it comes to the location of the cables and pipelines. Due to insufficient knowledge or informative provision, this can sometimes lead to unforeseen events that need to be solved. Again, the coordination of the project is vital. It is important that the client has sufficient knowledge and information about the cables and pipelines in the area concerned. In the last couple years, many cables and pipelines in the underground were not registered, as the project manager of the project AVL states: *"almost three to four hundred years, they put everything in the ground. It is inevitable that you come across something if you are going to dig".* So, the client must have the knowledge to keep the unforeseen circumstances as low as possible.

This also has to do with the work experiences of people that work in the utility sector. Someone who has been working in the sector for years has more knowledge about the underground than someone who is new in the sector. So, because cables and pipelines have been put into the ground for years without registering, it is never possible to get a complete view on what to expect. Thus, the uncertainty of the underground cannot be solved, but it helps if someone in the process is involved who has experience and knowledge with a particular area. In the case of the project AVL, they had a Cable & Pipeline Coordinator from the engineering firm of the municipality of Amsterdam: *"For 20 years I do the cables and pipelines in Amsterdam. The city is getting fuller, both above and below the ground. So, it is more difficult to find traditional solutions".*

This C&P Coordinator is part of the project organisation AVL to make sure the process with the network administrators is running well. For example, he was the one who proposed and introduced the five steering drills to the network administrators. So, at the beginning of the process there was already a coordinator from the client who worked out design for the network administrators. From within the 'temporary organisation' this knowledge was received well:

> *"Look, the Cable and Pipeline Coordinator is very experienced and comes up with several plans and solutions for us, like we have figured this out, I think it should be feasible. It works much easier. But that's always the way, the more experience, the easier it goes"* (Project Manager, Liandon)

There are many different interests involved in the underground infrastructure projects, which often result in contradictions. Because there is a C&P Coordinator in the project AVL that comes up with plan in advance, the attitude of network administrators is quite different. As a consequence, the network administrators are more tolerated in the initial phase, which makes it possible to achieve more. However, it is not only important that there is enough knowledge in the initial phase. In the case of the project AVL, they apply a D&C contract, which means that the contractor takes over the coordination at some point. The different (dis)advantages of the D&C contract are already discussed in the previous chapter. But for the contractor, it is also essential to have enough knowledge about the cables and pipelines to enhance a better performance. Thus, the client and contractor will also have to collaborate during the realisation of the project to prevent unforeseen situations. The contractor involved in the project AVL is VITAL. This consortium is part of a larger concern, namely VolkerWessels. Because this concern has the operation of 120 companies under their flag, there is enough knowledge they can use in the project. The contractor VITAL also states that not only knowledge is important: *"yes, it is knowledge. It is knowledge about the field, but also acquaintances. So, in the consultation, our coordinator already spoke with half of the cable and pipeline owners, who already knew him".* Knowledge they can use to be present on all disciplines within the underground infrastructure. For example, within the project AVL, they have put together three different companies in one consortium, each with its own specialty. Despite it being beneficial for them, it is a disadvantage for other smaller companies, as the competition is just too big.

# 6. DISCUSSION

In this chapter, the discussion that emerges from this thesis is described. It will be discussed whether the chosen framework of ANT was sufficient to obtain the results, but also whether and how these results provide a theoretical contribution to the academic debate. A critical view on the relation between theory and findings will be given. Finally, the limitations for further research will be described. In the table below a brief summary of the findings and the themes that emerged is given.

| **Aim:** to explore the inter-organisational collaboration in the governance of underground infrastructure networks | | |
|---|---|---|
| **Perspective:** inter-organisational project as a temporary organisation, from the actor-network perspective | | |
| **Theme** | **Description** | **Findings** |
| Conflicting interests in the underground | The various interests of the actors involved in an underground infrastructure project are often contradictory and can cause tensions amongst the actors | Lowest Society Costs<br>Obstacles to overcome<br>Short-term vs. long-term |
| The role of non-human actors in the network | Various non-human objects affect projects in the underground infrastructure sector, because: 1) the underground often involves unknown situations (i.e. unexploded bombs, poisoned subsoil, unknown cables or pipelines), and 2) the material of the cables and pipelines has influence on the operation and management practices of the actors | The Underground<br>Materiality of cables and pipelines |
| Temporality | The project AVL is a temporary organisation in which the actors involved must collaborate. This involves the time pressure within the project (i.e. deadlines), but also the timing when the different actors are involved in the process | Time<br>Timing (Lifecycle Project) |
| Governing the uncertainties | The different uncertainties that occur in underground infrastructure projects can be prevented by good governance. Additionally, knowledge, coordination and alignment play a major role in the governance. | Knowledge<br>Coordination<br>Alignment |

*Table 5. Overview of the Emerged Themes from Findings*

## 6.1 Discussion of the Findings

The aim of this study is to explore the inter-organisational collaboration in the governance of underground infrastructure networks. The case study project AVL could be seen as a temporary organisation where different stakeholders must collaborate, each having their own interest and goal they want to accomplish. Various aspects influence this so-called temporary organisation. The conducted study at the project AVL revealed a number of themes that refers back to the theoretical framework. The themes that emerged are: 1) conflicting interests in the underground and 2) the role of non-human actors in the network 3) temporality, and 4) governing the uncertainties.

*Conflicting interests in the underground*

The first theme revealed in the findings is the conflicting interests in the underground. The study shows that four different types of actors can be distinguished in underground infrastructure projects: 1) the client, 2) the contractor, 3) the network administrators, and 4) the non-humans such as the underground or materiality. These are the actors who have interface with cables and pipelines in an underground infrastructure project, but each has its own interest(s) within the project. As a consequence, conflicts and tensions can arise in the project. Clearly, various actors must overcome certain obstacles to achieve their own goal interest. In most underground infrastructure projects the lowest society costs are often the central interest, which actually emphasizes the most cost-effective solution for all actors, but also the best solution for the environment. However, this also creates conflicting interests, as the actors often choose the lowest society costs for their own interest. A good way to visualize these conflicting interests in an underground infrastructure project is the translation model of Callon (1986). Within this model, no distinction is made between human and non-human actors in the project, which provides an overview of the whole project. For example, the Obligatory Passage Points (OPP) can identify what obstacle each actor has to face in order to achieve their goal. By applying the Obligatory Passage Points in the project AVL, the conflicts within an underground infrastructure project were made visible (Clegg et al., 2002), but also the particular roles that the actors involved must fulfil (Van Marrewijk et al., 2016). In order to capture these roles and conflicts, a D&C contract has been applied in the project AVL.

Another finding in this theme of conflicting interests is the role of the contractor, who takes over the role of coordinator when the realisation phase starts. This study showed that the agreement of roles is essential in the process, as well as the relations and collaboration amongst the actors involved in the project AVL. This is in line with Van Marrewijk et al. (2016), emphasizing that these aspects do not only play a role in the preparation phase, but also in the realisation phase of the project, where the contractor takes over the responsibility. When dealing with a D&C contract, the contractor takes both the design and construct into account. However, the contractor often has a different mind-set than the client or network administrator.

It can be argued that the contractor has a short-term mind-set as they want to be ready as soon as possible so they can make (more) profit. In short, he has a short-term mind-set within the project. The client or network administrator has a long-term mind-set when it comes to their cable or pipeline. They want to find the most optimal solution, also for the future. Thus, the D&C contract and the difference in mind-set can cause conflicts with the project. These results correspond with the results of Clegg et al. (2002), showing that the distribution of design and construct is a fragmented and risky process. The D&C contract has been introduced to create a single point of responsibility within the project, but it remains difficult with the different and contradictory interests of the actors involved. The results of the study embody Clegg et al. (2002), who suggest that the short-term interest of the contractor still conflicts with the long-term interests of the client and network administrators.

*The role of non-human actors in the network*

The second theme that emerged from the findings is the role of non-human actors in the network. This is a remarkable and unexpected finding, as it has a major impact on underground infrastructure projects. First of all, it is the underground that has agency on the progress of a project. The core business, cable and pipelines, of network administrators are located in the underground. However, it is not an easy environment to deal with. For example, the location of the cables and pipelines that are already in the underground, but are not well registered in the KLIC-system. In the past, as relocations of cables and pipelines were not properly registered, thousands of unknown cables and pipelines still exists in the underground. As a consequence, unknown cables or pipelines can cause excavation damage, which results into delay. Damage to cables and pipelines attached to an underground network to provide electricity or heat to households can have catastrophic consequences. It is therefore important to keep this in mind in the project. This theme shows that the actor-network theory captures the risks of the underground, and therefore affects the entire process. This is in line with the school of thought of many social scientists such as Latour (1992), Law (2004), and Callon (1986). The underground has agency in underground infrastructure projects, which corresponds to the findings of Leonardi (2013). However, he emphasizes the fact that humans provoke this agency in material. They are interwoven with each other.

Another aspect that influences a temporary organisation and revealed in this theme is the material of the cable or pipeline. The findings show that the cable or pipeline has influence on the operations of the organisation in question. For example, pipelines are more difficult to relocate than cables. It has to do with the fact that pipelines are often large and inflexible. Also, pipelines are often constructed in parts, as it is not always possible to relocate them at once. As a result, pipeline operations often cause more nuisance to the environment, but the turnaround time of the processes are also longer. Pipeline owners, such as Gasunie or Stedin, should therefore be involved early in the process. And lastly, pipelines often transport dangerous

substances like gas. A gas leak can have serious consequences and impact on the environment. Safety requirements of the work practices on (gas) pipelines are much stricter than cables. In such sense, it affects the entire management of the pipeline owners. With cables it is a different case, these are narrower than pipelines and also flexible. This makes cables easier to move, but it also allows for innovative solutions that cause fewer nuisances for the environment. It is important that no excavation damage is made, but it has less impact on the safety requirements. Therefore, the turnaround times of the cable owners are shorter, which makes it possible to relocate the cable in short time. Theoretically, these actors could thus be involved later in the process. However, it is also in the interest of the cable owners to have enough time to consider a cost-effective solution for relocation.

These results confirm the position of Orlikowski (2007), arguing that the social and material are constitutively entangled in the everyday life, including project in the underground infrastructure. The human (Leonardi, 2011) and material (Leonardi, 2013) agency come together and affect the practices and processes of the network administrators. Finally, cables can also be an important backbone for the environment, as in the case of KPN with a major data centre for a bank. This data centre of the bank is crucial for the bank, as it contains all the important data of its customers. The findings show that underground infrastructure projects use different categories. This has to do with the above-mentioned aspects, such as turnaround times, importance of cable and pipeline, or location. This classification allows the project to estimate what and when work should be done in the process. The result that non-human actors also play a role in underground infrastructure projects correspond to the three elements of the actor-network theory according to Law (2009). Within these types of projects there are 1) semiotic relationality, where the organisations involved in the AVL influence each other, and 2) the organisations involved are heterogeneous and can be divided into the groups of clients, network administrators or contractors. Within the group of network administrators there is also heterogeneity, as cable and pipeline owners can be distinguished. And lastly 3) the materiality of the cables and pipelines within the project also affects the processes.

*Temporality*

The third theme revealed in this study is temporality. As the name of the temporary organisation suggests, time plays an important role in projects, including in the underground infrastructure sector. Now, there are several perspectives to study the element of time in projects such as time, i.e. deadlines, delays, but also timing, i.e. certain phases of the project (start-to-finish phases). The results of these two perspectives correspond with Krowhinkel-Karlsson (2008), arguing that these perspectives contribute to the temporary structure within the project and how the various actors involved in the project AVL can deal with it. The first notion has to do with the time limit in underground infrastructure projects. It can lead to tensions, as

deadlines need to be met. Another factor that matters are the organisations that must collaborate in a temporary setting. If the processes of the organisations involved in the AVL have not been structured well, precise schedule planning is needed within the project. According to Dille & Söderlund (2011) this is called isochronism, where organisations in the same environment, such as the project AVL, create the same time orientation. In addition, this has to do with the different categories to which cables and pipelines are linked, as discussed in the previous theme. These results are related to earlier studies that revealed the importance of time in such organisations (Lundin & Söderholm, 1995; Bakker et al., 2016). Both Bakker (2010) and Lundin & Söderholm (1995) emphasize 'time' in their papers to study the characteristic of temporary organisations, as for example, failure to reach deadlines can cost money, because a project may delay.

The second perspective on how the element 'time' can be viewed within temporary organisations is 'timing'. Timing concerns the precise moment when the organisations get involved in the project and is described by Lundin & Söderholm (1995) in figure 7. The actors in underground infrastructure projects need to keep the different turnaround times in mind. The moment when an actor is involved in the process of cables and pipelines is crucial for the project. This should be done in the initial phase of a project, as there is still enough time for (better) solutions and collaboration with other actors. Therefore, it is important that the client discusses the issues of cables and pipelines early in the process, both internally and externally. The intensity of knowledge and coordination of the cables and pipelines issues will therefore have to be higher in the initial and preparation phase, which could later be reduced in the process. In doing so, we can retrieve the project lifecycle (figure 1) from the theoretical framework to see where this intensity of knowledge and coordination should be increased. Below the new (dotted) line has been added focusing on the cable and pipeline issues within a project:

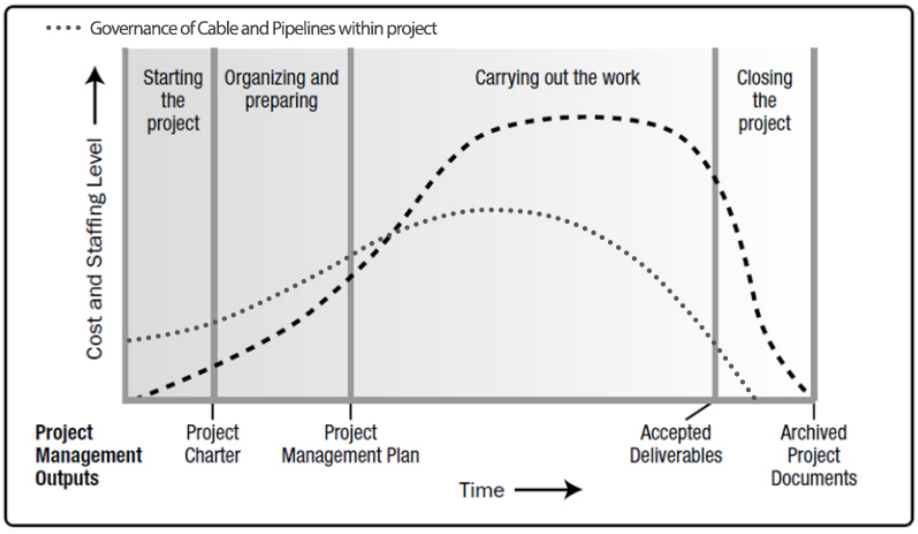


***Figure 7**. Governance of Cable and Pipeline issues* (Source: PMI, 2008)

The dotted line means the governance of cables and pipelines in an underground infrastructure project. In the figure above, it is can be seen that the issue of cables and pipelines within a project should be taken into account during the start of the project. By responding to these issues and preparing them well with the relevant network administrators, the risks can be reduced which can prevent unforeseen situations during the execution of the project. This can result in less unforeseen costs and a more streamlined process during the four phases.

*Governing the Uncertainties*

The last theme that emerged from the findings is the governance of the uncertainties that occur in underground infrastructure projects. The fact that temporary organisations are interwoven with both an organisational and social context has been recognised by Grabher (2004), showing that expertise, reputation and legitimisation are key resources in an underground infrastructure project. Moreover, this study revealed that the notions knowledge, coordination and alignment are also important in the governance. A balance between these three aspects is crucial for the governance of an underground infrastructure project. As discussed earlier, the underground involves uncertainties through, for example, unknown cables and pipelines in the area, but also the different types of materials (Callon, 1986; Latour, 1992). Knowledge about the different processes of the actors, but also about the area, plays a significant role, as unforeseen situations (or problems) can be prevented. In order to reduce the uncertainties, knowledge can be a supporting factor in the coordination of the project. This result illustrates the idea of Menger (1999), suggesting that coordination mechanisms are needed to reduce uncertainties and time constraints in underground infrastructure projects. Coordination means all processes of the different actors are ensured. Those who take this coordinating role will have to ensure that the various actors are involved on time and will provide them with sufficient information for possible relocations. The one that takes on the coordination role also has the responsibility to ensure stability within the project. A notion that can contribute to this is alignment, which means that the composition of the various actors involved is well structured. For example, the classification of categories in cables and pipelines, in which the actors are aligned. Both the coordination and alignment correspond to the results of Callon (1990), showing that these two concepts contribute to the convergence within a project. If the alignment and coordination mechanisms in an underground infrastructure project is not developed and organized well, it can cause performance problems (Sanderson, 2012). By finding the right balance in the coordination and alignment of all the above-mentioned themes, it can contribute to the governance (Klijn & Koppenjan, 2016; Clegg et al, 2002) of an underground infrastructure project, such as the project AVL, to secure the stability and consensus.

# 7. CONCLUSION

This section will focus on answering the main research question based on the findings of exploring the inter-organisational collaboration in the governance of underground infrastructure networks. An inter-organisational project can be seen as a temporary organisation, where temporality plays a crucial role in the process of such projects. Therefore, the main research question answered in this thesis is as follows: *"How is an inter-organisational project with multiple stakeholders governed in subsurface utility projects from an actor-network perspective?"* This question is divided into four sub questions, each forming building blocks for a collective answer.

The first sub question in this study was about the theoretical debate of inter-organisational projects that can be seen as temporary organisations. There is much literature about both inter-organisational projects (Jones and Lichtenstein, 2008, Van Marrewijk, 2016) and temporary organisations (Lundin & Soderhölm, 1995; Kenis et al, 2009; Bakker, 2016). It becomes clear that a number of aspects are important in such projects, i.e. temporary organisations. According to Bakker (2010) these aspects are: time, team, task and context. Lundin & Söderholm (1995) add another aspect, namely transition, as there is often a change in these types of projects. However, a multiplicity of organisations is involved in a temporary setting, which may cause conflicting interests (Clegg et al, 2002) that need to be solved. Mechanisms for coordination and dealing with the element of time play an important role in reducing uncertainties and time constraints (Menger, 1999; Dille and Söderlund, 2011). These theoretical insights will support the answers on the following sub questions.

To answer the second sub question, a qualitative case study was executed. This study was conducted within an underground infrastructure project, namely the project AVL, which can be identified as a temporary organisation. For example, the different interests of the actors involved create tensions, but also the underground affects the business of the temporary organisation. A method to study such a temporary organisation is the actor-network theory (Latour, 1992; Law, 2009). From this perspective, it does not distinguish the humans and the non-humans such as objects, or in this case, the underground and material of the cable or pipeline. This method can be used to study these types of projects to see how exactly the network is connected and established.

An interesting framework that maps these interests and obstacles is the translation model of Callon (1986), which consists out of four phases. In the second phase of the model, the interests and obstacles of each actor is processed in the Obligatory Passage Points (OPP). In this OPP model, the client can see how every actor is involved in the project and what their goal is. It allows the client to divide the network into groups of the

same 'language'. In the world of underground infrastructure this is done through different labels of categories. Actors who have to deal with a long turnaround time are categorized differently. Furthermore, another qualification is the importance in the network of the cables or pipelines. These categories can be taken into consideration in the time schedule of the project.

The third sub question to answer concerned the factors that influence an underground infrastructure project, like the project AVL. First, the different interests of the actors involved in the temporary organisation affects the project. These interests are often contradictory, because the actors have different goals. In addition, the material of the cables and pipelines plays a major role in the division of the actors. Cables are easier to relocate and consequently have more possibilities to move. It is different with pipelines, which are bound to certain procedures and therefore time and money. The importance of the cable or pipeline itself in the area is also crucial. It can be concluded that the material and location of the cable or pipeline has influence on the operations of the actors and the temporary organisation. It also brings us to a different, but increasingly important factor: the environment of the project. The municipalities in the Netherlands focus more on managing the surroundings by minimizing the nuisance. They try to achieve the lowest society costs for every actor involved. However, as every actor has his own thoughts about these costs, it is not always possible to find the most cost-efficient solution. It could even lead to unsolicited tensions within the temporary organisation. How these tensions and problems are solved depends on the coordination of the temporary organisation.

The last sub question was about governing the uncertainties within a project. To complete underground infrastructure projects, coordination is crucial. In doing so, it tries to keep the uncertainties as low as possible and, if necessary, to solve them. It is important that someone at the client organisation is present and capable to take this responsibility. A prerequisite for this person is to have experience in coordinating projects with cables and pipelines involved. The study has shown that knowledge is another ability of this so-called Cable and Pipeline Coordinator and making that knowledge accessible for the actors involved is essential within the project. However, even when the coordinator has all these abilities, it is inevitable that uncertainties will show up during the realisation of the underground infrastructure. It is up to the coordinator to solve these issues as quickly as possible, without delaying the project. Furthermore, it is important to realise the social interest of the project AVL, such as the integrated design of the underground networks. Not to forget the environment, minimal nuisance, efficient but cost-effective solutions and long-term thinking. In addition, accepting the interests of the actors involved combined with the common goal of the project is crucial. Improving governance is not attributable to one specific actor. However, governance in the right manner within a project is common concern and benefits everyone.

This study showed that it is difficult to govern a project in the underground infrastructure, but not impossible. From this study, it can be concluded that the governance of such projects in the preparation phase is the responsibility of the client. Therefore, the client must have sufficient knowledge of the cables and pipelines in the area. It indicates that more time and staff has to be shifted to the initial phase of the project to come up with solutions for the cables and pipelines issues. As a result, it can prevent unforeseen situations that could have potentially delayed the project. In addition, the categories of the cables and pipelines have to be executed well. By dividing the cables and pipelines based on the importance, turnaround times, and materiality, it is possible to get an insight in the process when the cable or pipeline has to be relocated. The uncertainties in underground infrastructure projects will always play a role, but if the above aspects are well executed, it can contribute to the governance of an underground infrastructure project.

## 7.1 Recommendations

A proactive role of the municipality in the coordination in the processes of an underground infrastructure project is crucial. The aim of 'lowest society costs' must be the shared objective within the project. In particular, the alignment of the long-term planning in the project is important and can result into social profits. In order to improve the process within the project and avoid unnecessary situations, it is important to discuss the issues about cables and pipelines early with the network administrators. They must be involved in the first phase of the project, as they will have enough time to achieve the shared objective of the lowest society costs. The municipality, as well as the client, have an important role to facilitate and coordinate this. The network administrators have to communicate and share their short- and long-term goals and seek alliances to collaborate for beneficial results. In addition, next to coordinating the processes, the municipality must be responsible for the way the construction of the cable and pipeline networks is done without any, or as little, nuisance for the environment. This coordinating role will have to be carried out to the contractor when he begins with the realisation phase. However, the municipality will still have to fulfil the role of coordinating, also during the realisation, to avoid conflicts between the various actors. Before the contractor starts with the realisation, the shared goal to achieve the lowest society costs must be clearly communicated and is also the responsibility of the contractor. Throughout the whole process, the knowledge about cables and pipelines issues, as well as the area in which the project is located, is necessary to prevent any unforeseen situations. This can be done by a Cable and Pipeline Coordinator (C&P Coordinator), who organizes and manages the process with the triangle of actors (i.e. the client, network administrators, contractor).

## 7.2 Theoretical and Practical Implications

This study produced results that are consistent with the findings of previous work in the field of temporary organisations (Beckhy, 2006; Van Marrewijk et al., 2016). Firstly, it creates awareness of the importance of certain aspects in these organisations, such as coordination. For example, these temporary organisations have to deal with the element of 'time', which can cause tensions that can affect the process of the project. Therefore, it contributes to the literature on how temporality within organisations can be studied (Lundin & Söderholm 1995; Bakker et al., 2016). This study adds one more notion to it: timing within the organisation. Especially in underground infrastructure projects the timing of when to involve certain organisations is crucial for the governance of the project. With this notion, it supports the paper of Dille and Söderlund (2011) on managing inter-institutional projects. Secondly, the study contributes to the debate on inter-organisational projects. Construction projects can (often) be seen as inter-organisational projects and are constantly influenced by an ever-changing environment and increasingly trend towards urban areas. The actors in the project create subprojects and shift alliances with each other (Van Marrewijk et al., 2008). The findings have shown that knowledge is crucial in the subsurface utility projects in order to minimize uncertainties and unforeseen situations. It is an on-going dialogue between the actors involved in the inter-organisational project to achieve a common goal. The last theoretical implication is the use of the actor-network theory to get a better understanding of an underground infrastructure project. It connects the dots within the network, with no exclusion of the underground and the material of the cables and pipelines.

The findings have important practical implications for developing a better understanding about the governance within underground infrastructure projects. It is impossible to develop a so-called 'best practice' that can be applied to any project in the sector, but it can be concluded from the findings that certain aspects may affect the success of the project. Additionally, it is the awareness within the sector about these aspects that play a role in order to succeed. If the initiator beforehand prepares the coordination and knowledge within the project, it can add great value to the efficiency of the project. Many projects where cables and pipelines issues are involved often have problems or delays. It is the unknown character of the underground about the exact location of cables or pipelines that has influence on the projects. Consequently, unforeseen situations, such as excavation damage, can be prevented by sufficient knowledge and coordination. A second aspect is the growing economy, which attracts project developers to build more. However, project developers often have no sense or knowledge about the underground. When they start building and they encounter unknown situations such as cables or pipelines, the project could be delayed. And delays in a project costs money. This study showed that it is important to have the knowledge and coordination about the issue of cables and pipelines in the preparation phase of the project, also for new projects initiated by project developers.

## 7.3 Limitations and Further Research

This section will describe the limitations, but also the opportunities for further research. In this thesis, only one project was studied, namely the AVL. The findings and situations of the project AVL are unique to this project. Consequently, it has its limitations.

The first limitation in this thesis is a single case study, meaning that the answer to the research question has only been studied within one project. The research question may be answered, but there is no evidence that other projects would have resulted in the same answer. For further research, it is therefore helpful to look at how the governance is organised in other projects. The project AVL was a rail project, so it could be interesting to study a road or tunnel construction project for a complete overview of the entire cable and pipeline sector.

The second limitation of this thesis is the fact that not all organisations that are involved have been interviewed. The contact person in the project AVL contacted the organisations, but not everyone responded on the request to participate in this study. However, the organisations that have been interviewed have a large share in the project AVL. Despite this, it could be considered for further research to interview more organisations (and disciplines) within the project, like sewage or water. In addition, different levels (e.g. management, execution) within the organisation could be interviewed in further research.

The third limitation is the fact that the study was conducted in the initial phase of an underground infrastructure project. As the findings showed, the shifting between the role of the client and contractor is important in the process. Additionally, further research in the different phases of a project should be executed to get a better understanding of the governance in an inter-organisational project.

The last limitation of this thesis addresses the qualitative methods. In fact, this study only used semi-structured interviews and document analysis to gather data. The interview is a snapshot and there is a chance the interviewee will give you answers that, for example, shed positive thoughts on their own organisation. Through participant observations at meetings a better overview can be created about the behaviour and attitude of the various organisations involved. Furthermore, information gathered through the interviews may be refuted with participation observations.

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# APPENDICES

## Appendix 1: Topic Guide

### INTRODUCTION

- Purpose of the study
- Explanation Project [Renewal Amstelveenline (AVL)]

### GENERAL INFORMATION

- Introduction Interviewee
- Name & Position
- Description of the Organisation
- Mission of the Organisation
- What is [organisation] like? (values, colleagues, etc.)

### PROJECT AVL

- How is the organisation involved in the project AVL?
- How is the procedure of the organisation within the project AVL? (Request, Divisions, Time, Responsibility)
- What does the project AVL means to you? (Interpretation)
- What are the risks within the project AVL? And of the underground? (Soft ground, high water level, unknown cables or pipelines, etc.)
- What is the experience so far with the project AVL?

### PREPARATION

- Reasons to collaborate
- Tension with the cables or pipelines
- Interests (individual interest, common interest, interest of the AVL)
- Is there a common interest/problem?
- Collaboration (Business as usual?)
- Why is this approach used in the project AVL?
- Would you rather have thought of a different approach?
- Does the culture of the organization has influence within the sector?

COLLABORATION

- What are the starting point of the project?
- Interest (enough time in preparation phase, balancing different interests)
- Are these incorporated in a contract?
- Most discussion was about …
- Tasks and responsibilities
- How is the trust within the sector of cables and pipelines?
- What is your relation with the involved actors?
- How do you ideally see the relationship between the different stakeholders?

THE NETWORK

- Composition of Teams
- How is the communication between the actors involved?
- How do you make certain things negotiable? (e.g. frustrations)
- Is this also about the attitude and behaviour within the project?
- Knowledge (Content and Organisational)
- Competences within the project

FINAL NOTE

- What are the lessons learned? What can be improved?
- On what matters do you still want to shed light on during this interview?

## Appendix 2: Translated Quotes

"And it has been a wish of the municipality to make tunnels at the intersections. There are still some accidents happening, also deadly accidents. And the Transport Region Amsterdam does not want that, they are for the safety and the accessibility" (Specialist District Management, Municipality of Amstelveen)

> En het is een wens van de gemeente geweest om dit dan ongelijkvloers te maken. Er zijn hier nog wel wat ongelukken gebeurd. Ook dodelijke ongelukken. En dat wil die vervoersregio ook niet, die zijn ook voor de veiligheid. En de bereikbaarheid en hij moet door.

"But the client who has the final responsibility is the Transport Region Amsterdam. They have a new role. Where they were formerly subsidiary, they are now client and tenderer for the first time. And we, as the project organisation, do not decide these things. So, we need the approval of the client, Transport Region Amsterdam, but also as the project as the entity. That takes time." (Environment Manager, Project Organisation AVL)

> Maar de uiteindelijke opdrachtgever van dit project is de Vervoersregio Amsterdam. Die zit in een nieuwe rol, vroeger voornamelijk subsidie verlener, en ze hebben hier voor het eerst opdrachtgever en officieel ook aanbesteder. En dat wij dat als projectorganisatie ook niet even, zelf volledig besluiten. Dus ook de goedkeuring van onze opdrachtgever, de Vervoersregio, maar ook zijnde de opdrachtgever van dat project als geheel. En dat kost ook tijd.

"The municipality is an important actor, but it is also about the surroundings and environment management. Because, of course, a lot of things happen in the area. Therefore, the municipality has a destination plan, which allows them to carry out such projects. But the impact is huge. There must be temporary lanes, bike paths must be sacrificed, trees must be removed, all of it must be possible. So, the municipality must completely support it" (Project Manager, Nuon Warmte)

> De gemeente is dan een belangrijke partij, maar dan gaat het ook meer om omgeving en omgevingsmanagement. Want er gebeurt natuurlijk heel veel in de omgeving. De gemeente heeft dus een plan daar, dat laten ze uitvoeren door zo'n projectteam. Maar de impact is enorm. Er moeten tijdelijke rijbanen gemaakt worden, fietspaden moeten opgeofferd worden, hele bomenrijen moeten opgeofferd worden, dat moet allemaal maar kunnen. Dus die gemeente moet daar helemaal achterstaan.

"Interests are so contradictory. It is just about the money. That's it. And the person of an energy company who is at the meeting, have the responsibility *to keep it cost-efficient. So, if it can stay, leave it."* (Project Manager, Nuon Warmte)

> Overal, omdat die belangen zo tegenstrijdig zijn. Dus als je daar, het gaat gewoon om geld. Dus dat is het gewoon. En de mens die aan tafel zitten van een energiebedrijf, die krijgen gewoon een opdracht van probeer het gewoon binnen de perken te houden. Dus als het kan blijven liggen, laat het dan liggen.

"The asset manager became important, within NUON Warmte as well. Nothing wrong with that though. In this case, it is a Business Manager who monitors it. The dime is reversed a few times before it is really spent" (Project Manager, Nuon Warmte)

> De assetmanager is een belangrijke man geworden, ook hier zo, bij Warmte ook zo, niks mis mee. In dit geval is het dan een Business Manager die het bewaakt. Het dubbeltje wordt een paar keer omgedraaid, voordat die echt uitgegeven wordt.

"Working with natural gas is bounded with all kinds of rules. This also has to do with skills and capacity. Not everyone can work on the gas network. So, we have less choice between contractors, because an organisation with mantle tubes can be executed by a civil contractor. They can call steereddrill.com for example and it's done" (Engineer, Stedin)

> En aan aardgas werken dat is aan allerlei regels gebonden. Dat heeft ook te maken met vaardigheid. Lang niet iedereen mag aan het gasnet werken. Dus wij zijn veel beperkter in de keuze van onze aannemer, dan een mantelbuis trekker want dat mag een civiele aannemer zelf doen. Die belt gestuurdboren.com ik zeg maar wat en die trekt er een buis in.

"Yes, safety plays a very important role. We are getting managed and governed on the aspect 'safety', also with the solutions we are considering, like 'is it safe?' Look, of course, we have to make profit as well in that sense. But we are actually kind of, yes, we are semi-government, because all the shares of Gasunie is property of the Ministry of Finance" (Project Manager, Gasunie)

> Ja, veiligheid speelt bij ons een hele belangrijke rol. Daar wordt ook heel veel opgestuurd. Ook met oplossingen die we bedenken. Dat we daarnaar kijken van oké ligt het dan ook veilig. Kijk, wij moeten natuurlijk ook gewoon een winstgevend bedrijf zijn in die zin. Maar wij zijn eigenlijk een soort van, ja we zijn semioverheid, want alle aandelen van Gasunie liggen bij de Ministerie van Financiën.

"At the time of reconstruction, we have to interrupt our customers very often. And that's something we prefer not to do. Or actually not at all." (Liaison Manager, KPN)

> Op het moment dat er een reconstructie komt, moeten we heel vaak onze klanten onderbreken. En dat is iets wat we liever niet doen. Of eigenlijk helemaal niet willen.

"We are a large contractor, with an engineering firm, with a lot of smart and creative minds, we like those tender projects" (Contractor, VITAL)

> We zijn een grote aannemer, met een ingenieursbureau, met veel denkkracht en creatieve geesten, dat vinden wij de leukste tenders.

"What is different above the ground... A building can be engineered to the final detail. You will get things against you. But in fact, a car or a building can be completely engineered. The underground doesn't work that way, because you do not know what is in it. And yes, that makes the underground different. And there you have to operate differently." (Project Manager, Project Organisation AVL)

> Wat anders is dan bovengrond. Een gebouw kan je bij wijze van spreken uittypen tot het laatste steentje en voeg. En dan nog kom je dingen tegen die. Maar in feite, een auto of een gebouw kan je helemaal uit engineeren. Ondergrond gaat gewoon niet, omdat je niet weet wat er is. En ja, dat maakt de ondergrond anders. En daar moet je ook anders in opereren.

"The underground consists out of much more interests, besides cables and pipelines, which are, by the way, not easy to forget. They also have their rights and duties. The water level, if that goes wrong, the building around here will collapse. It's really a wonderful world of interests" (Policy Officer, Municipality of Amsterdam)

> Dus het stikt van ook weer in de ondergrond van allerlei belangen buiten die K&L-wereld, die ook niet klein zijn. Die ook hun rechten en plichten hebben. De waterstand, als dat niet goed gaat, dan verzakken al die panden hier die op palen staan. Het is echt een wonderlijke wereld van belang.

"It is clear that when you start, you do a KLIC notification, that's the starting point. But, between that, where it is about decision-making, it is a grey unknown area. That's the challenge." (Project Manager, Engineering Office)

> Het is wel duidelijk dat je moet beginnen, je doet een KLIC, je hebt een start moment, maar daartussen, om al die, gaat over besluiten schijnbaar, om al die beslissingen te nemen, besluiten te vormen, dat is een grijs gebied. Daar ligt wel de uitdaging.

"And finally, we are also limited in the possibilities of where the pipeline could be located. Because, for example: buildings. There must be a distance between it of at least 4 meters. You cannot just build within that distance. Especially in urban areas where many houses and other cables and pipelines are located. It is often very difficult, that's what we call free trace, where you can locate your pipeline" (Project Manager, Gasunie)

> En uiteindelijk, wij zijn ook wel weer beperkt in de mogelijkheden van waar we kunnen gaan liggen. Omdat we bijvoorbeeld ook gebouwen, bebouwing moet minimaal 4 meter van die leiding verwijderd zijn. Er mag gewoon niet binnen die afstand gebouwd worden. En vooral in stedelijk gebied. Waar veel woningen staan. Maar waar ook andere kabels en leidingen liggen. Daar is het vaak heel moeilijk, dat noemen wij vrij tracé, te vinden waar je kan gaan liggen.

"When the VTA or VTM is accomplished, they are going to prepare. When the POS is done, they will also prepare the realisation phase. Are they going to do the work separately and put it on the market to get it done? Eventually, some coordination has to be taken into account" (Cable and Pipeline Coordinator AVL)

> En op het moment dat de VTA dan wel VTM er is, gaan ze voorbereiden. En op het moment dat de POS er is, gaan ze ook de uitvoering voorbereiden. Gaan ze de werkzaamheden uitvoeren tot een bestek en gaan ze dat in de markt zetten en uitgevoerd krijgen. En uiteindelijk moet er ook nog een stukje uitvoering coördinatie plaatsvinden.

"With pipeline owners, such as Gasunie or Stedin, they want a layer on top of the pipeline with not too much pressure. Meaning that if you are going to excavate, that there is not too much pressure of the subsoil on the pipeline. A gas pipeline is located quite tight in the underground. It can move a little, but not too much." (Specialist District Management, Municipality of Amstelveen)

> Ze gaan als je gas hebt, Gasunie of Stedin, die willen in een zettingsvrije laag zitten. Dat je daarna als er gegraven is, niet dat de grond nog gaat zetten. Een gasleiding die ligt natuurlijk redelijk strak. Die mag wel ietsje, maar die kan ook niet teveel hebben.

"Certainly, where a long turnaround time is the case, they will mitigate it. Gasunie is an organisation that has a long turnaround time, but NUON Warmte is also one. Certain telecom organisations are important, because glass fibre could have a long turnaround time, especially with all the connections in it. So, the client usually takes responsibility of these cables and pipelines." (Contractor, VITAL)

> Zeker wel een langere doorlooptijd aan verbonden zijn, gaan zij dan al mitigeren. Gasunie is wel eentje die langer doorlooptijd kent, maar NUON Warmte is ook zo'n eentje. Bepaalde telecommers die belangrijk zijn, glasvezels kennen ook langere doorlooptijden, zeker met al die overnames die erin zitten. Dus de opdrachtgever pakt die meestal eruit, gaat dat zelf doen.

"This is often linked to the design of the contractor. Well, maybe some organisations may have more problems with it. Usually they say: 'you figure it out, but also take the costs for your account'. And as a contractor, you can be smart with the design, for example; if I do this, the cable or pipeline can just stay there." (Contractor, VITAL)

> Want dat zit vaak, zit het verbonden aan de ontwerpoplossing van de aannemer. Nou, de ene partij die heeft er misschien wat meer problemen mee dan anderen. Dan zeggen ze van joh, zoek dat helemaal zelf uit. En neem ook de kosten voor je rekening. En daar kan je dan als aannemer slim met je ontwerp omgaan van nou, ik weet mijn ontwerp zo te maken dat ik die K&L ongestoord kan laten liggen.

"You will always meet each other in the field, which has its pros and cons. The advantage is that you know each other at some point. Only if you mess it up, you also messed it up with the others involved. On the other hand, if they work against you in, for example, Alkmaar… In the end you need each other, because without it you cannot achieve a successful project." (C&P Coordinator, Municipality of Amsterdam)

> Je komt elkaar elke keer weer tegen in het veld. En dat heeft voor- en nadelen. Het voordeel is dat je elkaar op een gegeven moment kent. Alleen als je het daar verkloot, dan heb je het ook bij de ander verkloot. Aan de andere kant, als zij in Alkmaar heel erg tegenwerken… Uiteindelijk heb je elkaar nodig, want zonder kan je geen project maken.

"In the end, if you are involved in it together, you have all kinds of interests. The funny thing is, of course, that if you really want to achieve your goal, you will not get there, so you will have to collaborate. There is a common problem. With all the different interest, it is a game of interests and that has to be coordinated" (Policy Officer, Municipality of Amsterdam)

> Zodat je inderdaad met elkaar uiteindelijk, ja je hebt allerlei belangen maar het grappige is natuurlijk dat als je je eigen deel belangetje volgt dan kom je er niet, dus je zal toch echt met die andere moet samenwerken.

Er is een gemeenschappelijk probleem. Met alle eigen belangen erin, dus het is een groot belangenspel en dat moet geregisseerd worden.

"Because I am involved early in the process, the scope of the project is often not entirely engineered. So, there are also possibilities to maybe change the plans a bit, so no adjustment has to be done" (Project Manager, Gasunie)

Omdat ik vroegtijdig aangesloten ben, is vaak die scope van het project ook nog geen eens helemaal vast. Dus er zijn ook wel mogelijkheden van joh kan dat niet iets opgeschoven worden of wat dan ook. Zodat ie kan blijven liggen.

"Sometimes the environment is a bit more in the lead and sometimes the technical aspects are a bit more in the lead. With the network administrators, it is often the other way around, it is often the technology which is in the lead and we attach the environment aspect to monitor the interfaces with other stakeholders and connect when necessary" (Environment Manager, Project Organisation AVL)

De ene keer is de omgeving wat meer in de lead, dan is het weer techniek. Bij beheerders is het vaak andersom, dan is het vaak de techniek meer in de lead is en dat wij als omgeving aansluiten om de raakvlakken met andere stakeholders te bewaken en verbindingen te leggen, waar nodig is.

"You can close down the street and get the shopkeepers against you, but those are society costs and also income, basically a detour of the road. These are basically all the costs that are included in a MKBA analysis" (C&P Coordinator, Municipality of Amsterdam)

Je kan een straat wel vierkant afsluiten en alle winkeliers over de kop laten gaan, maar dat zijn dan ook maatschappelijke kosten, maar ook inkomsten, daarvan in principe het omrijden van je autoverkeer, het omrijden van busverkeer. Dat zijn in principe allemaal kosten die daaronder vallen. Dan moet je MKBA analyse maken.

"Within the project boundaries, more and more is about the Lowest Society Costs, which is the sum of the costs of everyone involved. And it is a topic where, yeah, often everybody is going for his own interest, check if it is possible to make their own share as cheap as possible" (Liaison Manager, KPN)

Maar binnen de projectgrenzen zie ik 'm steeds vaker vallen, laagst maatschappelijke kosten. En dat is dan die optelsom van de kosten van eenieder. En dat is al een onderwerp waar je, ja iedereen zit toch gauw aan z'n eigen touwtje te trekken van, zien of ik mijn eigen project hier zo goedkoop mogelijk eruit sleep.

"I mean, cables and pipelines are just an integral part of the job. That doesn't mean that you have to take it as an integral topic in the tender or in the contract. I do not think so. My opinion is that you have figure out what is the best solution for the contract and what is not. But it does not matter how you do it, just make sure to make it an integral part of your project" (Environment Manager, AVL)

> Ik bedoel K&L is gewoon een integraal onderdeel van het werk. Dat betekent niet dat je per definitie dat je het als integraal onderwerp in je bestek mee hoeft te nemen he. Of in je contract. Dat denk ik dus juist niet. Ik denk dat je van tevoren moet kijken van wat past het beste wel in het contract en wat past het beste niet. Maar hoe je dat dan vervolgens oppakt, zorgt er wel voor dat het een integraal onderwerp van je project is.

"That is, on the one hand, that's annoying. Because with such a D&C contract, everything is figured out in the end, at that point you are involved. They are going to think of solutions and there will always be long turnarounds and bandwidths and those sort of things" (Project Manager, Liandon)

> Dat is aan de ene kant is dat wel het vervelende. Want bij zo'n D&C-contract, die worden pas helemaal aan eind, als alles uitgedacht is, dan worden die erbij betrokken. De aannemer? Ja. En die gaat dan in oplossingen denken. En daar zit je ook met doorlooptijden en bandbreedtes en dat soort dingen.

"No, the contractor certainly has a different interest. 1) he has a registration price 2) he wants to make profit. So, they want to cause as less inconvenience as possible, there are requirements that needs to be followed, and the sooner he's gone, the more profit he is making. So, that's always a contradiction in the realisation phase if that's the responsibility of the contractor" (C&P Coordinator, Municipality of Amsterdam)

> Nee, die heeft zeker een ander belang. 1) hij heeft een inschrijfprijs. 2) hij wil winst maken. Dus die wil zo min mogelijk overlast veroorzaken. Er zitten allemaal eisen in het contract waar hij aan moet voldoen, en hoe eerder hij weg is, des te meer hij verdiend. Dus dat is altijd een tegenstelling in de uitvoering als je dat soort dingen bij de aannemer neerlegt.

"A barrier plan for the environment, so during the construction, how do you ensure that there is no nuisance for environment and surroundings. The second was a barrier plan for the road user, especially traffic from the Beneluxlane, but also crossing traffic. How do you ensure that the traffic is not stuck every morning and evening? And third, a barrier plan for the public transport. So, for the tram and metro user" (Contractor, VITAL)

> Een hinderplan voor de omgeving, dus tijdens de bouw, hoe ga je ervoor zorgen dat de omgeving zo min mogelijk hinder heeft. Tweede was hinder voor de weggebruiker, met name het verkeer op de Beneluxbaan,

maar ook het kruisend verkeerd. Hoe ga jij ervoor zorgen dat het niet permanent vastzit elke ochtend- en avondspits. En derde, hinder voor de OV-reiziger. Dus de gebruiker van de tram en de metro.

"For the contractor, it was a risk. So, we actually looked from the risk perspective: what is the best solutions right now?" (Environment Manager, Project Organisation AVL)

Voor hem een risico. Dus we hebben eigenlijk vanuit de risicobenadering, zijn we gaan kijken van wat is nou verstandig om te gaan doen?

"Copper cables of the KPN, which has to be extended by 800 meters, will lose a lot of signal strength. So that was not an option. We had to do it differently. Plus, if 800 meters of cable has to be relocated the traditional way by digging up, relocate cable, closing the gap. Yes, that causes disturbance." (C&P Coordinator, Municipality of Amsterdam)

Koperkabels van KPN, die met 800 meter verlengd worden, verlies je gewoon heel veel signaalsterkte zeg maar. Dus dat ging al niet. Dus moesten we anders doen. Plus dat die 800 meter traditioneel aangelegd moest worden, van boven gegraven moest worden, kabeltje erin, sleufje dicht. Ja, dat brengt ook overlast met zich mee zeg maar.

"Within the time limit, the time that was left, is it actually enough for the contractor to contact all the cable and pipeline owners to send out the VTAs and VTMs, to set up the POS, and then give the organisations involved the time to relocate their cable or pipeline, before even starting the realisation phase" (Environment AVL, Project Organisation AVL)

Is die, dat tijdspad, wat daar dan zeg maar overbleef is dat nou eigenlijk voldoende voor die aannemer om contact te gaan leggen met al die K&L eigenaren om al die VTA en VTM's te gaan versturen, de POS op te gaan stellen en dan ook nog de tijd te bieden aan die partijen om die verleggingen uit te gaan voeren, voordat die überhaupt zelf aan de slag kan gaan.

"We know that the client coordinates a lot of these projects nowadays" and "if we would do it ourselves, there will always be one of the actors involved that does not agree and then, the planning of the drill would be extended and delayed" (Technical Manager, Project Organisation AVL)

Wij kennen heel veel projecten tegenwoordig waar de opdrachtgever dat coördineert en als wij dat nou zelf gaan doen, dan zul je altijd zien dat dan op een gegeven moment gaat een van die andere eigenaren gaat dan niet akkoord, dan hebben we gedoe en dat, dan gaat die boring die gaat naar achter.

"The moment you have that, you should start with C&P, is my opinion. Because the sooner, the better. I mean, it is better to start in the initial phase with some extra hours, which might have been possible later. But if you start too late, and you find out that you should have done it earlier, you will not regain the hours. It's easy as that. And eventually you have to spent those hours anyway" (C&P Coordinator)

> Op het moment dat je dat hebt, moet je eigenlijk al met K&L beginnen ben ik van mening. Want hoe eerder, hoe beter. Ik bedoel, kan beter in de voorfase wat extra uren instoppen, die achteraf misschien ook later hadden gekund. Maar als je er te laat mee begint, en je komt erachter dat je het eerder had moeten doen, dan ga je dit tijd niet meer terugwinnen. Zo simpel is het. En de uren moet je er toch een keer instoppen.

"We noticed that the client has gathered a lot of information in advance, in details, with the conversations with the C&P owners. So, you felt that they worked very hard to get that information. And in the dialogue discussions we have always asked about it" (Contractor, VITAL)

> De opdrachtgever heeft het wel heel goed uitgezocht, behoorlijk ver gegaan in detaillering, met de gesprekken met de K&L eigenaren, dat merkte je wel. Dus je voelde dus wel er wordt heel intensief aan gewerkt. En in de dialooggesprekken hebben we er ook wel steeds naar gevraagd.

"Almost three to four hundred years, they put everything in the ground. It is inevitable that you come across something if you are going to dig" (Project Manager, Project Organisation AVL)

> Men heeft drie tot vierhonderd jaar van alles in de grond gedouwd, ja dat kom je tegen als je gaat graven.

"For 20 years I do the cables and pipelines in Amsterdam. The city is getting fuller, both above and below the ground. So, it is more difficult to find traditional solutions" (C&P coordinator)

> Al sinds 20 jaar K&L in Amsterdam. De stad wordt steeds voller, zowel boven als onder de grond. Dus het wordt steeds lastiger om traditionele oplossingen te vinden.

"Look, the Cable and Pipeline Coordinator is very experienced and comes up with several plans and solutions for us, like we have figured this out, I think it should be feasible. It works much easier. But that's always the way, the more experience, the easier it goes" (Project Manager, Liandon)

> Kijk, de K&L coordinator is super ervaren en die komt zelf eigenlijk al, die legt eigenlijk al de plannen voor aan ons van kijk, dit hebben we bedacht dat volgens mij haalbaar moet zijn. Dus dat werkt al veel makkelijker. Maar dat is altijd zo, hoe meer ervaring, hoe makkelijker het gaat.