DELFT UNIVERSITY OF TECHNOLOGY

MASTER THESIS

SEN233

Using A Case and An Analytical Framework to Explore The Planning Challenges of The Dutch DSO

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Executive Summary

The predestined energy transition will induce major changes in the energy system. As demand for electricity is expected to rise, the electricity grid expansion by the DSO is viewed as an essential aspect in the transition. It is argued that the DSO currently face two major challenges; an increased workload, and ageing and scarcity of personnel. This ultimately results in the fact that the DSO's with their current way of working are required to manage a higher workload with fewer resources. An aspect that can influence their way of working, and may alleviate these challenges, is planning.

This study aims to understand the challenges, issues and factors that corresponds with the operational and tactical planning of the DSO. Also it aims to provide an understanding of the DSO in terms of its context, role, activities, organisation, internal processes, and internal & external actors. To achieve this goal the research will answer the following four sub-questions:

(i) What aspects contribute to the perceived difficulties of the DSO with regard its planning processes?

(ii) What are the internal and external factors that influence the planning and the way the DSO tries to manage these processes?

(iii) What solutions are currently being considered and implemented in and around the organisation to cope with the planning challenges?

(iv) How do the current solutions relate to the suggested improvements of the analysis of this research?

It uses a qualitative research approach, in which the focus was directed onto a specific DSO, one of the three big Dutch DSO's, in a case study. In the literature, there is no comprehensive analytical framework or theories found that could properly examine these forms of planning at the Dutch DSO's. This study provides a new and unique perspective to comprehend and analyse the issues regarding planning at the DSO´s, by incorporating multiple theories in a constructed analytical framework. This contributes to the structure of the analysis and helps the researcher to work in a certain direction towards tangible outcomes. The theories incorporated into the analytical framework of this study are Images of Organ- isation from the organisational perspective, and the Four-layer model and Transaction Cost Theoryfrom the institutional economic perspective.

The Images of Organisation serves as a tool to analyse organisations by comparing the organisation from the case to different organisational archetypes using metaphors. By analysing an organisation through the lens of a specific metaphor, one could gain insights when looking at their similarities, differences and variations. The various metaphors provide an opportunity to recognise which metaphor and associated organisational ideal-types are applicable to the case. Only the considered most relevant metaphors, that can address the organisation´characteristics and organisational challenges with regard to planning in the best manner, are included into the analysis which include the machine, organism, brain, and flux & transformation metaphor. The Williamson's four-layer model is a framework to analyse complex institutions. It can be complex to understand the interactions and patterns between these social elements, and this model provides a certain structure that helps the researcher analyse the complexity of real world institutions. With this theory the institutions in the organisation that influence the planning processes or its interactions are identified. The model helps to describe and integrate institutions in a single framework, which structures the observed institutions and facilitates the analysis of the relations and interactions between them. The Transaction Cost Theory can analyse governance structures regarding their generated transaction costs. The theory suggests that costs arise from every activity that takes place in a transaction between actors, named as transaction costs. The transaction cost theory opts for an organisational structure that reaches its optimal state of

economic efficiency by minimising the transaction costs. In this study certain transactions of the interactions and activities around the planning processes within a DSO will be analysed, this will provide insights into the functioning and managing of the organisation, and where the actual costs are situated.

The observations of the case study showed that the workload has undergone a steady increase in recent years. And, the number of bottlenecks in the electricity grid still increased because of the insufficient capacity compared with the enormous workload. It is argued that the DSO´s will not be able to tackle the workload efficiently with their current set-up and are compelled to make several changes. DSO operates in a complex industry with a lot of uncertainties, different parties, and external and internal variables. It is a collection of factors that contribute to the experienced challenges of A DSO in applying planning processes. Also, the regulations in effect are no longer argued to be appropriatefor the current needs of the DSO.

The main insights of the Images of Organisation theory are divided in the insights of the four different used metaphors. The main aspects that comply with the machine metaphor can be found in their internal processes and in their goals regarding their internal processes, such as predictability, inhibition to fast adaptations, efficiency, and the need for plan, organise and control. Other aspects that were less compliant within the organisation, were the definition of roles and responsibilities, and the lack of uniformity and forecasting capabilities. From the analysis with the organism metaphor, the main mentioned similarities can be found in their contextual situation, and is comparable with their reality in which they are located. A far ahead planning can be applied accurately in a stable environment, but in the setting of a DSO with numerous uncertainties, a more convenient approach would be towards a more flexible planning. Many of the similarities with the brain metaphor are connected to the organisation dealing with data and working digitally. Especially in an increasing digital working environment, a form of proper processing and usage of data is considered increasingly important. Flux & transformation metaphor is correlated with the unpredictable context regarding tactical planning, unpredictable project specific variables regarding operational planning, and proactive way of working in coping with the changing distribution network of the organisation. Also, the personnel of the organisation is ageing and there is an old and conservative working environment experienced. It is assumed this contributes to DSO experiencing difficulties in the implementation of organisational change and working proactively.

The most important insights of the four-model is discussed by describing the interactions of some institutions. The governance structure of the definition of roles and responsibilities within the organisation is connected to reliability, lack of uniformity, and insights into capacity. The outdated regulatory framework is in conflict with current workload and capacity conditions. Forecasting capabilities can be used to manage future workload and capacity, but may be in conflict with justifiable investments and affordability. The lack of uniformity leads to different ways of prioritisation, data processing and other activities. Prioritisation can play a role in the service to customers but is in conflict with the current regulations. Data processing and usage is connected to a supporting IT system, and can play a role in forecasting, lead time determination, prioritisation, capacity and workload insights.

The key findings of the transaction cost theory are represented into two areas; aspects that currently cost significant transaction costs and aspects that can help reduce the transaction costs within the organisation. The lack of uniformity, unclearly defined roles and responsibilities, and little sharing of accurate and up-to-date information in the operations are all aspects that currently costs significant transaction costs for the organisation. Aspects that can reduce the made transaction costs of the organisation include prioritisation, standardisation, increase in uniformity, better defined roles and responsibilities, better information management, and an expansion of the competency matrix.

In conclusion, the changing conditions of the DSO and its environment as a result of the energy tran-

sition influences the planning. Which results in a clear increase in the workload. Thereby, there are challenges with the ageing of the current personnel and a scarcity of technically trained people on the job market. Another aspect that influences the planning, especially the operational planning, are the unpredictable project specific variables and complexities of the operations.

The key factors influencing the planning and managing of the process can be divided into three clusters. The first cluster is linked to its historical legacy. Where one of the implications of the organisation‘s conservative working environment are the difficulties experienced in implementing organisational reforms. Also, it influences the way DSO works digitally with little data processing incorporated in the processes. Furthermore, there is little uniformity throughout the organisation, which has an impact on unclearly defined roles, different ways of prioritisation, various methods of data processing and difficulties in implementing changes. The second cluster are connected to the difficulties in the operations. In the operations the organisation has to take into account numerous uncertainties, complexities and variables. Therefore, flexibility should be incorporated into the operational planning. However, the organisation is compelled to discard a share of flexibility due to the current high workload and capacity issue. Also, prioritisation can contribute to this by allowing the organisation to make more informed decisions. Although, prioritisation can currently not be executed optimally due to the constraints of the regulatory framework. The final cluster is associated with working proactively. The organisation experience difficulties in working proactively. In which the organisation has insufficient forecasting capabilities. Factors that are argued can influence the forecasting capabilities are data processing and data usage, by providing insights into capacity and workload, increase accuracy of the information and improve reliability of the tools. Although, the quality of the data resulting from the current little data processing of the organisation, is often insufficient to provide significant insights. Furthermore, working proactively is in conflict with the value of affordability and the regulation feature of justifiable investments.

The current solutions of the organisation to cope with the mentioned planning issues are IT system improvements, making prioritisation more prominent in the future, standardisation of processes, incorporation of flexibility into the operational planning and acting proactively.

The results of the analysis of this study is similar with the current solutions in that the planning issues is a multi-layered problem stretching out in various sectors of the organisation, that will require a set of solutions. Also, prioritisation should be given more weight in the organisation. And, flexibility in the operational planning is considered important. The differences are that instead of adopting a new IT system, the organisation should focus on improving working digitally, data processing and data usage to create valuable insights. Moreover, considering the lack of uniformity, lack of knowledge of areas to standardise, little data processing and usage, and the implementation problems within the organisation it is considered that standardisation is currently a bridge too far. Lastly, increasing the uniformity of the organisation is considered that it should be more of a priority of the organisation to focus on.

In short, the key challenges of the DSO according to the findings of this case are: the increasing workload, the ageing and scarcity of the internal and external capacity combined with limits in which these can be scaled up, and the unpredictable project specific variables and complexities of the operational projects. The main factors that influence the planning processes can be clustered into three groups, the factors that coincide with its historical legacy, experienced difficulties in the operations and ability to working proactively. From the analysis the main solutions to cope with these challenges and factors are to focus on a set of solutions, prioritisation should be made more important, incorporate flexibility into the operations, improve working digitally and data processing skills, make more use of available data, and increase the uniformity of the organisation.

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Problem Introduction

1.1 Situation of the problem

As a result of the growing concerns of climate change, countries increasingly acknowledge the pressing need to accelerate the transition to sustainable energy systems. The world showed the ambition to make the energy transition happen, when 196 countries signed the Paris Agreement in 2015. Hereby, the countries agreed to try to limit the temperature rise compared with 1990 to 2 degrees in 2050 [1]. In line with this, the EU generated a roadmap of stringent climate policy goals to strive for an almost (80%) carbon-free energy system by 2050 [2]. This global energy system shift from fossil fuel based - including oil, coal and natural gas - energy production and consumption to a renewable based energy system - including wind and solar - is called the energy transition. The energy transition will induce major changes in the way energy is generated, transported and consumed. But it is still unclear how the energy transition precisely should and will take shape. An essential technology to cope with these changes is the expansion and the intensification of the current electricity grid by its owners and operators, the transmission system operator (TSO) and the distribution system operators (DSO's) [3]. As the demand for electricity will only increase in the coming years, electricity grid expansion is seen as an indispensable part of the energy transition to deliver electricity securely and cost-efficiently [4]. Less effective implementation of new cables and stations may delay the transition to a carbon-free economy in a way that the Netherlands will not achieve its climate goals. To realise the government's climate plans, it is estimated by the network operators that about twice more network capacity is required [5]. This boils down to the construction of many substations, transformer houses, and electricity cables.

In order to successfully transition from a fossil fuel based energy system to a renewable based system, the DSO´s have to prepare the electricity distribution network for the future. As stated by independent consultants to the European Commission [6], the DSO's is argued to play a significant role of importance in the successfulness of the energy transition. But what is the effect of the energy transition on the DSO and what challenges do they currently face? Within the DSO´s there are currently two major challenges recognised with regard to their planning:

- An increased workload due the acceleration of the energy transition
- The ageing of their current personnel and scarcity of technically trained personnel on the job market.

Increased workload

The amount of work that must be completed is referred to as the workload. The increased workload of the distribution system operators occurs as a consequence of the energy transition. This will result in increased workloads, due to the impact it has on the energy system. The opposed changes of the grid regarding the energy transition will be further discussed in sec. 2.5. Viewed through the lens of conventional grid planning, one of the main solutions of DSO's to cope with the opposed changes with regard to the energy transition, is by increasing the overall capacity of the electricity network through

expansion and amplification of the grid [3].

Ageing and scarcity of personnel
As mentioned earlier, besides the increased workload, the ageing personnel is a serious problem of the Dutch DSO's. There is little accretion of young technically trained people on the job market. In the case that there is not enough personnel for the workload of the DSO, this will create congestion in the implementation of the grid which eventually will result in a delay in the energy transition. As stated by the Chief Transition Officer of Alliander, "Over the next four years, we and our subcontractors need to hire 3500 people. That just won't work, and is one of the biggest bottlenecks right now. We are now investing hundreds of millions of euros extra. But there are simply not enough technicians" [7]. This shows the urgency of the issue around the personnel of the DSO. It boils down to the fact that the DSO's are required to manage a higher workload with less people. The DSO's are argued to have trouble tackling the current and future workload with the current set-up of the organisation considering the capacity limitations [8]. An aspect that influences their way of working and may soothe these challenges, is planning.

Planning
Planning is a procedure that entails deciding on a course of action. The methods and tools required to attain specific goals form an essential part of planning. For example, a construction project of the DSO is realised by a combination of various activities and interactions with changing participants and processes in an ever changing environment. The planning includes the structuring and scheduling of these activities and interactions to construct the project. Planning has the ability to give insights in supply and demand, which can help by making a proper decision in the efficient deployment of the capacity. It also may create a more prioritised and predictable workload for own personnel and external parties, and can result in cost savings by working more efficiently [9]. This makes planning an important part of such construction projects, the DSO and, thereby, of the expansion of the grid as a whole.

1.2 Complication of the problem

A dream written down with a date becomes a goal
A goal broken down into steps becomes a plan
A plan backed by action becomes reality

These are the simple steps of a plan but planning is not as simple as it seems. For example, there are various complexities around planning that contribute to its degree of difficulty. One of the issues around planning derives from its terminology and the way it is used. Firstly, planning is a container concept, for example there is project planning, grid planning, strategic planning, tactical planning, resource planning, operational planning, asset planning, and work planning. Also, different actors use the word "planning" differently. Planning can mean something different for an external contractor company than for the distribution system operators. Even within the same organisation there are differences, for example, for strategic managers planning could mean a plan that contains the long term strategy goals of the organisation, while for day-to-day managers planning could mean a spreadsheet of the daily activities and tasks of their personnel. Thus, the term planning exceeds various levels and organisations in the way it is used, this makes the term planning difficult to grasp and adds to the complexity of the subject.

There are mainly three types of planning mentioned in the interviews, consults and other sources within the DSO specifically; strategic, tactical and operational planning. The strategic planning has a time horizon of 10-20 years, and is focused on changes that happen inside the energy system. It incorporates the long term objectives of the DSO. This planning is more conceptual, and does not

take specific assets into account. Tactical planning has a time horizon of 1-5 years. This planning will take assets into account, and indicate what assets are required for internal activities and forecast expected external workload for the mentioned time horizon. In operational planning the focus lies on the activities of the projects. These projects have time horizons of months, weeks or depending on the size and content of the specific projects. It plans all the activities and interactions to accomplish the construction projects.

It is unclear which factors influence the planning process of distribution system operators regarding its construction projects in the expansion of the grid. And, because the planning processes are completely influenced by the way the processes are set within the organisation, the challenges related to the interactions and activities surrounding planning of a DSO are also relevant for this study.

1.3 Societal relevance

The energy transition in the Netherlands is currently at full swing. The increase in demand for electricity and the rapid implementation of renewable energy resources are putting pressure on the electricity grid. Also, there are increasing concerns about the availability and security of the electricity grid [8]. Therefore, it is required for the DSO´s to expand and intensify the electricity grid where needed. Until recently, the DSO´s were mainly concerned with maintenance activities of the existing gas and electricity network [5]. They operated in a steady and stable market until the energy transition changed that. Their current operations are much more invested in the expansion of the electricity network [5]. Unfortunately, the operators experience difficulty to maintain the speed of the transition, due to the challenges these organisations experience. For the DSO´s it is essential to cope with these challenges in a better and more productive way. This study will derive some contributions to may steer these problems forward. For example, it will identify and connect factors that influence the planning processes of DSO's. Also, it will contribute to the understanding of the processes, actors, relations and context around the planning processes, which is required to properly analyse and identify its challenges and influential factors. To achieve progress in the planning´process, the understanding of these challenges and influential factors is important. This may create a starting point in finding improvements.

This study may be relevant for various parties, such as; governmental bodies, consultancy companies, network operators or other interested actors. For example, governmental bodies may be interested in the aspect of this research to weigh the current institutions up against the current issues of the DSO. It may allow them to make more substantiated decisions regarding the needs and expectations of DSO´s considering the energy transition. Or consultancy companies, by improving their understanding of the issues around planning, may accommodate their clients in the energy sector in an enhanced fashion on this aspect. For the distribution network operators, the insights of this study may contribute to the understanding of their challenges. It may even lead to some perceptions where the DSO should focus their attention on.

1.4 Scientific relevance

The scientific relevance of the study relates to several aspects. Considering planning as a subject, there exists some amount of scientific knowledge about planning within the context of the DSO´s. Although, these studies were all focused on other kinds of planning, such as network planning or day-ahead planning, or used in a different setting compared with this study. In this study the focus of planning is on the operational and the tactical planning of the construction projects. Also, there is no comprehensive analytical framework or theories found that could properly examine these forms of planning at the Dutch distribution system operators. Therefore this research will construct it´s own

analytical framework, that will consist of several theories to examine the subject. With no comprehensive analytical framework considered, the framework of this study will be constructed from scratch. This study provides a new and unique perspective to comprehend and analyse the issues regarding planning at the DSO´s, by incorporating multiple theories in its analytical framework.

1.5 CoSEM relevance

In the Master program of Complex Systems Engineering and Management (CoSEM) at the Delft University of Technology students learn to analyse and solve problems in complex socio-technical environments [10]. This study examines the role of planning within the internal and external context of the Dutch DSO, while taking into account the energy transition, different internal perspectives of actors and human behaviour among other things. These aspects all contribute to the complexity of the subject and its environment. The DSO´s are a part of the energy system which is a large complex system with many actors and interactive processes. Planning is such an interactive process that depends on the interaction of various parts of an organisation including its social, organisational, technical and institutional characteristics. This interdependence between these aspects is the reason the study also takes into account different perspectives, in which adequate theories are used to analyse this. Each of the models used in this research are derived from and used in the Master program of CoSEM. As a result, this research is in line with the CoSEM Master program, because it comprehends a socio-technical process set in a complex and multi-actor environment where public and private stakeholders with distinctive viewpoints are involved.

1.6 Research Objectives

The main goal of the research is to understand the challenges, issues and factors surrounding the planning process of the DSO. Also it aims to provide an understanding of the DSO in terms of its context, role, activities, organisation, internal processes, and internal & external actors.

The research objectives of this study are:

- to create a way to examine planning within the context of a Dutch DSO
- to understand the reasons the DSO's experience difficulties in their planning processes
- to identify which factors play an important role in influencing and managing the operational and tactical planning processes
- to capture solutions to be considered to cope with the planning challenges

1.7 Research Questions

Considering the research objectives, the research question is formulated as follows:

What are the key challenges, and factors surrounding the operational and tactical planning process of the Dutch DSO, and what are adequate solutions to cope with these?

The research will approach this research question by answering the following sub-questions:

(i) What aspects contribute to the perceived difficulties of the DSO with regard its planning processes?

(ii) What are the internal and external factors that influence the planning and the way the DSO tries to manage these processes?

(iii) What solutions are currently being considered and implemented in and around the organisation to cope with the planning challenges?

(iv) How do the current solutions relate to the suggested improvements of the analysis of this research?

1.8 Thesis Outline

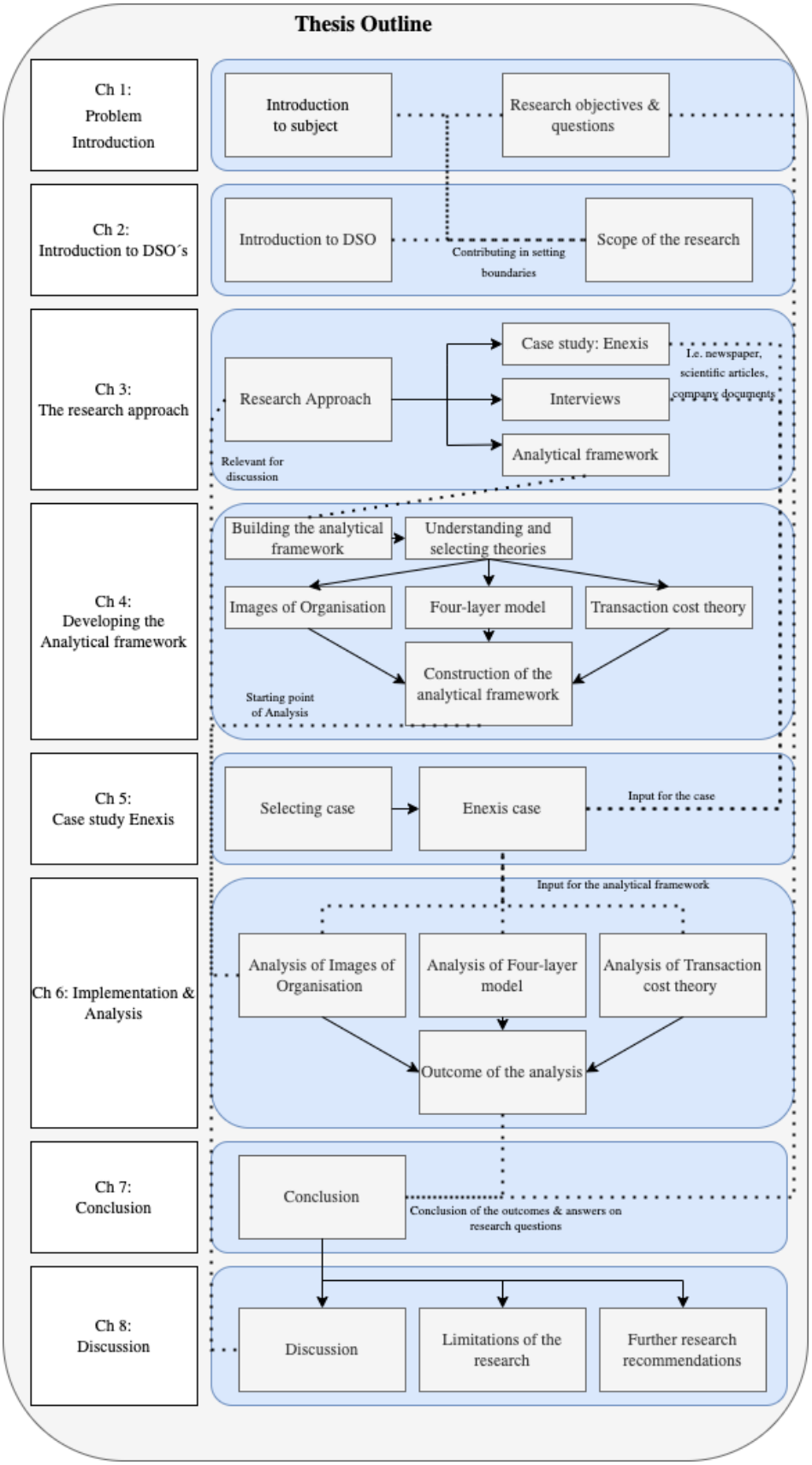

Figure 1: The outline of the thesis

1.9 Outline of the Report

In chapter 1, an introduction of the subject of the research is provided, where important context for the understanding of the issues and challenges surrounding the operational and tactical planning of the construction projects of the DSO is given. The next chapter provides a better understanding of the broader context the DSO is situated in and clarifies the role and the activities of the DSO. Chapter 3 discusses the research approach and additional methodologies used in this study. Chapter 4 outlines the theoretical foundation of this research. In this chapter the analytical framework is developed and explained. Chapter 5 presents the findings of the executed case study, these serve as the input for the analysis. Chapter 6 describes the analysis of the gathered data with the analytical framework. Chapter 7 discusses the conclusion of the research. And, in chapter 8 several discussion points, limitations of the executed study and further research recommendations are being discussed.

2

Introduction to distribution system operators

In this chapter, an introduction of the development and the current landscape of the DSO´s is discussed to provide a better understanding of the broader context in which the DSO´s are situated. Also, the working activities and the role of the DSO is described. Furthermore, there will be elaborated on the impact of the energy transition on the DSO's. Lastly, the scope of the research will be addressed in this section to set the boundaries for the rest of the study.

2.1 The various roles in the energy system

All market roles are jointly responsible for the proper organisation of the energy system. This will be explained by describing the four main actors and using a simple overview of the Dutch electrical system fig. 2. First, on the far left side of the figure the electricity is generated by the energy producers that act in a free market, which still occurs mainly centrally. Following that, on the far right side the energy suppliers purchase the electricity from the producers and resell this to the customers. The energy suppliers also act in a free market. Where in some cases, the energy producer and the energy supplier even may be the same entity. The TSO (left middle side) and DSO (right middle side), both regulated, make sure that the energy that is purchased by the consumers, is transported from the energy producers to the consumers.

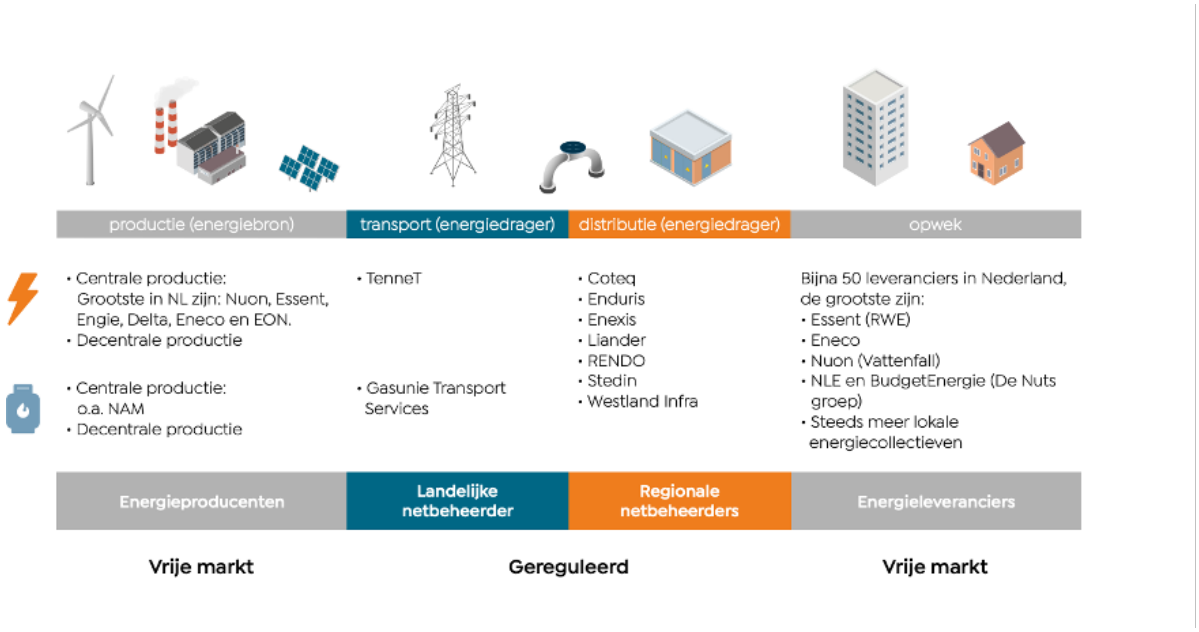

Figure 2: A simplified overview of the Dutch energy system [11]

Energy producer
This actor produces the energy that will enter the energy system. The main source of energy production still comes from centrally produced power plants [11]. The energy producers operate in a free market with plenty of competition. Some of the biggest energy producers of the Netherlands are Vattenfall, Essent, Engie, Delta, Eneco and EON. Although, the share of decentralised production is growing, in 2020 there were more than 500.000 connections that returned generated energy back to the grid of the regional network of DSO [12]

Energy suppliers
The energy suppliers are the link with the consumers. These companies draw up a contract in which they sell the energy for an agreed price to the consumers. Regarding energy suppliers, there are more than 50 suppliers in the country, with many local energy collectives [11]. Many of the energy producers are also the energy suppliers, some of the biggest energy suppliers are Essent, Eneco, Vattenfall, NLE and BudgetEnergie.

TSO
In the Dutch electricity system, there is one Transmission System Operator (TSO) for the electricity grid and one for the gas network. The TSO is the monopolistic system operator on a national scale, which is Tennet with respect to the electricity grid. Tennet has the exclusive right to the electricity transmission in the Netherlands. They transport vast amounts of electricity on the extra high voltage (EHV) and the high voltage (HV) grid, to the grids of the regional DSO's. They are responsible for the correct functioning of the electricity network. Tennet is also the one who manages the high voltage grids and ensures that trade can take place in the Dutch electricity network. The TSO of the gas network is Gasunie. It has the same clear task as Tennet but then in facilitating the gas market, where they offer a trading platform between buyers and sellers of gas and provide the required physical infrastructure.

DSO
The Distribution System Operators (DSO's) are responsible for the transportation of energy to the local end users on various voltage levels and the management of the regional grids. It receives the energy in bulk from the networks of the TSO and distributes it further down the line to the final consumers. There are seven DSO's in the Netherlands, each responsible for their designated area, in which they do not experience competition (fig. 3). Of these seven there are three big (Enexis, Liander and Stedin) and four smaller DSO's (Coteq, Enduria, Rendo and Westland Infra). These DSO´s are responsible for both the distribution of the gas and electricity networks.

Figure 3: Overview of the regional Dutch DSO's of the electricity network [13]

2.2 The development of the DSO

The Netherlands´ modern energy system is a massive interconnected network with many different actors and a big number of electrical cables and stations. In the Netherlands, the current energy system has been an amalgamation of government policies and market forces. To understand how the DSO became what it is today, some important historical changes of the energy system will be addressed in order.

In the nineties of the 20th century, the Dutch energy sector experienced a wave of mergers, which has still repercussions for the energy landscape of today [14]. Beforehand, many of the first energy companies were partly or completely in hands of local governments. But, to get a better competitive advantage various companies decided to merge with neighbouring companies. In this period three main energy companies were created that controlled the majority of the market; Nuon, Eneco and Essent. Also, the free trade in electricity and gas was released in Europe in the European Directives for electricity of the European Union in 1996. Responding to this, The Netherlands incorporated the requirements of the directives into the Dutch Electricity Act in 1998 [15], [16]. This stature paved the way for the Dutch government's policy in the years to come, which is still relevant today.

Also, alongside this new road, the Dutch energy market was privatised, to give customers a free choice, and thus more influence on the energy companies. The rationale behind this was that new companies could compete with existing companies that eventually would lead to more affordable energy prices on the energy supply side [17], [18], [19].

Furthermore, to avoid unfair competition from the traditional companies and to have less chance of power failure among other reasons, the traditional energy companies had to be unbundled from the network company under the policy " Wet Onafhankelijk Netbeheer" (WON) (2006), which was an addition to the Electricity Act (1998) [15]. Unbundling is the process of institutional separation of technological processes, it creates separate modules, functions and interfaces, where the ownership and control are in the hands of a variety of actors (Investopedia). For the energy sector this meant that the generation, transportation, distribution and management of the grid were separated. Each module with their own owners and controllers. Previously, an energy supplier was also a grid operator, in this

new way, fixed income on the transportation of energy could not be used to compete on the side of the electricity supply [19]. From the three mentioned main energy companies; Nuon, Eneco and Essent, were three distribution system operators derived respectfully; Alliander, Stedin and Enexis.

2.3 Role of the DSO

By referring to the Dutch Electricity Act (1998), the DSO's tasks are further addressed. As mentioned, the DSO's are responsible for the distribution, with the use of its distribution network, to deliver energy to the consumers. In the Dutch Electricity Act (1998) [15] a detailed description is presented of the obligation and task of the DSO:

"The DSO´s are obligated to provide a long-term ability of the system to meet reasonable demands for the distribution of electricity, for operating, maintaining and developing under economic conditions secure, reliable and efficient electricity distribution system [...] with due regard for the environment and energy efficiency." [15]

The DSO´s are a semi governmental organisation that facilitates the transport of gas and electricity. They are highly regulated and monitored, due to the fact it is publicly owned. The society as a whole pays the network operators through periodic costs, in which certain agreements have been made about the activities of a DSO [15]. For example, this makes it complicated for them to invest public money in innovation and renewal that lies outside of their range of obligations. There is strict control over these activities, where public money must be used for what it is intended, namely facilitating the gas and electricity grid. To make sure that the DSO's are ensuring their obligations they are monitored by the Dutch electricity regulator, "Authoriteit Consument en Markt" (ACM). As mentioned, the regional DSO's all work in their designated area. The main reason for this is that it simply would be too expensive to construct and maintain multiple energy networks in the same region. Although the DSO's have a monopoly position in their own region, they are being benchmarked between the various regions by the ACM to ensure their efficiency [14].

2.4 Working activities of the DSO

The work activities of the DSO´s are described to gain a better understanding of their working areas. There are three main working activities identified at the DSO's:

- *Outages process*
  The outages process includes the repairing and managing of outages. In the case there is an outage on a part of the grid, the responsible DSO will send an engineer to the situation to overcome the issue. The outage process consists of a pre-active work environment, where several engineers are on duty to fix the issues and manage the outages. With regard to planning this means that this process has more agile planning that allows for changes in requirements throughout and relies on ongoing feedback from the grid. It corresponds more to putting out fires and managing day-to-day issues [14].

- *Maintenance process*
  The maintenance process includes maintaining the grid as it is. This includes checking up on the status of the stations and the grids. When data received by the employees show that there is network equipment that is walking on its last legs, it is labelled and will qualify to be replaced. With regard to planning, this is standard work that can be planned far ahead. Within the organisation little difficulties are experienced in this process [14].

- *Construction process*
  The construction process includes the construction and expansion of the grid. This work activity

of the DSO is of high importance for the energy transition. The expansion of the grid is still the main solution to increase the overall capacity of the grid. The construction process can be further divided into separate workflows. There are external and internal driven work flows within the construction process. The external, also ´customer´, driven workflows consist of customisation and reconstruction, and the internal driven workflows consist of replacements, grid expansion and grid improvements. With regard to planning, this process has to deal with all the factors that impacts the operations.

2.5 Energy transition impact on the DSO

The steady and stable environment in which the DSO´s were situated, has made way for an uncertain and changing environment highly influenced by the energy transition. Despite the corona crisis, the energy transition continues unabated [20]. All in all the energy transition is in a complex phase, while the public debate is still ongoing, the implementation is in full swing. The energy transition impacts the energy system in various ways. To better understand the changing environment in which the DSO's are located in, the various ways that the energy transition impacts the energy system will be discussed in this section.

One of the EU policies that influences the energy system is called the Renewables Directive [21], where EU Member States are required to achieve demanding targets for the implementation of renewable energy in the current electricity system. This implementation of large amounts of renewables into the electricity system also poses some challenges. The intermittency of solar and wind energy challenges the ability of current electricity networks to deal with peak loads at the distribution level, because with these technologies it is harder to determine the quantity and scheduling of power consumption and production [22]. In addition, the demand for electricity at distribution level will increase, as a result of the electrification of mobility and house heating. On top of this, the Netherlands is expected to experience an increase in electricity demand due to the construction of data centres. Data centres consume large amounts of electricity. They contracted around 1.3 gigawatts (GW) of power in 2019 in the Netherlands, representing around 3% of total power consumption. This number is expected to rise to between 1.8 and 3.5 GW in 2030 [23]. Also, the increasing amount of decentralised energy generation causes a changing balance of the electricity grid. Whereas, the implementation of innovations in the grid will diversify and complicate the workload of DSO's. Another change felt is that solar and wind parks will be built in more rural areas that are more distant from the residential area. Reasons for installing a solar panel or wind park in a rural area is that there is more space, often less obstacles due to the sparsely populated area, a better business case and the land is cheaper. These more remote areas generally have insufficient grid capacity to comprehend this locally increased energy supply. In addition to the expanded workload that accompanies the increasing electricity demand, the changes on the grid give rise to issues such as, voltage violations and power congestion [22]. Which in turn may induce a shortened lifespan of network equipment, increased network losses and network outages [22]. Which is also contributing to the growing workload and increase in investments of the DSO's. This adds to the significance of the regional DSO's contribution to the energy transition. In fig. 4 the planned investments of the three biggest DSO's and Tennet are presented. This figure shows that the average yearly investments in this decade increases with €1,5 billion. This is almost entirely due to the increase of investments required in the electricity sector, while the gas sector investments remain relatively constant.

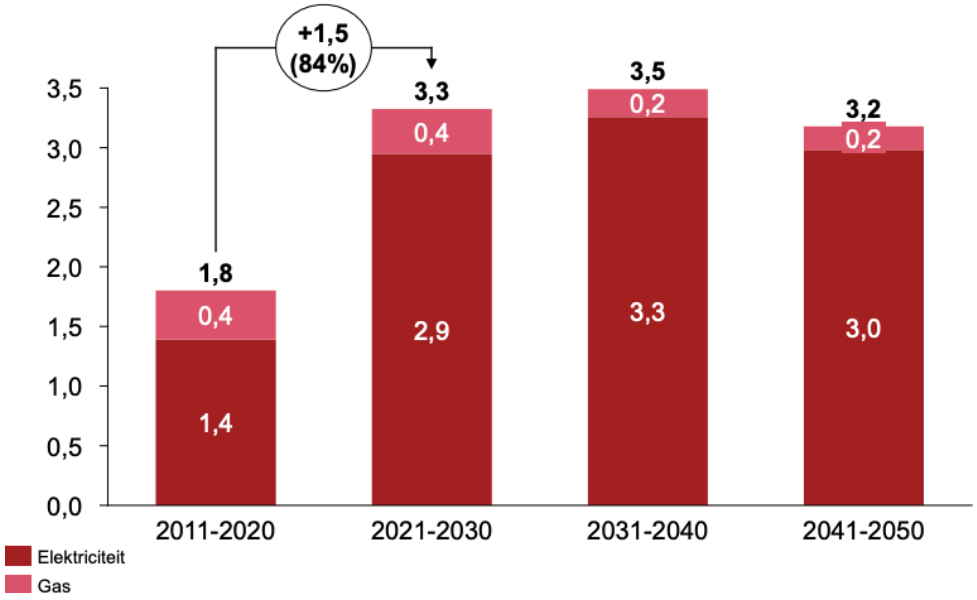

Figure 4: Combined average yearly investments of Stedin, Enexis, Alliander and Tennet in the Dutch electricity & gas sector from 2011-2050 based on investments plans (in billion euros) [24]

2.6 Scope of the research

It was an iterative process to determine the scope of the research. Through the literature study and by consulting with several experienced people of the sector, the scope of the research was shaped.

- Firstly, a decision was made to focus on the Dutch distribution system operators. The reason for the research derives from the assumed issues at the Dutch DSO's, therefore it has a direct link to the circumstances at those organisations. In addition, the research is carried out in the Netherlands. Also, it is regarded as more interesting for both Accenture and TU Delft, because of their close ties to the Dutch DSO's. Although, as part of the energy transition, challenges such as an increased workload and diluting internal capacity can be encountered by other DSO´s in other nations as well.
- Another scoping decision is made about the division between gas and electricity. With regard to the energy transition there is a clear division between the gas and electricity world. As seen in fig. 4 the energy transition is more closely linked to the electricity grid. For example, the construction of solar and wind parks, the electrification of the transport and heating sector, and decentralised electricity production are all causing disturbance in the electricity system. In the gas network the impact of the energy transition results in little differences. Also, within the DSO the increased workload is mainly caused by the increase in working activities on the electricity side of the company. Although these sides within the organisations could not be seen completely separated from each other. Due to the vast size of the subject it is considered to only focus on the electricity side of the DSO.
- Moreover, a decision was made to focus on the construction processes. Because of this the outage and maintenance processes were considered out of scope. The different processes have different ideas and expectations about planning. Outage processes are determined out of scope, due to the different sort of planning required. The outage process consists more of a pre-active work environment instead of operational planning, this is a structural difference compared with the construction processes. Instead of the maintenance process, the researcher chose to focus on the construction process including the expansion of the grid due to the direct connection with the energy transition.

- Furthermore, in sec.1.2 there are three types of planning mentioned within the borders of the DSO. Because of the vastness of the subject, the relevance of these planning' types are assessed. Strategic planning is considered too conceptual, and is too distant from the experienced issues. Tactical and operational planning are considered to be both interesting topics, that both are influenced by the impact of the energy transition and the current pressing challenges. Thereby, the challenges in these types of planning are considered to be to some extent connected to each other. Therefore, only the tactical and operational planning perspectives will be taken into account.

All these out-of-scope directions are considered to be further research recommendations. As they seem close to the subject and are also interesting paths to follow. This research can serve as a starting point for them by providing structure, information, proposed focus areas and an analytical framework.

In the next section the research approach and affiliated methodologies of this study is specified.

3

The Research Approach

This chapter presents the research approach and affiliated methodologies used in this research. Firstly, the type of research is addressed which includes its rationale, methodology and explanation for the case-study approach. Secondly, this chapter addresses the various methods of data collection applied in this study. Finally, it concludes with an examination of the methods used for the analysis of the data.

3.1 Type of Research

Empirical study
The research aims to increase our understanding of planning issues DSO´s currently face and can best be characterised as an empirical study of a phenomenon. Such a study refers to one where conclusions are derived from evidence that is observed or experienced [25], [26]. Due to the aspect that this study is focused on obtaining an improved understanding of internal processes and experiences, a research approach that will acquire in-depth insights and understanding of the processes inside the DSO´s organisation relating to the planning and/or construction projects is considered to be appropriate. In particular a qualitative research method is considered suitable.

Qualitative research approach
Qualitative research refers to specific methods to collect and analyse data. It found its origin in social sciences, where it tried to find the meaning of social interactions of a closed focused group [27]. In qualitative research there are methods used that describe and explain experiences, interactions and behaviour of individuals without the use of quantification [28]. It is used to gather and analyse non numerical data. These data sets are often descriptive, textual and/or even conversational information, that are obtained and represented in an unstructured or semi-structured manner [27]. This approach focuses not only on the ´what´- the experiences and interactions - of people, but also on the ´why´- the beliefs and thoughts - behind their statements. The sample size of these data sets is often small, and provides more in-depth details of the examined subject. There are various types of qualitative research methods, such as, interviews, experiments, focus groups, text analysis and case study.

The selection of the research approach is chosen with regard to the objective of the research and the type of data that is expected. One of the objectives of the research is that it creates a starting point for the way planning can be examined within the context of the Dutch DSO. This research is largely exploratory as it takes place in an unknown setting with little known experiences in examining issues DSO's face in terms of planning [29]. It can hence be utilised to construct a foundation for further research. Another aspect is that one of the types of data that was expected for this research consists of a small amount of personal perspectives and experiences around the subject that will be provided in a descriptive manner. A qualitative approach enables the researcher to examine the subject up close, which allows an attention to detail of the experiences [27]. Moreover, due to these small amounts of data points, a quantitative approach would not be of much value to the research, as a qualitative

approach would have. Whereas, the qualitative approach is also far better suited to deal with the subjective experiences and thoughts of individuals. In addition, the unstructured and descriptive aspects of this expected data fits perfectly with the qualitative research methodology. Therefore, executing a qualitative research approach was considered the appropriate method to be used [29], [30]. In particular a case study approach was chosen in an attempt to study the planning issues of the Dutch DSO.

Case study

In a case study, to analyse a phenomenon thoroughly and get an in-depth understanding of its workings, the researcher focuses on a single or small number of cases in the context of the real-world. So, by taking a close look at a real-world case it may result in a better understanding of the real-world. Yin (2012) defines a case study as "an empirical inquiry about a contemporary phenomenon, set within its real-world context, especially when the boundaries between phenomenon and context are not clearly evident" [31]. So, in other words, not only the case itself is of importance to achieve insights in the real-world, but also the environment and other complex aspects associated with the case are of importance to include in the examination. The case will try to clarify the characteristics of a larger group, in which the selected case plays the representative of the wider group [32]. Where it will be assumed that the examined case and the other DSO´s have comparable processes with rather the same variables and factors, and that the conflicts that are present at one DSO also apply to the other DSO´s. The idea of a case study is that through the richness of the material the observer gains insight into which factors actually influence the subject, in this case the planning aspect of the organisation.

Case studies often use multiple sources of evidence to analyse a case, such as, articles, interviews, company documents or archives. In this study, several sources of evidence will be used in the analysis, such as newspaper articles, company documents, reports, and on one-on-one interviews. In the next sec. 3.2 Data Collection there will be elaborated on the used sources. Case studies can be applied for different types of research. It can be used to provide description, test or generate theory. In this research the data of the case study will be used to validate the analytical framework in describing and analysing the subject. Yin (2012), identifies four types of case study design in a two-by-two matrix fig. 5, single or multiple case study, and holistic or embedded case study designs [31]. A single case study focuses on one case and a multiple case study focuses on multiple cases. A holistic case design refers to the interconnected aspect of the case, where the whole case will be analysed by a single unit of analysis and that parts of the case can only be fully understood in reference to the whole. Whereas, the embedded case design uses multiple units of analysis, to understand different aspects within the case. Because the case will focus on and is limited to a single organisation, a single case design is appropriate. The other choice is between holistic and embedded. Through the use of the analytical framework that emphasises multiple units of analysis, and shed light on the problem from different perspectives a single, embedded case study is used in this study.

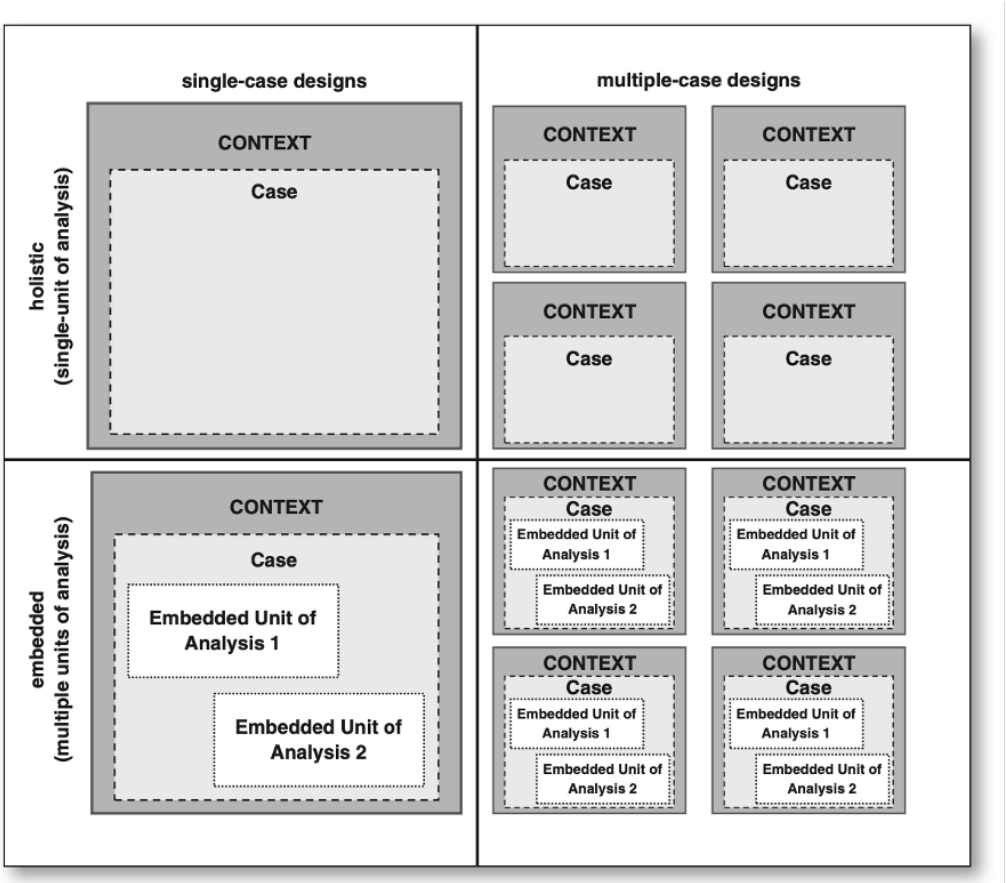

Figure 5: Four different types of case study [31]

3.2 Data Collection

The methods of data collection will be discussed in this section. In this study three methods of data collection are used to develop an analytical framework and examine a case; a desk research, explorative interviews and in-depth interviews. The first phase of the empirical study will consist of desk research and explorative interviews. The second phase will focus on the in-depth interviews.

Desk research
Firstly, a desk research of newspaper articles, scientific articles, governmental and company documents was executed. The use of the desk research can be split up into three parts. The first part focused on acquiring the necessary background information which is presented in chapt. 2. This data was used to help introduce the subject, explain some terminology and set limits to the research. It also provides a more complete picture of the energy system and the distribution system operators, in which the DSO´s tasks and context were defined, and the issues they are currently dealing with were addressed. The second part of the desk research contributed to the construction of the analytical framework, which will provide a focus to the case study. The construction of the analytical framework was performed in parallel with the first exploratory interviews. Thus, the exploratory interviews were not only guiding the development of the framework, but the framework was also guiding the interviews. The first thing to do in the construction of the framework was trying to understand what areas were relevant to shed the light on in this study. When the relevant perspectives were clear, the selection of the theories was executed. In a later phase, the desk research also helped to identify and understand the actual proposed theories for the analytical framework. The final part of the desk research focused on relevant case documents. These documents were linked to the actual case, especially their construction projects and/or planning. The documents of public regulated companies, such as DSO, are in most cases well registered and open for access.

Interviews
To comprehend the qualitative research, interviews were considered to be an appropriate method. As interviews are considered to be a widely used method to acquire qualitative data, people's perspectives and people's experiences [29]. Fourteen face-to-face interviews were conducted with staff in or surrounding DSO, specifically its construction processes. Every interview was conducted online via a video connection. This made the planning of the interviews easier and less time consuming, but also made the non verbal communication more difficult to interpret. But, the most important limitation of this data acquiring method was that during the interview it was harder to read if the interviewee wanted to explore their thoughts a bit more or that we proceeded to the next question, which may have led to a less optimal acquisition of the data. The interviews were conducted in a semi-structured fashion, with a couple of predesigned questions on a limited number of themes. These were, together with certain interview guidelines, included into the interview protocol. This style of interviewing is considered especially appropriate in a setting where the interviewer knows little about the subject or context [30]. Also, the interviewees were encouraged to discuss every subject as elaborate as they could. The interviewer followed a conversation type like interview, in which there was room for follow-up questions if it was considered to be complementary or some extra explanation was required. Finally, the interviewer was probing for examples given by the participants to stay away from broad generalisations and vague concepts [30]. In this study, a distinction was made between two different types of interviews, explorative and in-depth interviews. Therefore, there are also two interview protocols included into the study, the explorative interviews chapt. 9 and in-depth interviews chapt. 10.

Explorative interviews
To obtain a better understanding of the complexities of the challenges regarding planning at the DSO's, a small number of broad explorative interview questions was formulated. The interviewees consist of one employee of DSO, and of seven consultancy experts of the sector that work closely with the DSO in question. These first interviews were used to get a better picture of the context of the DSO and the DSO as an organisation. Also, to understand what kind of work they actually do, how the processes are organised and what kind of issues they perceive. By taking the perspective from outside the organisation into account, it was considered that a more objective view could add to the understanding of the issues. From these explorative interviews, the researcher inductively derived certain perspectives, themes and problems considered as important. Moreover, by identifying these aspects, these interviews aided in the selection of the theories used in the analytical framework. Although these interviews are not as detailed as the in-depth interviews, the gathered data will also be used in the analysis.

In-depth interviews
In the second phase of the data collection, in-depth interviews were conducted with employees of DSO. So, in the first set of interviews the structure of the in-depth interviews was determined, in the in-depth interviews more detailed data was obtained about specific issues. The interviews with the employees of DSO are conducted with several different functions. In each of the interviews, questions were prepared for the specific functions in the organisation, allowing respondents to talk about their experience in their functions [30]. The data that is gathered with these interviews will be analysed with the help of the analytical framework. Although the explorative interviews also add additional data, the majority of the data used in the analysis will come from these in-depth interviews.

3.3 Data analysis

In this segment there will be described how the data is analysed, and which methods were used. The various activities in the analysis are discussed, and the rationale is given for certain considerations.

Making transcripts of the interviews
The interviews were transcripted to obtain as much data as possible and to become familiar with the data, which subsequently aided in the interpretation and categorisation of the data [33].

Categorising the data
Another step in the analysis of the interview data was its categorisation. By categorising, the researcher already implements a degree of interpretation of the data [30]. First, the data was sorted in categories, with the help of PowerPoint. The data was represented in a tree diagram, so that not only the data is categorised but also the connections between the data points are specified. This phase has been carefully applied in this research, to make sure that no important data was overlooked. A strong point of this method is that it allows the researcher to identify common threads which helps to connect the various interviews. Also, this structures the data which is useful in the analysis and in the manner the research can be communicated to others [29]. The responses from respondents of interviews were structured in five categories. These five categories are: Organisation, Rules and Regulations, Actors, Process, and Planning. This will also be the structure in which this data will be represented in chapt. 5.

Applying the analytical framework
Because of a lack of a comprehensive analytical framework to examine the planning processes of the DSO, an analytical framework will be developed. An analytical framework helps a researcher to conduct a proper analysis, it will contribute to the structure of the analysis and helps the researcher to follow logical steps in the process to understand the phenomenon [33]. An analytical framework helps the analyst work in a certain direction towards tangible outcomes. It also ensures that the data is structured for analysis in a way that the analyst can answer the research questions more easily [33]. However, the analytical framework also limits the ability to make observations, due to the boundaries set by the theoretical perspectives. To execute a case study with no theoretical propositions, called inductive analysis, can be highly rewarding because it solely focuses on the acquired data and may result in original and out-of-the-box outcomes [31]. Nevertheless, it is fairly risky, especially without prior experience of executing a case study. The risk is that the study will have unclear structure, the researcher may lose significant time in describing and analysing the case, and will have trouble convincing others of the value in the outcomes [31]. Therefore, the researcher in this study chose to adopt the use of existing, well-known theoretical perspectives into the analysis, which is called a deductive analysis.

The analytical framework of this study will consist of several theories that examine the issue of planning from different perspectives. The theories incorporated into the analytical framework of this study are Images of Organisation [34] from the organisational perspective, and the Four-layer model [35] and Transaction Cost Theory [36] from the institutional economic perspective. What these perspectives represent will be discussed in the next chapter. By designing an analytical framework this study serves as a litmus test in the examination of planning processes of the Dutch DSO, therefore the usefulness and applicability of these theories will also be tested. The analyst will compare and where possible connect the empirical data to corresponding parts of the theories. The next step in the analysis, the interpretation of the data will follow subsequently. This step showed how the data could be interpreted in relation to the theories. The final step of the analysis was to derive conclusions from this.

In the next chapter the understanding and explanation of the analytical framework is discussed.

4

Developing the analytical framework

This chapter serves as the theoretical basis of the research. In this chapter the motivation and identification of the relevant perspectives to examine the planning process of the DSO are outlined. Within these perspectives specific theories will be addressed and explained that will form the structure of the analytical framework. Finally, the analytical framework will be described in the way it will be used in this research.

4.1 Explain the perspectives

Since the available planning literature was inadequate, it did not help the research much further in examining the tactical and operational planning of the DSO. The study was in search of tools or other measures to investigate the topic. The researcher has to examine the organisation from a variety of perspectives to have an understanding of the planning process. During the early phases of the research, it came to an understanding that the subject of planning was a multifaceted and complex issue. Therefore, the different perspectives with their analytical concepts are used to provide an understanding of the complex dynamics of the subject. The advantage of analysing from multiple viewpoints is that the links and interrelated interactions of factors may thoroughly be examined [37]. Also, it can provide a better understanding about the behaviours and attitudes of the various actors. It is argued that complex issues are best analysed by adopting more than one level of perspective into the analysis [38]. In this study the focus was on two broad perspectives that are expected to play a significant role in the internal planning processes; the organisational and institutional perspective.

The internal view predominates in this research, therefore it is critical that the organisation is properly analysed from within. The organisational perspective helps to understand and analyse the organisation, its characteristics and its activities. For example, it allows the researcher to look at specific organisational traits and discover how they affect the planning process. It also helps to clarify the context and conditions in which the organisation is situated in. This may assist the organisation in finding a configuration that is more appropriate for its environment. Another perspective that is expected to be useful in this study, was the institutional perspective. The institutional perspective allows the researcher to understand what is going on in and around the organisations, as well as shed a light on the institutional environment of the DSO. Thereby, it allows for an evaluation of specific incentives of the organisation, in which it becomes evident why an organisation and its people operate the way they do. The planning process takes place between internal and external actors, in which these actors have specific relationships with each other, as well as defined jobs, roles and motives. These aspects are all driven by certain rules or institutions in which the interactions take place. This is also analysed within the institutional perspective.

4.2 Explanation of the theories

Now that the perspectives are explained, the explanation of the selected theories will be addressed. Three theories were selected, in which their broad outlines and the rationale behind their selection are discussed in the next section. In this the key concepts, assumptions and the variables are presented in more detail, by explaining this it becomes evident how the theories work and operate. Also, the applicability of the theories are discussed in their relative relevance for the research, in which arguments are given for the selection of these theories.

4.3 Images of Organisation

4.3.1 Explanation of the theory

Developed by Gareth Morgan [34], Images of Organisation provides a broad overview of organisational literature in metaphors, which can be utilised as a framework for the analysis of organisations. The framework serves as a tool to analyse organisations, allowing researchers to discuss insights and observations of organisations via comparison between different organisational archetypes (similarities, differences and variations) among multiple metaphors [39].

Images of Organisation uses metaphors to understand the detailed and complex functioning of organisations. The purpose of using metaphors in the analysis is to better understand complex and intangible concepts through simpler and more concrete concepts and alignment with objects [40]. By analysing an organisation through the lens of a specific metaphor, one could gain insights in (part of) organisations, in particular in the dominant values and implicit assumptions of the organisation model which drives organisational behaviour [39]. However, the metaphors come with limitations, as a "way of seeing becomes a way of not seeing" [34]. In other words, the metaphors allow the observer to focus on certain aspects relative to the used metaphors but may ignore aspects that are not covered within its scope. Thus, observing through a specific lens can filter information. Another aspect is that different metaphors produce conflicting insights, the enhancement of a specific insight of one metaphor will diminish insights of other metaphors. For example, the increased need to plan, organise and control, as machine-like aspects, clashes with the notion of a flexible system, an organism-like aspect. To understand and assess the complexities of organisations Morgan stresses the contrasting of multiple metaphors and their interactions for an open and pluralistic approach.

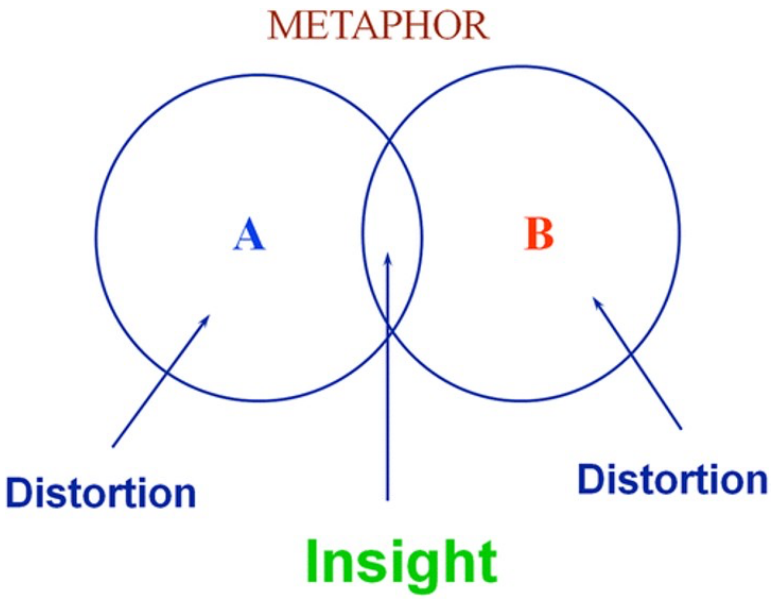

Figure 6: Explanation of a metaphor [39]

The fundamentals of how the metaphors are used in this research is shown in fig. 6. The metaphor uses a notion that "A is B", for example "the organisation is a machine". In this way, a point of reference "B", in this case a machine, is used to understand the point of data "A", in this case the organisation. Accordingly, in the execution of the analysis there will be sought after other machine-like aspects of the organisation. As a result, generated partial truths or insights are generated where the reference point and point of data overlap. These give insights of the understanding of the organisation as a whole [39]. For example, it becomes more clear which processes or characteristics of the organisation resonate with machine-like aspects. And, where those machine-like aspects are located in the organisation. Also, it becomes clear where the two points will differ from each other, in which the organisation is distorted from the metaphor.

4.3.2 Assumptions of the theory

Every metaphor is based on its own assumptions, which are drawn from organisational science. In the operationalisation of this model, a limited amount of organisational metaphors or perspectives will be used. By doing so, the assumptions of these specific theories will be taken into account.

4.3.3 Variables of the theory

The variables of Morgan´s model of images consist of eight organisational forms, with each their strengths, weaknesses and limitations. The metaphors represent the various types of organisations identified in organisational theory and the various perspectives the organisation can be analysed from. These eight metaphors consist of *Machine, Organism, Brain, Culture, Political system, Psychic prison, Flux and transformation and Instrument of domination* metaphor, and will be addressed accordingly.

Machine
The machine metaphor compares the function of an organisation with that of a machine. It assumes an organisation that puts an emphasis on closed systems, efficiency, uniformity and mechanical features of organisations. Such mechanical features include; an inhibition of fast adaptations and adjustments to transformations, clearly defined roles and jobs and maximum utilisation of labour. This results in a reasoning that managers strive for "efficiency, precision, predictability and reliability" [41], with a high need to plan, organise and control. Theories that can be used to analyse organisations via this metaphor are, Taylor's scientific management or Weber's bureaucracy [42]. These organisations fit the ideal-type of a bureaucracy, with top-down direction, detailed rules and regulations. This metaphor and underlying organisational ideal-type thrives in a stable environment, when there are relatively simple and direct tasks to be performed, when the work is repeatable and the employees of an organisation are compliant. A limitation and weakness of this metaphor and accompanying organisational ideal-type is that it ignores the human side of the organisation.

Organism
In this metaphor, an organisation is considered as a living organism. In this perspective, the organisational ideal-type assumes they are open systems with certain environmental conditions that are flexible and readily aligned with their environment. It recognises that organisations are clusters of interconnectivity. This metaphor contradicts the machine metaphor in multiple dimensions but primarily in its focus on human aspects and relations [41]. And can be analysed via contingency theories, which assume that the best course of action is contingent on the internal and external factors of a situation [42]. Thus, it is dependent on a given situation or task what the best decision is, and may include different approaches for different tasks [40]. Survival and growth are important tasks of the organisation, as it is for living organisms, and this depends on controllable and uncontrollable factors. To 'survive´ and ´evolve´ optimised internal processes need to be balanced with flexibility to accommodate the organisation´s environmental conditions [41]. It does inspire managers to create lively organic systems that are receptive to new challenges.

Brain
In this metaphor, the organisation focuses on functions which feature in information processing, distribution of knowledge and learning theories [42]. The ability to question, challenge and change methods of operating makes learning and progress feasible, especially handy in a dynamic world with unprecedented high-speed technology, development and changes[40], [41]. Learning organisations are more innovative and open; they possess the ability to challenge their operating norms and self-organise and self-adjust, focusing on continuous improvement via small, incremental changes in processes [40]. The strengths of an open and adaptive focused view, its ability to self-organise, adapt and develop is offset with its limitation of self-referencing [40], [41].

Culture
The concepts associated with this metaphor are the creation of shared meanings and informal facets of organisations [42]. Reality construction is driven by the acceptance of shared views, norms, beliefs and meanings. The symbolic weight of beliefs, norms, values and understanding of shared meaning among actors is important. The influence on and power over the organisation´s culture by leaders in this metaphor is significant. Within an organisation the culture relates to "a process of reality construction that allows people to see and understand particular events, actions, objects, utterances, or situations in distinctive ways" [40], [34]. Effective organisational change originates from the successful change of views, and values within an organisation. The limitations of this metaphor is that ´span of control´ of management is limited to encouragement, and the shaping of values, norms and beliefs. The actions of the organisation can not be completely controlled.

Political system
Organisations are organised as political systems; a network of individuals with different interests, conflicts and power that influence the activities of the organisation. Theories to analyse organisations through this perspective include stakeholder theories, and distribution of interest, conflict and power theories [42]. As in political systems, a key concept is power and institutional practices of power that are linked to actions implemented in the organisations [41]. A limitation of this metaphor is that it pays little attention to group interests, and often favours authority power.

Psychic prison
This metaphor is organised around unconscious factors such as thoughts, ideas and beliefs of people. Within organisations, these factors may affect people significantly and, if ´employed´, can mobilise constructive change [40]. This metaphor uses psychoanalytical theories to study the psyche, the unconscious, and to examine means of organisations to influence their employees [42]. Managers and leaders can obtain a better understanding of the effects and how to control unconscious factors via this metaphor [41]. The sole focus on the unconscious side can be seen as a limitation of this perspective, and whether the unconscious can be managed within an organisation is questionable [40].

Flux and transformation
The metaphor of flux and transformation focuses on understanding and managing internal drivers of organisational change. This ability, called autopoiesis, can be found in theories of autopoiesis and is linked to factors such as autonomy, circularity, proactivity and self-reference [40], [42]. The metaphor contrasts with the (traditional) notion that change originates from the environment [40]. A limitation is that the metaphor assumes organisations are closed systems and incorporates limited focus on the broader context [41].

Instrument of domination
This metaphor evolves around organisations as tools of domination, where certain people dominate others via a top-down approach. Dominance expresses itself in ¨exploitation and misuse of employees,

institutionalised biases, discrimination and power plays of people in the organisation¨ [34],[41] This is observed in organizations such as the military, governments or even student fraternities [40]. This metaphor is connected to the political system metaphor, but the focus reinforces the moral and ethical dimensions of the use of power [41]. Theories that analyse organisations on exploitation, biases, and unbalanced distribution of power, are connected to this metaphor. The strength of this perspective is to make managers more aware of the issues that play a role in the organisation and allow them to dive deeper into the ethical responsibility they carry in their work [40].

4.3.4 Applicability of the theory

The theory of Images of Organisation gives a multidimensional view of organisations based on an organisational perspective [42]. This research aims to understand the subject of planning in Dutch DSO‘s, and a huge component of this planning is influenced by organisational components. The various metaphors provide an opportunity to recognise which metaphor and associated organisational ideal-types (and thus organisational-theoretical concepts) seem applicable to the case.

The Images of Organisation is applied in this study to better understand the organisation and its organisational problems that are related to the planning processes. It is argued that metaphors help researchers to think and reason about organisations. Because they reflect a new perspective in understanding the reality, where utilising these potential tools can be beneficial in pushing the perception of the researcher [43]. Single metaphors can help to understand certain aspects of an organisation, but they are still incomplete. Instead of incorporating a single perspective when analysing an organisation in this study it is decided to include multiple perspectives, due to the fact most organisations require a set of metaphors to draw a comprehensive picture [40]. The researcher would have applied all the metaphors to the case study to get the most comprehensible analysis and application of the theory. But considering the multi-theory approach, the limited time of this research, and the sheer size of this theory, not all metaphors will be taken into account in the analysis. Thereby, it is argued in a study that the usefulness of a metaphor is depended on two aspects: the degree of relevance considering the subject and the organisation, and the degree of ease a certain metaphor is understood [43]. Therefore, only the considered most relevant metaphors, that can address the organisation´characteristics and organisational challenges with regard to planning in the best manner, are included into the analysis.

Selected metaphors

- *Machine*. The first metaphor that is believed to be relevant is the machine analogy. The machine metaphor is the first metaphor that was incorporated into the Images of Organisations, it is a classic view of organisations that serves as the basis of bureaucratic organisations and scientific management. Due to the fact DSO is a governmental regulated company with bureaucratic elements, in which there is considered to be a high necessity of planning, organising and controlling, the machine metaphor is believed to be suited. Thereby, it is considered that planning is an integral part of bureaucracy and is therefore closely linked with the machine metaphor. Although, the unstable environment of the DSO´s and the influences of the energy transition on the organisation, indicates a need to view the organisation from other perspectives.

- *Organism*. Secondly, in contrast to the machine metaphor the organism metaphor allows the researcher to observe the organisation within the context they are situated in. The necessity for DSO to adapt to the internal and external environmental factors in the operational as well as in the tactical level, underlines the importance to focus on these factors. Also, the emphasis on flexibility and human relations was believed to be a good argument to incorporate this metaphor in the analysis.

- *Brain*. The third metaphor that is perceived suitable in the analysis is the brain metaphor. This

metaphor focuses on processing and learning of information. It is perceived that this will play an increasingly important role in the future. Therefore, this metaphor is assumed to be suited to identify certain organisational challenges that are required to be conquered by the organisation to cope with its current issues. Thereby, the repeatability of certain processes and projects may offer opportunities for DSO to do more with information processing and learning. Moreover, this metaphor is closely linked to certain expectations of the IT-system, this way the challenges around IT may be incorporated into the analysis.

- *Flux and transformation*. Finally, the flux and transformation metaphor will be addressed in this study. This last metaphor is not considered one of the strengths of the organisation, but in terms of implementing changes they may have to grow in this aspect to comprehend the vast changing environment. Also, the aspect of a proactive way of working is addressed with this metaphor.

Not selected metaphors
The reason for not selecting the culture metaphor is that it is best analysed by the examination if the actions of leadership are aligned with the stated values of the organisation. This is assumed to be too far up the ladder when analysing planning. In this research it is more interesting what happens in the operations than in leadership. Moreover, the focus of this study is less focused on the unconscious factors of the employees with regard to planning. But rather tries to uncover the organisational factors that influence the planning processes. Therefore, the psychic prison metaphor is not included in the analysis. Also, the instrument of domination metaphor is assumed to dive in more than required detail about the moral and ethical dimensions of the use of power. However, the political systems metaphor is assumed to be an interesting analogy to analyse specific interests, conflicts and power relations within the planning processes, but the chosen metaphors were considered to be more relevant to shed a light on specific aspects of the process.

4.4 Four-layer Model

4.4.1 Explanation of the theory

The Williamson‘s four-layer model is a framework to analyse complex institutions. Within and surrounding all organisations are social components that engage them with their environment. These social elements that influence them include actors, institutions, laws and policies [35]. It can be complex to understand the interactions and patterns between these social elements, and this model provides a certain structure that helps the researcher analyse the complexity of real world institutions [44]. The term institutions is defined by Ostrom as “the set of rules actually used by a set of individuals to organise repetitive activities that produce outcomes affecting those individuals and potentially affecting others” [45]. Institutions are meant to structure human behaviour with the reason of obtaining specific goals. They offer structures that guide interactions, shape the premise for trust and enable a certain assurance and stability. This way institutions serve as a body of rules that controls, guides and limits the behaviour of actors and their interactions [35].

The four-layer model fig. 7 helps to describe and integrate institutions in a single framework. Specific institutions are identified and positioned at four institutional levels that are interconnected with each other, where the top levels impose constraints on the lower levels, and also the other way around where the lower levels may provide feedback on the top levels [44]. This way the multi-layer model shows the relationship between these levels from top-down and from bottom-up [35]. Williamson distinguished the four levels by three criteria; the characteristics of the levels, the frequency of change and the ´purpose´ of change. The characteristics of the levels will be explained in the next segment when discussing the variables of the theory. The frequency of change signifies the regularity the institutions

in this level change, this ranges from approximately a hundred to a thousand years in level 1 to continuous change in level 4. The ´purpose´ of change indicates the underlying meaning of these changes or how these changes happen over time. So, the purpose of the institutional change of level 1 occurs non calculative and spontaneous, where in level 4 the changes are connected to getting the marginal conditions right.

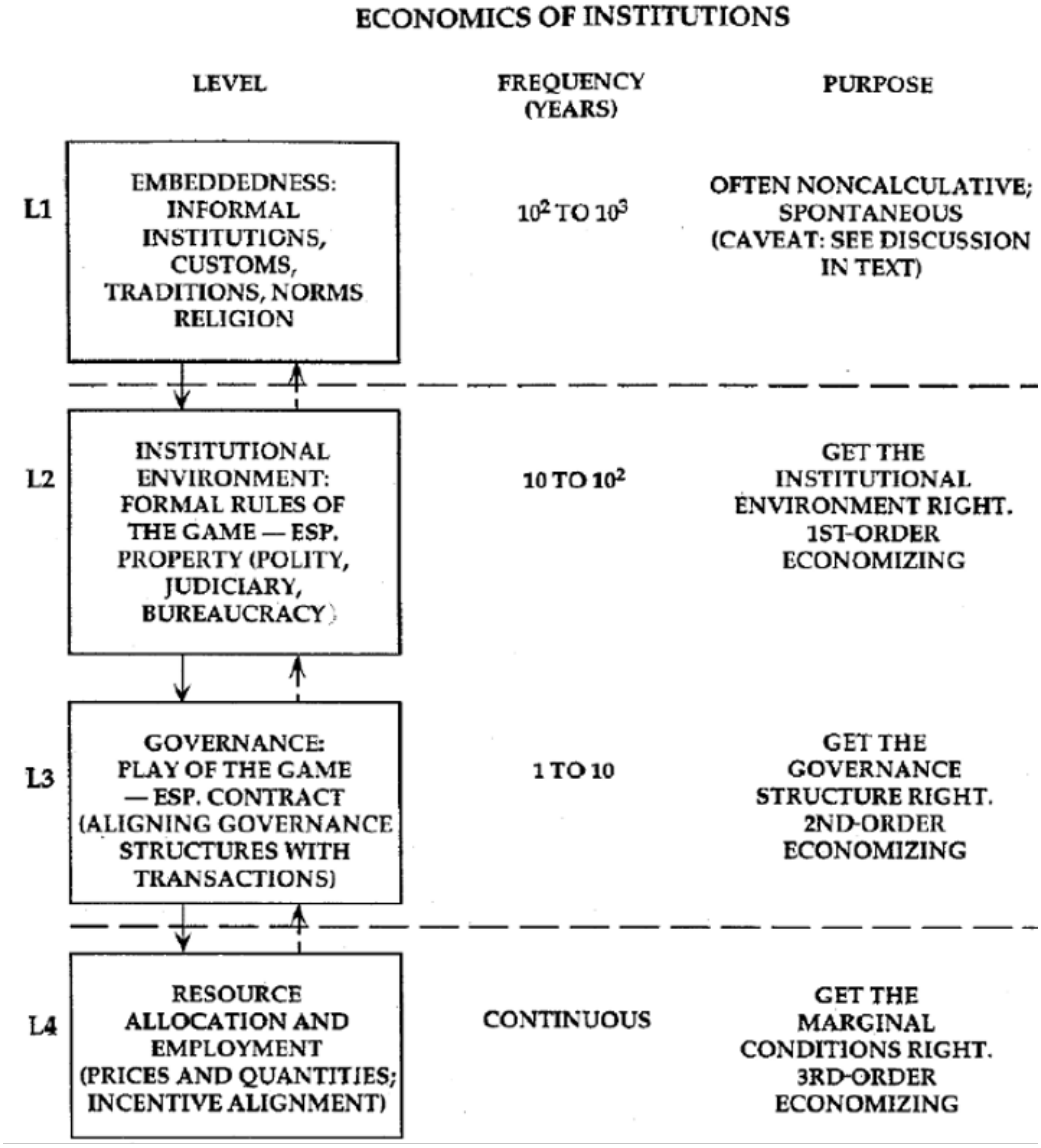

Figure 7: Four-layer Model of Williamson [46]

4.4.2 Variables of the theory

The variables of this model can be described according to the four levels of institutions. The levels of the four-layer model are:

Level 1

The first level is the ´social embeddedness´ level. This addresses the informal institutions that the system experiences; examples of concepts that are associated with informal institutions include values, customs, norms, traditions, religion and culture [46]. This perspective of the impact of these institutions is commonly referred to as ´Original Institutional Economics´ (OIE), which studies the influence of informal institutions on economic and social behaviour [46]. These institutions are usually present

for a long period of time, and the regularity of change is rare, in the order of hundreds of years. The origins of the institutional change mainly appears to happen spontaneously and non calculative. The importance of these institutions should not be underestimated, they can have a great deal of influence on a system. This level often functions as a limitation on the faster moving lower levels with which it has continuous interactions, the same way a brake is slowing down a car. However, the reverse is also true. Bottom-up change can occur through the accumulation of the proceedings of the lower levels. As a result of continuous interaction with the lower levels, this top-layer is shaped and moulded with a great deal of inertia [35]. Because these institutions can become so embedded in a culture or system that it is not necessary to appoint specific rules for them, they are often more descriptive by character [46].

Level 2
In the second level of the model, the formal rules of the institutional environment are addressed. Also, referred to as the ´rules of the game´, this layer includes the formal rules in which the economic activities are organised; such as, property rights, laws, legal rules and constitutions [46]. All of the political, legal and governmental agreements are situated in this second layer [35]. Lengthy periods of negotiations are required to create and shape these formal rules, and the frequency of change is in the order of decades. Occasionally a specific situation, such as a revolution, a financial crisis or a military coup, can lead to a sudden window of change. Nevertheless, these situations are more of an exception rather than the norm. To analyse the influence of the ´rules of the game´ on economic behaviour, theories around the economics of property rights are used. These theories focus on “the incentives and costs of the enforcement of formal rules [46].

Level 3
The third layer of the model incorporates the governance structures of organisations. Also, referred to as the ´play of the game´, which describes the institutions that manage the interaction between individuals [35]. Typical aspects that are addressed in this layer are contract arrangements, such as contract definition and enforcement, and other social agreements based on trust, together with methods of conflict resolution. Through analysing the institutions of this layer it shows the possibilities and the constraints of the agreements between individuals. The agency theory and transaction cost theory are theories that are being used by economists to study this layer. These theories along with the economics of property rights of level 2, form the New Institutional Economics (NIE) [46]. The frequency of change is considered to be between a year and a decade.

Level 4
The bottom-layer of this framework is focused on the economic activities and resource allocation. This layer dives deeper into the operational level, where it deals with the individual forces in play. It takes into account the incentives of individuals that determine and make decisions on prices and quantities, where the emphasis lies on getting the marginal conditions right [35]. The changes felt in this layer are generated in response to the constantly changing conditions (for example of the market), therefore the frequency of the change in level 4 is continuous. The analysis of this layer is presented in the Neoclassical Economics (NCE) [46].

4.4.3 Applicability of the theory

The use of the four-layer model is considered relevant for this study, for a number of reasons. First, the four-layer model of Williamson distinguishes various types of institutions and so aids in the operationalisation of the concept of institutions, which may be considered something of a ‘container term‘ [47]. Second, the model positions the institutions and puts them in a single framework, which facilitates the study and analysis of relations between the various levels [35]. Also, the model incorporates a broad institutional-economic view on analysing the planning processes of the DSO.

With this theory the institutions in the organisation that influence the planning processes or its interactions are identified. In the analysis the underlying institutions will be identified per level and will explain in what way the institutions guide, control or limit the behaviour of actors and their interactions. The four-layer model is used to structure the observed institutions, and used to represent the relations between them. In other words, it consists of a multi-layered model that influences the behaviour and interactions on the different levels. Thus, for example, a formal rule (level 2) is shaped by the cultural views (level 1) of the organisation, and it will also be applied in a certain way with specific governance structures (level 3) which influences what actually happens in the operation (level 4).

4.5 Transaction Cost Theory

4.5.1 Explanation of the theory

Following up on the four-layer model of Wiliamson, the Transaction Cost Theory will be discussed. This theory is part of the third layer of the previous model, which refers to the governance structures and the ´play of the game´. With transaction cost economics individuals can analyse governance structures regarding their generated transaction costs. According to Williamson [48], transactions can be defined in two seperate ways: via a contract or via a physical exchange. The definition of the contractual agreement includes, the negotiated and agreed terms of the execution, conflict resolution and the enforcement between two parties of a contract. The other definition refers to the exchange of a good or a service [48]. The transaction costs are all the costs that are made by agreeing to the contract or in the execution of the exchange. Moreover, a paper that heavily influenced this theory written by Ronald Coase [49] “The Nature of The Firm”, indicates that the organisational structure that incorporates the transaction costs in the analysis shows the optimal structure [50]. In the same way the transaction cost theory opts for an organisational structure that reaches its optimal state of economic efficiency by minimising these transaction costs [51]. The theory suggests that transaction costs arise from every activity that takes place in a transaction between actors. In the early stages of the creation by Williamson, the theory implies that coordination costs were subscribed to just the monitoring, controlling and managing of transactions. Later on, this interpretation is broadened by other researchers through the integration of costs of other activities into the theory, such as, the costs of deciding, planning, coordinating, and negotiating. Also, altering plans, settling conflicts, renegotiating terms are included as costs of transactions [51].

The theory is often used to provide explanation and guidance to individuals to the costs of the transactions of an organisation. Also, it can be used to make coherent decisions if a certain activity should be structured with internal servicing or outsourcing with a market contract, also referred to as make-or-buy decisions [51]. The theory maintains that a company should contract in the market for specialised expertise when doing so is more efficient than keeping it in-house. Another implementation of the theory is as a tool for managers in determining the strategy and for identifying opportunities. It can specify which exchanges coincide with high or low transaction costs, which then can be incorporated into the strategy and decisions of the organisation. Transaction costs are hard to evaluate, but there are certain key attributes that influence the degree of the transaction costs. These key attributes are its frequency of exchange, asset specificity, and uncertainty. These variables all have an effect on the transaction costs, and thereby influences the outcome of the optimal organisational structure. These will be further explained in the variables segment.

4.5.2 Assumptions of the theory

In the understanding of the Transaction cost theory, two key assumptions can be recognised, threat of opportunism and bounded rationality [52]. Both assumptions are linked to the behaviour and actions

of human actors.

Threat of opportunism
The threat of opportunism is attributed to the nature of humans, in which they seek self-interest. This means that individuals act in their own favour instead of doing the things as promised [52]. Even though actors do not necessarily act with negative externalities in mind, opportunistic behaviour increases transaction costs [51]. Inside the organisation there is always to some extent opportunism experienced, due to the presence of humans.

Bounded rationality
Bounded rationality means that actors cannot behave rationally, due to their own limited perspective of their environment. People always experience a form of asymmetric information. Similarly, as the opportunistic behaviour, individuals try to maximise the benefits while acting within their limitations.

On the notion that these two assumptions are always present in organisations, the most efficient economic allocation will never be established. Contracts, or transactions in a broader sense are defined as incomplete due to the bounded rationality and opportunistic behaviour by actors, that results in additional costs for the organisation. But, by organising in a way that conserves bounded rationality and protects transactions from opportunism, added value will be realised.

4.5.3 Variables of the theory

Various studies that operationalise this theory, use different variables. This constitutes that there are different interpretations in the operationalisation of the Transaction Cost Theory. This study uses three variables to describe the transaction costs.

Frequency of exchange
The first variable that will be discussed is the frequency of exchange. This refers to the amount a specific transaction happens. The frequency that a specific transaction occurs between actors, has influence on the transaction costs generated. As the frequency of a certain transaction increases, the transaction costs increase.

Asset specificity
The next variable is called the asset specificity of a transaction. Asset specificity refers to the extent to which assets that are being used for the transaction can be redeployed to “alternative uses and by alternative users without sacrifice of productive value” [36]. In other words, asset specificity refers to specific resources of organisations that contribute to producing or maintaining a strategic advantage [52]. The theory proposes that the organisational structure is most efficient when there are nonspecific assets used in the transactions. Because, if the assets are less idiosyncratic, they can more easily be used for alternatives or by other users. Also, this way assets are in a better position to be standardised and these assets reduce the complexity of the transaction. Simply put if asset specificity increases, the redeployability of assets decreases. Also, with an increase in asset specificity, the bilateral dependency increases. Assets with high bilateral dependency can mean two things; 1) external parties need much adaptability to deal with these assets which lead to high transaction costs, or 2) the involved parties are much dependent on each other which lead to high contracting hazards, or high costs to abandon the transaction and organise it in a different way. Therefore, the theory suggests that transactions involved with high asset specificity are better handled internally, by hierarchical forms of governance. And transactions with low asset specificity would be easier handled by the market [53].

Uncertainty
The third variable of transaction cost theory is uncertainty. This relates to the uncertain context of the transaction, which for example may increase the time, and harden the processes of monitoring and

controlling by an organisation. In other words, to what extent an organisation can not perceive the details of all the conditions of a specific transaction, is represented in the uncertainty. If uncertainty is present in the transaction the organisation is required to adapt to this, in the form of coordinating actions, planning and acquiring information [51]. If the uncertainty rises, the transaction costs increases.

4.5.4 Applicability of the theory

This theory focuses on analysing the governance structures with regard to their generated transaction costs. In this study certain transactions of the interactions and activities around the planning processes within DSO will be analysed, this will provide insights into the functioning and managing of the organisation, and where the actual costs are situated. The transactions will be analysed in terms of how they react to their transaction costs, as well as their connection to the theory‘s variables and assumptions. This study will make use of a simplified version of the transaction cost theory fig. 8. Influenced by [51], [52], [54], in this study the various transaction costs are subdivided into four categories: coordination costs, search and information costs, bargaining and decision costs, and policing and enforcement costs. While the first three forms of transaction costs are known as ´ex-ante´costs, that are costs incurred before the exchange, the policing and enforcement costs are known as ´ex-post´ costs, that are costs incurred after the exchange. The theory is useful because it can reduce the ex-post risks by allowing for ex-ante governance choices. Safeguards can be put in place to prevent actors creating transaction costs when it is clear where and what kind of transaction costs are present in the processes. Here below is the simplified version shown of the transaction cost theory, as how it will be used in this study.

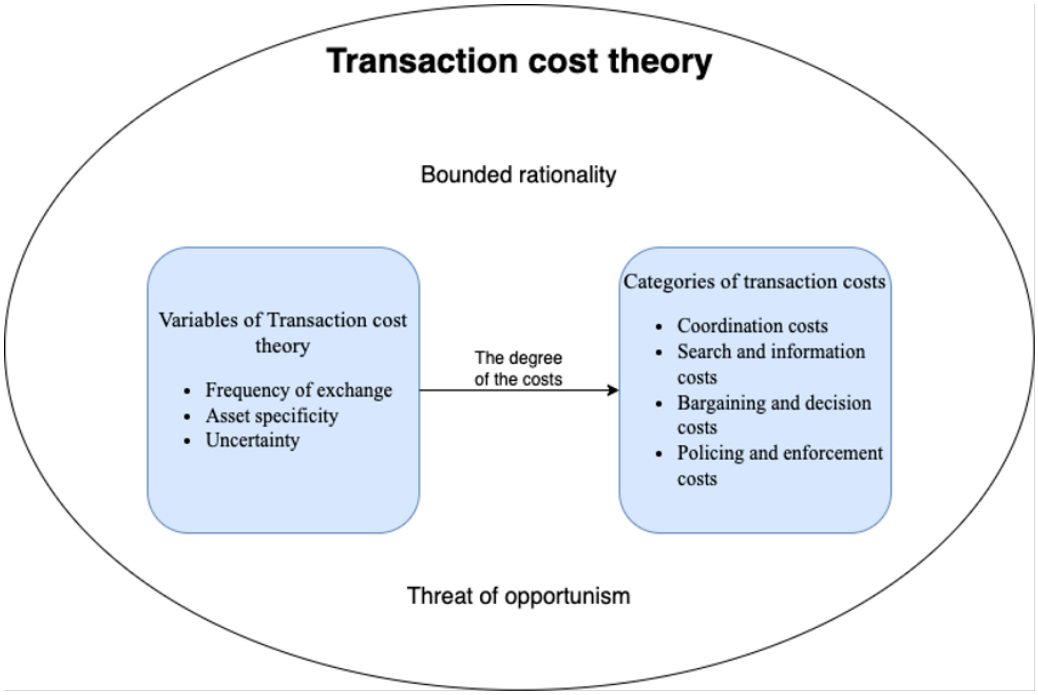

Figure 8: A simplified version of the Transaction Cost Theory

Specified transaction costs
In this section the transaction costs are described in detail[51], [52], [54].

- *Coordination costs*. This refers to the transaction costs made with the coordination of the transactions such as; monitoring, controlling, communicating, planning and managing transactions. Also, maintaining an administrative apparatus is included into this category.

- *Search and information costs*. This refers to the transaction costs that are accompanied by the effort and resources that are used in order to initiate an exchange. This will include the standardisation of processes and the usage of data.
- *Bargaining and decision costs*. This refers to the transaction costs that handle the effort and resources spent on negotiating and deciding terms between both parties of the exchange. This can be between internal and external parties.
- *Policing and enforcement costs*. This refers to the transaction costs made by monitoring quality and evaluating the exchange. Other examples that are included into this category are the costs through the violation of agreements, resolving conflicts and altering plans.

4.6 Construction of the analytical framework

The aim of the analytical framework is to identify, understand and analyse the planning challenges and its influential factors and interactions. In the analytical framework the links between the various concepts and elements become clear. Also, the framework can substantiate the data that is generated from the interviews. The framework is a sum of the perspectives that are considered to be important for the researcher to take into account. There is a diabolical dilemma in this, because ideally one put in as many perspectives as possible, but the more perspectives are included into the framework the more difficult and complex it gets, and it becomes more and more unmanageable. So, it is important that the researcher finds a balance in this, and makes certain choices. Eventually, the analytical framework includes four metaphors of the images of organisation, the four-layer model, and the transaction cost theory.

In fig. 9 the construction of the analytical framework is shown. In the research three main areas of importance are recognised to have a connection to the challenges and factors of the planning process of the DSO. Or influence on the interactions, activities or behaviour of actors of the process. These areas consist of the organisational, institutional and external area. In this study, only the organisational and institutional aspects are included due to the focus on the internal organisation, the limited time, and size of the subject. Although, by analysing the organisational & institutional aspects in this study certain interactions and activities with external actors are uncovered, but the external side of the subject is still underexposed. As seen in fig. 9, the images of organisation model analysis the organisational aspects, and the four-layer model and the transaction cost theory analyses the institutional aspects. In this the different perspectives are complementary to each other.

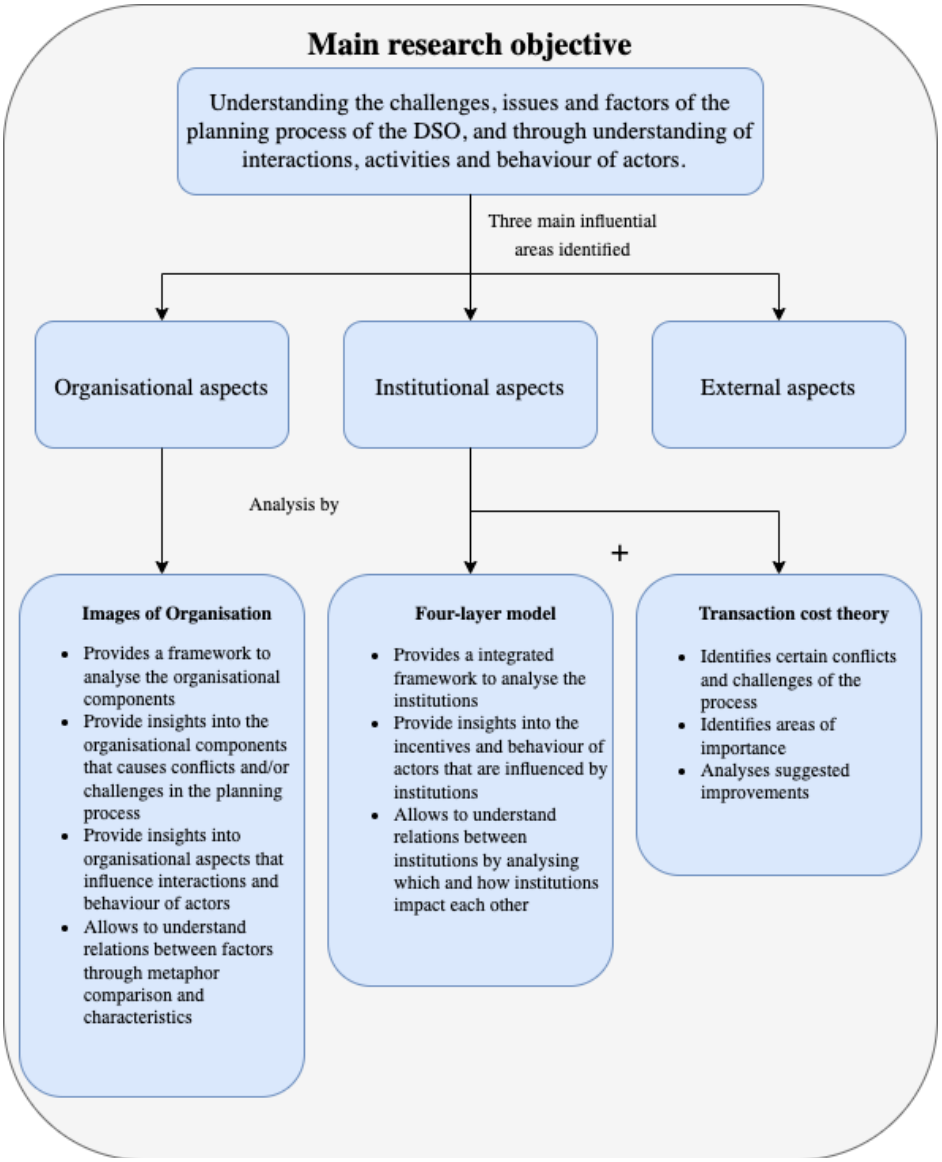

Figure 9: The construction of the analytical framework

Firstly, the images of organisation incorporates different ways to view and analyse the organisation. It allows to understand the organisational components that influences the planning processes. Due to its broad view on the subject, it is assumed that this theory will identify a large amount of factors. And, by identifying specific conflicts it can more easily detect the challenges of the process. The machine metaphor will analyse the organisation's bureaucratic elements. Also, because this metaphor is assumed to be closely linked to planning, it is expected to provide significant insights about influential plannings factors. The organism metaphor will analyse the organisation with special attention to its contextual factors, in which it takes the whole process into account. The brain metaphor will focus on the aspects of the planning process that are connected to data processing, the IT system and other informational aspects. The flux & transformation metaphor, just as the brain metaphor, focuses on a specific aspect of the planning process. In which the ability of organisational change and proactive working environment are its main focus areas.

Secondly, the four-layer model will be used to structure and analyse institutions of the organisations, which is expected to provide insights into the rationale of behaviours of actors and the organisation as a whole. It also will be used to identify and analyse the relationships between the various institutions. Lastly, the transaction cost theory will be used to analyse certain interactions that deemed important

for the planning processes in terms of their costs. It is expected to provide insights into the rationale of the use of these interactions. Also, may provide insights in certain conflicts and challenges of the process. And, may also make clear which activities generate significant costs and may be in need of an organisational change. By aligning the institutions, and analyse its interrelations and activities, it will become clearer how and why the organisation acts the way it does. Which in turn can be used to generate more precise solutions for the perceived challenges.

In the end, the used theories will generate and analyse the factors that influences the planning processes, will provide insights into the challenges, and derive certain solutions to cope with the perceived challenges.

In the next chapter the observations and findings of the case will be addressed.

5

Case study: DSO

Given that this study is trying to understand the challenges and issues of the current internal planning processes and its interactions of the Dutch DSO, as mentioned in sec. 3.1 a case study is carried out to examine this. In this chapter the findings of the executed case study will be addressed. First, the arguments for the selection of the case will be explained. Then some general information is given to introduce the case subject. Then all the observations of the gathered data from the interviews and the desk research are addressed according to five categories. Finally, the planning´s factors found in the data will be reflected on.

5.1 Case selection

Case selection is an important process for the researcher, because it establishes an agenda for the examination, which implies that case selection and analysis are inextricably linked. In this segment several arguments will be addressed to narrow down and select a case to be studied.

There are seven Dutch DSOs and three of them (Liander, Stedin and Enexis) are responsible for nearly the whole energy distribution of the country, about 93% of the market according to Netbeheer Nederland [24]. In the study [32], the aspect of influential is important, that refers to cases that include many of the influential arrangements of the independent variables. With regard to the perceived challenges around planning and the national importance of the topic in light of the transition challenge, only the three largest organisations are considered. Although, due to limited time and added value of acquiring more in-depth understanding about issues encountered in one organisation over more information about the challenges they all face for this research, only one of these three organisations is chosen for the case study. A reason the study focused on a specific DSO was due to accessibility at this specific organisation. In the same study [32], the aspect of accessibility is considered a legitimate factor in case selection. With regard this thesis, it is executed in collaboration with Accenture. Accenture is an enormous company that has many clients and partners, including DSO. Because DSO and Accenture are closely working together, these organisations are well connected and this allowed the researcher to contact DSO‘ employees directly, interview some of them and obtain a comprehensive view of the internal processes and functions that were considered to be of importance. DSO is responsible for a big part of the North of the Netherlands, including Groningen and Drenthe, and the South, including Noord Brabant and Limburg [55]. These parts contain large rural areas which makes these parts of the country appealing potential construction zones for solar parks and wind parks to be built. The capacity of the grid in these remote areas is often insufficient and requires vast expansions to transport the energy generated in these locations to the locations where the energy is used. In 2030, approximately 50% of the total national climate targets for sustainable energy generation on land must be achieved in the area managed by DSO [20]. Therefore, it is assumed that the identified challenges around planning do much apply in the case of DSO.

5.2 General information of DSO

DSO is a regional distribution system operator, operating in the provinces of Groningen, Drenthe, Overijssel, Noord-Brabant and Limburg. DSO has a central role in the energy chain. In which all energy, both fossil fuels and sustainable generated energy produced on large and small scale is combined in their regional distribution grid. DSO is responsible for the energy supply of more than 3 million households and companies [12]. They are contributing to themes that are relevant in the light of the Dutch climate goals and that are related to the energy infrastructure and transition. In 2020 and 2021 DSO invested respectfully a record amount of 734 and 959 million euro in its distribution network; in the form of replacements, maintenance and expansions of the grid [12], [20]. This way the company is attempting to maintain a high level of reliability and security as the energy transition continues to place increasing demands on the organisation. Also, safety is paramount for DSO in all circumstances, including for consumers, businesses, employees and contractors [20]. To maintain the security, safety and reliability of the grid among other reasons, the workload of the organisation grows. In fig. 10 is the workload of DSO presented. It shows that the workload has undergone a steady increase in recent years, and it is expected that this will continue in the coming years [20].

Figure 10: Workload of DSO 2016 - 2021 (2021)

Despite the enormous investments in the grid, the number of bottlenecks in the electricity grid still increased [20]. It is even considered that the bottleneck of the energy transition may lie at the productivity of the DSO's, because of the insufficient capacity and the enormous workload of these organisations [1]. For example, there are project developers of solar parks that are required to wait a long time, two sometimes even three years, to get connected to the grid. Furthermore, it wants to make conscious choices with regard to sustainability as an organisation. Also, in order to keep the energy transition feasible and affordable, the organisation aims to take another step forward in terms of working efficiently and limiting costs [20]. The DSO has worked for a long period of time in a steady and stable market, the current problem is that they are being overtaken by the described trends in the market. This is the reason for the DSO to organise their processes differently, to make the company more future-proof [1] [2]. According to respondents, the DSO´s will not be able to tackle the workload

[1] Interview with JD

[2] Interview with JT

efficiently with their current set-up and are compelled to make several changes [1] [2] [3].

5.3 DSO case

The case study data regarding the planning issues that are observations and their possible implications will be presented via various challenges and problems that are experienced by the DSO and its employees report on in documents and in the interviews which were conducted. These findings are categorised into five groups: Organisation, Rules & Regulations, Actors, Process and Planning. This will also be the structure in which these observations will be addressed.

5.4 Organisation

DSO has always operated extensively in a stable market. The workload is increasing with regard to the energy transition, therefore planning is becoming increasingly important [3]. In the data several aspects about the experienced issues or other influential factors of the organisation with regard to its planning capabilities are identified. There are two main areas of importance recognised within the internal organisation, one is focused on the personnel and the other on the organisation of DSO.

5.4.1 Personnel

The rising demand for projects in light of the transition challenge and the increased requirements for maintenance and replacement that come with it results in an increasing pressure on available resources. On the personnel side, DSO is finding it increasingly difficult to maintain and recruit employees to cope with the work. Despite the fact that DSO hired more than 400 employees in 2020 to manage the increasing workload, there is still a short supply of personnel [12]. In particular, there is a shortage of technically schooled personnel on the job market which affects both the DSO and the contractors who work for them. In addition, the ageing of the employees has a significant influence in these professional groups. In fig. 11 it is represented that 2121 of the 4947, which coincides with approximately 43%, of the current workforce is above 50 years. In the coming years, it is expected that this will result in a large outflow of technically schooled personnel, exacerbating the current staff shortfall. This poses a serious threat to all plans DSO wishes to implement in the coming years [5] [56]. Thereby, it is claimed that there are pressing limits to which the capacity of internal and external parties can be scaled up [34]. Also, is it likely that the ongoing pandemic through an increase in sickness rates among employees, temporarily adds to the shortage of personnel [12]. DSO is aiming to absorb the effects of limited resources by implementing new processes that are more efficient and effective, as well as improve its ability to predict its own capacity [12].

	Man	Vrouw	Totaal
Leeftijdscategorie			
onder 30 jaar	431	89	520
30 t/m 50 jaar	1.841	465	2.306
boven 50 jaar	1.694	427	2.121
Totaal	**3.966**	**981**	**4.947**
Percentage	80,2%	19,8%	100%

Figure 11: Reflection of the workforce of DSO [12]

[1] Interview with JD
[2] Interview with JT
[3] First interview HD
[5] Interview with JB
[4] Interview with DC

5.4.2 Organisation

To better understand how DSO copes with the transition challenges, it is important to also note the organisation´s actions and beliefs, and its key goals and company values. It is important to understand that the transition is not identified as a goal in itself. In its Investment plan [57] DSO identifies five strategic goals which it aspires to, while coping with the energy transition.

- The networks and services are ready for changes in the energy world in a timely manner
- The energy supply is reliable
- The service is excellent, resulting in high customer satisfaction as well as cost reduction
- Together with local initiatives and partners, they realise the Dutch governmental goals regarding sustainable generation and energy saving
- They realise innovative scalable solutions that will lead the transition to a sustainable energy supply.

DSO seeks to attain the strategic goals via its own company values, which emphasises a systemic perspective which is in the interests of all involved stakeholders. The six company values that are mentioned are [57]:

1. *Reliability*, which refers to the ability of DSO to offer an uninterrupted supply of electricity and gas.
2. *Safety*, the extent to which employees, contractors and the general public are exposed to hazards to their lives and health as a result of DSO´s actions and/or infrastructure.
3. *Legality*, the extent to which DSO complies with applicable laws and regulations.
4. *Affordability*, how well the asset owner achieves his or her financial goals.
5. *Customer satisfaction*, refers to how satisfied customers are with the actions and/or performance with DSO.
6. *Sustainability*, the degree to which DSO´s behaviours and business operations impact social CO2 emissions or other environmental equivalents.

The changing environment of the energy transition required the DSO´s to change with them. But, some organisation characteristics are making it harder to make this internal transition. It is argued that the DSO´s are mature, conservative and highly regulated organisations, where it is hard to implement changes in the behavioural protocols of the employees [13]. Thereby, the institutions around the network operators are based on the old reality and are considered to be in much need for a reconfiguration, this will be elaborated in sec. 5.5 [36].

5.4.3 Working activities

There are two main working activities identified within the organisational department of the DSO which is responsible for construction of the grid. The organisation identifies; internally driven and externally driven work. These will be elaborated in the next section to provide a better understanding of the activities of DSO.

[1]Interview with JD
[3]First interview HD
[6]Interview with MB

Internally driven work
Internally driven work within the organisation of DSO is commissioned by the Asset Management department within the DSO. Characteristic of the type of work Asset Management commission, is that it mainly revolves around the aspect of safety. In other cases the internally driven work is connected to maintain the security or reliability of the network. Internally driven work includes grid maintenance such as grid replacements, improvements and expansions. Internal driven work is argued to be much more predictable than external driven work, because the durability and maturity of the network is known, therefore the risks are known [3]. Predictability refers in this case to the knowledge of the workload one needs to have to ensure safety, security or reliability. DSO often predict quite far in advance what they are required to produce for internal work. As stated by a respondent[3] they have a predictability time horizon of about 2 years. Furthermore, the internal work also allows for relatively more time to do the work as the safety-driven consideration (i.e. risk-driven nature) is based on an annual planning. It does not matter when the branch does the work, as long as they get it done sometime in the year. The annual order book to the different branches, that contains all planned changes to the network for the coming year, is supplied by Asset Management. The energy transition has not a direct impact on the amount of internally driven work. Although, due to the intermittency of renewables and higher pressure on the distribution network, which leads to voltage violations, results in a faster deterioration of the existing network. Also, an increase in external driven work will result in an indirect increase of required supporting internal work.

Externally driven work
External driven work, or customer driven work, is executed on the specific requests of customers such as individuals, companies or municipalities. Here the impact of the energy transition has had a direct impact on the work of this part of the organisation. While the internal driven work is affected in an indirect manner. The external driven work is harder to predict [3]. Although predictions for this type of work are made, this has a considerable higher degree of uncertainty than internal work. With internal work there is simply a file present that states when something within the grid needs to be replaced or improved and this generally does not change during a year [3]. External work has a different dynamic which increases the pressure on planning procedures. As is mentioned in the rules & regulation segment, the DSO must provide the customer with a connection to the grid within a certain period of time. This strict connection regulation in which the customer has to be connected to the grid within 18 weeks, does not apply to the internal work. Also, it is stated that considering the notion of "one would rather argue with a colleague than with the customer", the internal work is more easily rescheduled than the external driven work. Asset Management is inclined to commission the internal type of work relatively early, where for complete certainty it will be handled long before safety will actually become an issue. But because internal work is pre-emptive, there is little incentive for the operational department to get started with it, especially if they have a lot of other (customer) projects running with tight deadlines and more pressure. Though at a certain point safety can become an issue, then Asset Management will intervene and orders that the internal work can not be rescheduled any more, and action must be taken by the operational department [36].

Combining internal and external driven work
As we have seen, the internal and external driven work cannot entirely be seen apart. For example, as a result of a specific external driven project, the supporting grid on location has to be reinforced. This way the request of one external project leads to an extra internal driven project. So, because there is an increase in external work, there is also an increase in internal work. This situation is best to be explained using a metaphor. The electricity network can be seen as a heart and all the veins in the human body. In the classic situation there is a central power plant, in this case the heart, which is connected to the high voltage grid, the large veins that are connected to the heart such as

[3]First interview HD
[6]Interview with MB

the aorta. The connections of the consumers are the very thin veins on the tip of the finger. The energy transition is making changes to this classic view of the energy system. Instead of one large power production plant, there are several smaller fragmented plants. In the case a wind or solar park is placed in a more rural area, it can be compared if a second heart is placed on the tip of the finger. Then those thin veins cannot handle the production there. So it is required to increase the capacity of the veins to cope with this change, so that the production on the tip of your finger can start pumping blood to the rest of the body. This is noticed in the network of DSO´s, where a solar park is often connected to the grid of the DSO instead of the TSO [2]. Thus, it may start with an external driven project, but the local network should therefore also be expanded to cope with this external project.

The energy transition mainly creates more scarcity, which results in more conflicts in the planning and requires the organisation to make more choices [1] [2].

5.5 Rules & Regulation

In the rules and regulation, the institutional environment in which DSO is located is described. This determines requirements as well as the limits of the planning processes of the system operator. This section explains the laws and regulations of both the current and proposed legislation, and of the regulated context and its implications for planning.

5.5.1 Laws and regulation

The DSO´s are situated in a regulated working environment, where the ACM monitors and ensures that they act within the allowed restrictions. Considering operational and tactical planning, there are only a couple relevant regulations identified. One of the difficulties is that the reshaping of the energy world of tomorrow is realised within a regulatory framework that respondents and planning documents widely consider outdated [36] [12]. The current legislation of the network operators is designed on the basis of a stable environment. The regulations from the "Elektriciteitswet" (1998)[15] are no longer argued to be appropriate for the current needs of the DSO [12]. Although some alterations have been made to this agreement, the basis of the current legislation is more than 20 years old. Therefore, there are talks over a New Energy Act. The new bill is submitted to ACM for review, and still has to be approved by the “Ministerraad”, followed by the approval of the “Raad van State”. It is then expected to be sent to the Parliament in the first quarter of 2022 [58]. The goal of the New Energy Act is to put European legislation, as well as national climate agreements and other policies, into effect. Netbeheer Nederland [59] claims that the New Energy Act is decisive for the DSO´s in facilitating the major changes that the energy transition entails. In the proposals for the New Energy Act, several changes are made that are relevant considering the planning processes and the activities around it. The next segment will describe relevant changes of the New Energy Act, while addressing the current situation.

- At this moment the principle of “first come first served” for customer driven projects applies to ensure non-discrimination in application for projects. This means that a request for example for a new connection of a data centre that consumes a lot of energy has to be accorded the same priority as a residential neighbourhood or a solar park. New legislation aims to provide solace in allowing DSO´s to rank projects and make choices to determine whether homes, companies or data centres are given priority [58][60]. This provides more room for prioritisation in the planning, which grants the DSO‘s to make better augmented choices. For example, it allows them to give sustainable projects precedence over other projects.

[2] Interview with JT
[1] Interview with JD
[3] First interview HD
[6] Interview with MB

- In the current regulations there is an unconditional obligation for DSO‘s to connect anyone who requests a connection. Currently, an offer to construct a connection can only be rejected under the law in case the DSO can successfully claim it has insufficient transport capacity in the grid. The resulting unconditional obligation to provide capacity can lead to circumstances where parties require far more transit capacity than is physically available, resulting in untenable situations. In the new Energy Act a reassessment is considered with regard to this right to a connection [58][60].
- There will also be a reassessment of the maximum connection period. The current maximum term for connection is 18 weeks, but in many cases this appears to be inappropriate and in some cases technically infeasible. This will be replaced by ´a reasonable period of time´, which should provide DSO‘s more flexibility in their planning and relieve them from some pressure and lawsuits of customers. What the alleged ´reasonable period of time´ will be is not yet defined [58][60].
- It is stated that the current legal framework already provides the characteristics that make for a favourable investment climate. Where it should be noted that neither the Electricity Act (1998), nor the new Energy Act contain any barriers to TSO and DSO’s implementing proactive or anticipatory investments. Nonetheless, the possibilities for proactive action depend on the availability and accuracy of data about the spatial development of the electricity supply and demand, as well as the forecasting capabilities that contain the ability to understand and make sense of the data (The New Energy Act). Finally, it should be noted that the ACM has examined to what extent it is necessary to make revisions to the regulatory method in order to stimulate more proactive actions. The ACM presented stakeholders with a number of changes but these were not implemented due to a lack of support from them, and DSO’s have stated that the legislation is not the bottleneck of the proactive investments [58][60]. Although, one aspect of the current legislation is argued to limit the institutional room to act proactively. The DSO must be able to justify the money it invests in the grid, and therefore invests the public money with little risks[4].

5.5.2 Regulated context

Besides the legislation, the respondents mention several aspects that accompany an organisation in a regulated environment [3678]. The working activities of the DSO‘s are regulated activities. The regulated nature of DSO results in a culture of rules and regulations, and translates into various operational related obstacles to realise a project [37]. The organisation is required to comply with many procedures laid down by law. First of all, planning and permit procedures around the activities with the municipalities requires an explicit interplay between among others local governments, market parties and DSO. The often long lead time of permit applications can seriously slow down the accelerated expansion of the grids [56]. If something changes in a project due to its uncontrollable factors, you often have to make another permit adjustment which results in another long permit application[3]. This may distort the planning in the process, and results in less insight in the required activities and workload. It is even mentioned that the permits and requirements set by municipalities are increasing in numbers [8]. Also, the DSO is required sometimes to work with bureaucratic organisations such as the Raad van State which increases the lead time even more [3]. They are supervised by the ACM, who monitors the business operations, to assess whether the DSO complies with the rules and regulations. Therefore everything must be recorded well, including their bookkeeping. And because the

[4]Interview with DC

[3]First interview HD
[6]Interview with MB
[7]Interview with FO
[8]Interview with JE

DSO´s are semi-governmental, regulated companies, they are fearful to come in a publically bad light [6].

5.6 Actors

Contributing to the understanding of the planning processes is to map all the relevant actors. What are their roles and jobs, and what is their relationship to each other. First an overview of the relevant actors is presented. Then, a description of these actors is addressed.

Actors

Department	*Actor*	*Role*
Internal: Engineering and construction	Engineer	The engineer is the project leader, is in charge of the technical design and progress of the project.
	Preparator	Prepares everything that is needed to complete the project
	Executor	Executors are responsible for the execution activities, such as collaborating with the contractor and monitoring the production progress on the project.
Internal: Workforce management	Short term planner	The short term planner is responsible for the planning and prioritisation of the construction projects on the operational level.
	Mid term planner	The mid term planner ensures that the tactical planning is concretely coordinated within the operations.
	Workforce manager	The workforce manager ensures that the capacity can match the workload on a tactical level.
Internal: Asset management	Asset manager	The asset manager commissions the internally driven work and monitors the progress of these projects in the operations.
External parties	Contractor	The contractor carries out the work of the project in the field in collaboration with the internal executor.
	Customer	Externally driven work is commissioned by the customers.
	Municipalities	The municipalities are mainly a permit issuing entity.
	ACM	The ACM is the supervisory authority and has the task of assessing whether the DSO complies with the rules and regulations.

Table 1: An overview of the relevant actors of the tactical and operational planning processes of the DSO

5.6.1 Internal functions

In the internal organisation there are three departments recognised; Engineering and construction, Workforce management and Asset Management. Within these departments there are several internal functions linked to them. First the departments are discussed to better understand the motives of the employees, because it is assumed that the employees are largely guided by their department‘s incentives. Then the several functions are elaborated.

Departments
Engineering and construction

[6]Interview with MB

This department is responsible for the engineering and execution of the projects, in which it handles executive decision-making in the operations. This department focuses on the operational planning, in which the realisation of the internally driven annual order book as well as the externally driven requests of customers is managed. The internal functions that are connected to this department are; engineer, executor, and preparator.

Workforce management
This department watches over and controls the engineering and construction department. This section is responsible for the guidance of the planners. It also ensures the quality of the planning and guarantees that relevant consultations are held. The workforce manager, mid term planner and short term planner fall under this department.

Asset management
This department is trying to prepare the organisation for the future, with regard to the developments in the environment and considering the objectives and expectations of stakeholders [61]. Asset management is responsible for developing strategy that optimally achieves the objectives of the stakeholders. This strategy is determined in the annual order book of the branch, this consists of all the yearly internally driven work that is needed to be carried out. Asset management is also identified as the internal customer. In addition, it ensures adequate outsourcing to the engineering and construction department and monitors the progress of the commissioned work [61]. The asset manager is the function that is connected to this department.

Functions
Engineer
The engineer, who is also the project leader, is ultimately responsible for the project to deliver it on time in accordance with the determined and agreed deadlines. The engineer plans on the content within the project, is in charge of the project´s technical design and progress, and is financially responsible for the project budget and realised costs. The technical design provides insight into the required permits, characteristics of the project, coordination aspects that coincide with when the customer is ready to be connected, material lead times, soil reports and other lead time connected factors [3]. The engineer is accountable for the time, money and quality of the project. With short-term planners, the engineer coordinates project prioritisation. And they take responsibility for maintaining and communicating accurate data quality so planners can plan effectively [9].

Preparators
Complete preparatory activities, such as ordering of the required material and applying for permits at the municipalities, in accordance with the deadlines set in the plan system (Flux). Prepare everything that is needed so that the executors and contractors can start working.

Executors
Executors are responsible for the execution activities, such as collaborating with the contractor and monitoring the production progress on the project. They ensure that contractors meet the agreed dates on time and are responsible for the physical inspection in which the activities on location of the project will be explored in advance. This is one of the job functions where scarcity occurs. So there is an idea that the executors can be divided into a civil and a technical executor. Civil executors focus on excavating the cables and the technical executors focus on the assembly work. Civil executors are easier to attract, so by dividing these functions civil work activities can be removed from the technical side, which will decrease the pressure on their workload[1].

[3]First interview HD
[1]Interview with JD

Short term planner
The short term planner determines which employees will be designated to specific projects. The planner function shifted more to a work divider, which manages the entire workload, and how it is distributed fairly among employees. Previously, the planner was more concerned with the daily schedule of the employees. The short term planner is responsible for the planning and prioritisation of the construction projects on the operational level. This function also has to deal with last minute shifts in the operational planning [9]. It is the responsibility of the short term planner that decisions are made across projects, also, in case of a planning conflict. For example, if there is insufficient capacity the short term planner advises the branch management team on which decision should be taken. The management team then actually makes the decision[3].

Mid term planner
The mid term planner works closely with the short term planner to create support for the operational planning of the construction projects. In addition, it ensures that the tactical planning is concretely coordinated within the operations. Also, the mid term planner monitors progress of the annual order book and reports the findings to asset management. This function also advises the manager on personnel and services bottlenecks [9].

Workforce manager
The workforce manager plans on their personnel, such as engineers, planners, executors and contractors on a tactical level. It makes sure that the capacity is matched with the workload. This function overseas whether employees are productively deployed, the workload is manageable, and the right projects being worked on through prioritising. The data used by the workforce manager is focused on budgets and other financial units. Workforce manager plans at the level of a year to two years [3]. All short-term and mid-term planners are supervised by the workforce manager[6].

Asset manager
The asset manager ensures that the internally driven work is fully and timely assigned through the Flux plan system to workforce management. This function monitors the progress of the internally driven work in collaboration with the mid term planner [9].

5.6.2 External parties

Although, the expectations and ways of dealing with external parties differ amongst branches. The responsibilities are not necessarily different, but the interpretation of the roles are. Therefore, in this section a generalisation of the most important external parties will be discussed.

Contractor
The contractors are responsible for the excavation work, but could also be involved in the assembly work. This party actually carries out the work of the project in the field in collaboration with the internal executor. The contractors are closely involved with the process, and on various occasions they are contacted by the internal executor.

Customer
Externally driven work is commissioned by customers, so every project has its own customer. The coordination around planning is different for customer driven work, because DSO also needs to coordinate the planning with the customer and update them along the way. A part of the connection has to be handled by the customer, which is an additional dependency of a specific project. Currently, there is tension with customers with regard to the increasing lead times. In addition, they have a legal ground to be dissatisfied because the maximum connection time is 18 weeks for customer driven work

[3]First interview HD
[6]Interview with MB

which is almost never achieved. By maintaining customer contact, the organisation is increasing its transparency and understanding.

Municipality
In the construction of the projects the DSO are obligated to work with the relevant municipality. With municipalities the organisation is dependent on the local board, some municipalities are hard to work with and others are very cooperative and considerate. This refers mainly to the compliance with the issuing of permits. The permit process can take a long time, and can therefore influence the lead time of the whole project. Here too, the role and responsibilities of the municipality do not differ, but the interpretation locally is different which may require a different attitude towards different municipalities.

ACM
ACM monitors the business operations of the DSO´s. It is the supervisory authority and has the task of assessing whether the DSO complies with the rules and regulations. This organisation also examines if DSO makes reasonable investments as described in their investment plan. It checks whether the DSO makes a logical inventory of the bottlenecks and risks involved, and how the DSO wants to deal with them.

5.7 Process

This part will be used to better understand the execution of the operational process of the construction projects. This way it will be easier to comprehend the interactions between the various internal functions and external parties that are part of the operational process. And, provide also a better understanding of the activities of certain actors in the operational process. The process will be described according to the different phases it abides.

Phasing of the operational construction process
Phase 1: Intake phase
The request of a connection is received by the short term planner, which often mentions a delivery date by either the internal asset manager or the external customer. The short term planner will tie a certain workload to the project based on experience, and will look for an available engineer. The short term planner determines a fictitious start date and generates deadlines along the way. The planner assigns projects to engineers on the basis of the priority and availability [3][9].

Phase 2: Engineer phase
Then it will be handed to an engineer. The engineer will then consider several questions regarding the project´s technical design, for example: In what kind of environment does the project take place, what kind of design am I dealing with, what permits are required? The engineer refines the estimated workload, deadlines and start date determined by the planner. The engineer makes an estimation of the amount of days needed for the execution of the project. At the end of this phase the planner will perform a capacity assessment that validates the capacity that is required for the project. Here, the capacity and the workload will be matched and the project will be planned [3][9].

Phase 3: Preparation phase
After the engineer phase it goes to the preparation phase. Here the work is taken over by the preparator. In which the preparator will apply for the permits, order the materials and deliver all the work that needs to be prepared for the project[3].

Phase 4: Execution phase

[3]First interview HD

In the execution phase the project is actually getting executed. In some locations the contractor takes over, in other locations the internal executor has a more prominent role. The estimated execution days by the engineer will be refined in the physical inspection to a more specific amount of field work days. This is carried out by the executor and the contractor, and sometimes with the municipality. Subsequently, the project is executed, in which the digging can begin. During this the short term planner maintains contact with the contractor or executor, and monitors the planning of the project to make sure the latest information is included in the planning. In the end of this phase, the connection to the grid has to be made, which must be coordinated with the customer[3].

Phase 5: Completion and evaluation phase
In the last phase the project is completed and delivered to the customer. Certain administrative tasks remain and it will be checked whether the budgets have been adhered to in the evaluation. The evaluation is primarily used as a financial review of the project. Where the engineer looks if there are financial differences between what is estimated and what is actually spent. If there are major differences the engineer is required to explain this [38].

5.8 Planning

5.8.1 Planning within DSO

Planning entails assessing and understanding the goals as well as the methods for achieving them. It is a strategy for deciding what needs to be done and why. It may assist users in achieving their objectives and allow them to make better use of time and other resources. This segment will discuss the subject of planning within the organisation of DSO.

Planning is not equally important for every business and industry. If planning is part of the core business of an organisation, then this aspect will be generally further developed. For example, for a commercial logistics company, planning is very important and is part of its core business. By planning better it can have an edge over its competitors. In the case of DSO, planning is not one of its core businesses, in the past there even was little attention to planning in the organisation [1]. Planning revolves around making choices, but because there was almost never an imbalance in matching capacity and workload, there was less incentive to plan efficiently and invest in planning. It was more important that things happened properly and safely, rather than other objectives like speed and efficiency. Although the urgency has changed with regard to the energy transition. This increased the imbalance and thereby the importance of planning [12]. Looking at the strengths and advantages of planning, this will assess the significance of the subject planning within the borders of DSO. In the planners guide of DSO [9] are a couple of advantages of planning identified. Firstly it provides insights in the workload and capacity, allowing you to plan your own personnel. Also it creates a better alignment of capacity versus resources, that relates to a sharper prioritisation and smoother project flow. And it gives more ease, transparency, and predictability towards employees, customers, and contractors. Finally, it can help to effectively identify where the productivity and costs are located in the operation. However, one of the key limitations of planning mentioned in the data, is that planning is not able to reduce the workload or increase the capacity [236]. Although, it may provide the opportunity to manage these bottlenecks in a more effective way. The advantages arise from the purposes of planning. According to the [9] planning serves four main purposes:

- Planning is focused on the control of behaviour and respect of the roles and responsibilities of the various actors.

[8]Interview with JE
[1]Interview with JD
[2]Interview with JT
[3]First interview HD
[6]Interview with MB

- Planning is to create clear and transparent control of the activities and interactions within the processes.
- Planning is supported by a well-functioning system that facilitates decision-making and the processes.
- Planning is a collaborative effort between people.

5.8.2 Distinction operational and tactical planning

A distinction has to be made between operational and tactical planning. Due to the comprehensive meaning of planning in the organisation, these two forms of planning are used to distinguish how the term is used in this study. Operational planning refers to an activity of a planner, in monitoring the project. In operational planning the focus lies on the projects; planning individuals, activities and tasks on the operational level. Operational planning is more focused on a smaller time horizon and is concerned with the operations side. These projects have time horizons of months, weeks or depending on the size and content of the specific projects. Improvements could be implemented to work more efficiently in the operations. But if there is a problem perceived every month, then something is structurally wrong [12].

At such a moment tactical planning comes into place. The tactical planning is focused on matching the workload with the capacity. This goes across multiple projects, where one will look beyond the content of a specific project. This planning will take assets into account, and indicate what assets are required for internal activities and forecast expected external workload. The annual external workload estimation is important in matching the capacity with the workload on a tactical level. This way it is more clear how many people they have to hire in certain sectors to realise the workload. Tactical planning has a longer time horizon, approximately 1-5 years, and is situated on a higher level in the organisation [12]. Tactical planning is connected to the acceptance of workload, annual predictions of workload and the managing of the employee capacity needed to cope with this workload.

5.8.3 Planning's factors

In the data there are several factors recognised that influence operational and tactical planning. These are shown in tab. 2, before being addressed in more detail. This segment contains a description of the factors, in which the area of applicability is discussed as well as how it influences the planning. In some cases even the potential role that the various factors can obtain, are addressed.

[1]Interview with JD
[2]Interview with JT

Planning's factors

Factor	*Complication*	*Type of planning*
Semi governmental and regulated company	Regulations structure the planning processes. Bureaucratic organisation that can experience trouble making certain changes.	Tactical & Operational planning
IT system	Making insights transparent for the whole organisation. Contributes to better quality data. A better flow of information.	Tactical & Operational planning
Flexibility	The ability to move a project. Make the best use of available resources.	Operational planning
Implementation problems	Resistance in realising changes, negatively influences the speed of improvement.	Tactical & Operational planning
Forecasting capability	Provides insights in future workload and capacity	Tactical & Operational planning
Working digitally and data processing	Provide insights in what the system has to offer	Tactical & Operational planning
Project evaluation and data usage	Insights in comparing the forecast with the realisation. Allow for making a learning curve	Tactical & Operational planning
Prioritisation	Provides guidelines to make well informed choices about which projects should be worked on.	Operational planning
Standardisation	Makes the process more efficient, easy and controllable	Operational planning
Clear division of roles	Makes it easier to manage, organise, plan and control the responsibilities and activities of the employees. Provides insights into the capacity.	Tactical & Operational planning
Uniformity	Contributes to organising, managing and controlling activities. Adds to reducing the implementation problems.	Tactical & Operational planning
Acceptance of workload	Workload remains on a manageable level.	Operational planning
Project specific variables	Influences the progress of the projects	Operational planning

Table 2: An overview of the factors that influence the planning

Semi-governmental and regulated company

As mentioned earlier in the rules & regulation section, DSO is a semi-governmental and highly regulated organisation. Therefore, the organisation is required to follow various procedures laid down by law internally as well as externally. These regulations structure the planning processes and may influence the operations that have an indirect impact on the planning [7]. Also, DSO is a semi-governmental company [379]. These are organisations supported and monitored by the government but managed privately, and provide a given service. Some argue that as a result of the transition challenges rigorous changes must be made to the planning process to be able to cope with the energy transition [9]. It is a bureaucratic organisation that can experience trouble with making changes [379]. It is assumed if DSO had been a commercial organisation, some of these choices would have been made instantly. The problem that is in play here, is that many of these changes affect people. Because public sector

[7]Interview with FO
[3]First interview HD
[9]Interview with FA

organisations must perform their business in plain view of critics and the media, its decision-makers often avoid actions that appear to be controversial. Some respondents also argued that the position and role of the DSO tends to make decision makers at these organisations risk-averse [3]. This may result in that certain changes to improve the planning processes are not carried out.

IT system and communication management

According to respondents the planning discussion often turns into a discussion about their IT system [13710]. DSO had an outdated IT system, there is a step made with the implementation of the current planning system, the Flux system, but it is still considered to be far from optimal [3]. Because planning is mainly information management, in which people act on the basis of information, the IT system is considered to be an important component. IT can facilitate planning, communication, registration and monitoring tools of the projects that all help the planning in providing current and good information. A proper IT system can add to the transparency of information within the organisation and provide better quality data. IT can also facilitate keeping all data in one place, this way it is easier to gain more and better insights[7]. At the moment, the existing IT at DSO does not support this kind of system yet, because there are multiple separate systems such as planning system, time recording system and logistics system. Also, an IT system can uniform the way of working in an organisation [10]. In line with the aspect of IT, communication management may result in a better flow of the information distributed within the organisation, as well as to and from the external parties. Thereby, this will help to get the same and current information to the involved parties. This way there is more symmetric information where the actors can act on in the planning [3]. Limitations of a new IT system is that it is time consuming to learn, appreciate, understand and implement a new system, especially in a old and conservative environment of DSO. Thereby, it is often an expensive process that requires a lot of effort to convince the employees[11011].

Flexibility

The ability to move a project is considered an important aspect of the planning process, because this makes it more flexible. In the context of the construction projects of the DSO it is not uncommon that a project needs to be moved in the planning. It is argued that to effectively manage the portfolio of current projects and make the best use of the available resources, projects require a bit of flexibility [7]. There are various uncertainties that contribute to the need for flexibility in these projects. For example there are on site variables that can influence the planning such as soil contamination or frozen ground. Other factors could include municipal plan changes, permits that may be delayed, or clients who are not ready for the connection to the grid. In an interview[10] an example was given that underlines this aspect. In the beginning of the year, they experienced frozen ground which resulted in a two-week stop of the construction of projects. This had a massive impact on the planning, where the whole planning was in disarray. There was an enormous amount of work needed from the short term planners to plan everything back in order. Here a serious disadvantage of planning far in advance with little flexibility was perceived. Although, flexibility may not solve this whole problem, it could definitely make it easier [10].

Implementation problems

Another aspect that makes the implementation of changes difficult, is the working environment within DSO. The average age and experience of the workforce within DSO according to some sources has contributed to a rather conservative working environment [71112]. They work in a fashion, as it always has been with personnel that have on average a somewhat older age. Some respondents claim

[1]Interview with JD
[10]Interview with SL
[3]First interview HD
[11]Second interview HD
[7]Interview with FO
[10]Interview with SL

that the longer employees have been employed, the more changes they have experienced and the more resistance there will be to new changes. Also, with an older workforce it is considered that they are less open to change. Managers experience quite some resistance to realise rigorous changes to which negatively influences the speed of the realisation of improvements [313]. For example, it has hindered the organisation in introducing the IT system of Flux. This may make it more difficult to implement other (necessary) improvements to the planning processes.

Forecasting capability

Forecasting capabilities refers to the ability to make accurate estimations of future events based on past and present data. This can help an organisation make informed decisions and data driven strategies. For example, in a proactive style of organisation with regard to the expansion and reinforcement of the grid a certain degree of forecasting is required [11].To cope with the planning issues around the organisation it is argued that DSO should make more use of forecasting, and become more predictive in their workload [1112]. It is stated in several interviews that DSO experiences difficulty with the aspect of predicting their workload [41113]. On the operational level, according to a respondent[13], they should take more trends into account and be more forward-looking on location. For example, DSO has just installed a 10 kV capacity in a residential area, but there are already plans to build a residential area next to it, so they need to come back to the same location to increase the local grid to 25 kV. It would be more efficient, if they had put down immediately the increased grid, instead of coming back again. Also, forecasting capability can provide insights into the workload for the coming year. On a tactical level this can make it more clear how many employees they will need to hire in different sectors to meet the workload. Therefore, this capability is an essential part of the DSO´s willingness to respond proactively.

Working digitally and data processing

DSO is said to have underdeveloped tools when it comes to organising and incorporating data [3]. But not only the tools can be appointed to have influence on this. Although, it may start with the workings of the IT system and the processes, but if people do not act on the perceived data or other possibilities the system has to offer, the organisation can have the best IT system but still work inefficiently. Because planning requires a certain way of working, administrating and processing of data. If the data is not entered properly into the system, it is hard to derive substantial insights from it. According to a respondent[7] there is little effort put in entering the data in the system, compared with the amount of data available. Therefore there is little data used for further use in the planning of the projects. This is often blamed on the tool, but this is considered to be more connected to the way the organisation works. Also, certain structures are deemed to be missing in knowing what kind of data is necessary to be used and how they might translate that into practical terms in the process [11].

Project evaluation and data learning

Another aspect DSO is considered to be lacking in, is the use and learning of data. There is a little learning curve from the data during and after the projects. Learning from data is suggested, can provide greater insights into workload, capacity, bottlenecks and other important issues[4712]. This aspect applies to both tactical and operational planning. On the operational level, there are two main areas identified where learning of the data can be applied; deviations of projects and learning from experiences. Predictions are frequently made, but it is considered that there is far too little review of

[13]Interview with MH
[12]Interview with TS
[4]Interview with DC
[3]First interview HD
[7]Interview with FO
[11]Second interview HD
[12]Interview with TS

how things turned out afterwards. On the operational level according to a respondent[7] the purpose of the planning can be less focused on achieving the pre-scheduled date, but more on the side of learning why the planning deviated from the schedule. It is argued by continuous monitoring of a project one could learn when and why deviations happen [7]. This may give better insights why projects deviate from the initial dates, which can help to understand the bottlenecks, conflicts and pressing factors of the process. The other area is focused on learning from experiences of a project on the operational level. Naturally, each project has its unique set of dynamics. However, it is considered that within projects DSO winds up doing many of the same things [7]. Therefore, it is considered that DSO can learn much from the experiences of past projects. It may provide better insights in project variables such as lead times of permits and materials, workload, capacity and competency levels of their employees [4]. In an example given by a respondent[12], the planned workload often does not correspond to the booking behaviour of the project. The booking behaviour refers to the number of hours that have actually been credited to a specific project. Thus, this indicates that the in advance estimation of the workload often differs from the time actually spent on the project. On the tactical level, learning from the data can result in better forecasting capabilities of the annual workload and required capacity, due to the dependence of the quality of the data.

Prioritisation

In several interviews [1 23461014] prioritising is seen as an important aspect that will become more prominent in the future and is currently considered as an underdeveloped part of the organisation. Because the energy transition creates more scarcity, which results in more conflicts in the planning, DSO is inclined to make more choices. In instances where workload and capacity are out of balance, making decisions is necessary [12]. Prioritisation can accompany this by making well argumented choices, and determines which projects will be worked on first. Also, it is argued that prioritisation allows employees to work faster and more focused [20]. On a tactical level it is important for grid operators to make clear decisions for the coming years what should given priority, what can wait a little longer, and what will not be installed. There are currently three priority levels applied in the organisation on a tactical level: safety on level 0, customer driven on level 1 and reliability on level 2. In which safety has the highest and reliability has the lowest priority [4]. Annually the safety work has to be guaranteed, so this work has to at least fit into the work package of the year. It is about finding a certain balance between these three levels of prioritisation when it is translated to the operational level. Tactical prioritisation provides guidelines on how the people in the operation should prioritise the projects. Although tactical prioritisation is considered too simple and therefore not suitable for the operational level. On this level the organisation prioritises differently and works at a more detailed level [411]. Currently, on the operational level there are two factors that determine the prioritisation within customer driven work: the quotation date of the project on a first-come-first-serve basis and the desired date of the customer [1214].

Standardisation

A way that is proposed to improve the planning processes is by standardisation [9]. Standardisation of processes refers to a set of rules that describe how actors are supposed to act with regard to a specific activity or a sequence of activities [62]. Standardisation is possible when a certain process

[7]Interview with FO
[12]Interview with TS
[1]Interview with JD
[2]Interview with JT
[3]First interview HD
[4]Interview with DC
[6]Interview with MB
[10]Interview with SL
[14]Interview with MV
[11]Second interview HD
[14]Interview with MV
[9]Interview with FA

can be organised in the same way, due to the similarities in assets, activities or required materials. It establishes a set of rules that will structure the behaviour of the employees of the organisation to fulfil a certain task. Standardisation is considered to make the processes more efficient, with a decrease in interfering moments of employees and will reduce the process errors [9]. Also a clear set of instructions may increase productivity and result in less time spent on figuring out what the next steps are. Although, to be able to standardise, the assets and activities should be similar for every task. With regard to planning a standardised activity is very clear and easily controlled.

Clear division of roles

An important aspect of planning is about controlling, dealing and respecting the roles and responsibilities of the employees, in which clear division of roles plays an important role. This aspect is connected to values such as trust, dependency and transparency. In the interviews there are several examples mentioned that indicated an unclear understanding or allocation of the responsibilities within DSO [4101113]. This aspect applies to both the operational and tactical level of planning. This aspect mainly influences the operational level, where in the collaboration and communication between the involved parties trust and transparency are of high importance. But on the tactical level clearly defined roles will make it easier to manage, plan, organise and control from above. For example, the implementation of the workforce manager is considered to be not entirely clear and also is not uniformly applied between the different branches [11]. By better defining the roles and responsibilities it is clear which functions carry out the various activities in the planning, this way the emerging work can be deployed to the various functions in the most effective way. If the roles are ill-defined it is harder to plan and schedule the activities of the employees. Thereby, collaborating and communicating between the employees will also be harder, if it is not clear who executes which tasks.

Uniformity

Another reason for the current challenges regarding planning can be found in the history and origin of the company. This has resulted in a lack of uniformity within the organisation [17810111213]. An organisation with little to no differences between its various branches, can be considered as an uniform organisation. Uniformity may help in overcoming barriers of ambiguity, improve workflows and direct decision-making processes. As mentioned in chapter 2, the current network operators have in fact only existed for a few years. The legal predecessors existed longer, from which the DSO´s merged. Where multiple municipalities and provincial companies eventually merged to form the current network operators. This also explains the regional differences within the organisation [713]. According to a respondent[10], the current state of uniformity between the working activities of the different branches of DSO is closer to 20-30%, instead of the aspired 80%. They differ in aspects such as, their way of working, division of roles, relationships with external parties and other consensus. The aspect of uniformity is considered to be an important area of the organisation to focus on and influences both the operational and tactical planning. According to a respondent[11] uniformity is important because it ensures that the same tool is utilised in the same way, it prevents tool proliferation, and it decreases ambiguity and noise in the organisation. There are many differences between the branches identified in the interviews [181112]. The lack of uniformity also makes it difficult to implement a certain change, because the branches all work in a different way. And, organisations can experience more difficulty in organising, directing and controlling the activities from a higher level. In addition, more uniformity between branches is considered to help with the acceptance of changes. Because if there is a higher degree of difference, it is considered that there is a higher level of resistance. So, in an organisation

[7]Interview with FO

[8]Interview with JE

[10]Interview with SL

[11]Second interview HD

[12]Interview with TS

[13]Interview with MH

[1]Interview with JD

with less uniformity, there is wider spread in ways of working, which will increase the resistance in certain branches. In a similar way, an organisation with more uniformity, there is less spread in the way of working, which will result in a more equally distributed resistance. The latter is considered to be easier manageable with a better defined role of the change [11]. Additionally, becoming more uniform in the organisation, makes it easier to standardise and rationalise processes with less room for local differences and opportunistic behaviour. Which ultimately will increase operational efficiency and more streamlined processes[1] (JD).

Acceptance of work
Work is continuously being accepted in the organisation, which increases the workload on the operational level. It is important to match the capacity with the workload, in a way that it can be properly coordinated. This helps to ensure that the workload remains on a manageable level in the operations [5]. A problem with this is that the regulations are not compliant with this at the moment. Although, as mentioned it is proposed in the New Energy Act that there will be more room for declining workload.

Project specific variables
There are also several variables inside the projects that can impact the planning. These are linked to the operational planning because they are project specific. In the interviews it is referred to the next couple of variables:

- Volatility of customers
- Municipalities
- Permits
- Location specifics
- Weather

As long as everything is stable in a certain situation, an organisation can think out and plan everything in advance. But in the case, something has come up, it can cause a lot of problems. The impact can cause a delay of the specific project, but this may also affect the overall planning and can affect the planning of other projects [7]. As mentioned in the segment of flexibility, this is not uncommon within the borders of the operations. This aspect adds to the complexity, especially in a densely planned organisation. Although, almost all the project specific variables are uncontrollable factors where DSO do not have influence on. These factors still remain and have to be taken into account.

5.9 Reflection on the planning's factors

To give a better understanding in how and to what extent the factors influence the planning, the factors from tab. 2 are reflected on with the purposes of planning mentioned in sec. 5.8.1 [9]. As implementation of changes may relate to any changes made across the organisation, this aspect may influence every purpose of planning.

1. *The emphasis of planning is on the control and structure of behaviour and respect of the roles and responsibilities of the various actors.*
   The structure and behaviour of the roles and responsibilities of the various actors are influenced by several factors mentioned in sec. 5.8.3; semi-governmental and regulated aspects of the company, IT system, working digitally, division of roles and uniformity. The semi-governmental

[1]Interview with JD
[5]Interview with JB
[7]Interview with FO

status of DSO structures how they manage relations and behaviour with various actors. For example, it has a non-discriminator obligation to customers. Also, the IT system structures the behaviour of the various internal actors. Although it may begin with the workings of the IT system, the way employees act on the possibilities the system has to offer is more connected to the ability of working digitally. Furthermore, with a clear division of roles there is more trust and transparency of the roles and responsibilities of the actors. In addition, uniformity can influence the control and structure of the roles and responsibilities by for example overcoming barriers of ambiguity or more uniformly division of roles and responsibilities.

2. *Planning is to create clear and transparent control of the activities and interactions within the processes.*
   There are various factors that structure and control the activities and interactions within the processes. For example, the semi-governmental and regulated aspects of the organisation, results in institutional boundaries wherein DSO has to operate. Also, the IT system provides deadlines and structures activities among other things. Furthermore, the project evaluation and data learning may provide insights into aspects such as workload, capacity and lead times, this can influence the transparency and control of the activities if the data is properly used in the processes. Moreover, prioritisation makes clear which projects will be worked on next, and therefore may influence the overview, control and clarity of the activities and interactions of the processes. Clear division of roles and uniformity may also influence the control of the activities. For example, more clear roles and more uniformity may result in less opportunistic behaviour in the operations and therefore in more control of the activities. In addition, flexibility, forecasting capabilities and acceptance of work may influence the workload pressure, and can therefore increase or decrease the pressure on the planning. This may impact how clearly the activities and interactions can be controlled.

3. *Planning is supported by a well-functioning system that facilitates decision-making and the processes.*
   The aspect that immediately comes to mind is the IT system. IT and communication management may help with planning, communicating, decision-making and monitoring of the processes, all of which aid planning by delivering current and accurate information across the organisation. This aspect is also relevant for the collaborative effort of planning. Another related aspect close to the IT system is the factor of data processing. Because if there is little work spent entering available data into the system, there is little data used in the functioning of the system. This may be blamed on the tool, but it is thought to be more related to the way the organisation is processing the data. Furthermore, standardisation may influence the facilitation of the decision-making by describing how actors are intended to operate in relation to a certain activity.

4. *Planning is a collaborative effort between people*
   There are several factors that influence the collaborative effort of planning. First of all, the IT system and the communication management are important aspects that contribute to the collaboration. As mentioned the IT system is used as a tool to facilitate the planning by providing the involved parties accurate information. And communication management helps to distribute the information flow within and outside of the organisation as well as to and from external parties. This will help to ensure that all parties involved have access to the same, up-to-date information. Moreover, a clear division of roles makes it clear who executes which tasks. This makes it easier to plan and schedule activities of actors, and thus collaborate with one another. Also, uniformity within the organisation can result in a similar way of working, division of roles, relationships with external parties, utilisation of tools and other consensus that influences the extent of collaborative effort required between people.

DSO operates in a complex industry with a lot of uncertainties, different parties, and external and internal variables. It is a collection of factors that contribute to the experienced challenges of DSO

in applying planning processes. Therefore, it is argued that the DSO‘s planning challenges will not be solved by focusing on a single solution. It is a multi-layered problem with implications across the organisation that will necessitate a set of solutions [11012].

In the next chapter the analysis with the analytical framework is carried out and presented.

[1]Interview with JD
[10]Interview with SL
[12]Interview with TS

6

Implementation and Analysis

In this chapter the data retrieved via the case study will be analysed. The analytical framework discussed in chapt. 4 consists of three theoretical models that will guide and structure the analysis. In the first paragraph of this chapter the planning issues encountered by the network operator will be analysed via the organisational model, to understand the organisation and the organisational problems that DSO experiences. Secondly, the institutional economic perspective will be addressed by two models. Williamson´s four-layer approach focuses on the institutions that shape the planning, in which the interactions and relationship between the institutions are discussed. While the transaction cost model will attempt to provide insights into the functioning of the planning of the organisation with regard to its costs.

6.1 Images of Organisation

The Images of Organization model by Morgan [34] is used to shed a light on the subject from the organisational perspective. The observations are addressed in accordance with the used metaphors. The four metaphors that are used as a way of deciphering organisational problems are the *Machine*, *Organism*, *Brain*, and *Flux and Transformation* metaphor. The analysis is executed in two steps. First, the parts of the metaphor are addressed in terms of how prevalent they are in the organisation. Second, an elaboration of certain tension fields, that are thought to require a better understanding, takes place. Finally, a conclusion of the findings is discussed.

6.1.1 Machine metaphor

6.1.1 Machine metaphor The machine metaphor is looking for machine-like aspects of the organisation. The indicators of the machine metaphor derived from sec. 4.3 are:*Closed system, Efficiency, Predictability, Inhibition of fast adaptations, Clearly defined roles and jobs, Need to plan, organise and control, and Uniformity*

Machine metaphor

Indicator	*Analysis*	*Type of planning*
The following aspects are to a certain extent recognised within the organisation.		
Efficiency	Efficiency is present in the organisation. Efficiency is one of the main objectives of the organisation, and is found in the role description of the DSO. Due to the energy transition, the increasing workload and the decreasing capacity, it is argued that the organisation is required to work more efficiently [412]. Also managers do often strive for efficiency, which is linked to the high need to plan.	Tactical & Operational planning
Predictability	Predictability is present in the type of work they do. The tasks that are required to be performed are quite similar in projects. As can seen in 5.3.4, the process of a project normally follows the same steps, such as prioritising the project, creating a technical design, and estimating the workload [36].	Operational planning
Inhibition to fast adaptation	This is recognised in the organisation, in the implementation problems DSO experiences with organisational changes. This is in conflict with the required changes, that several interviewees emphasise, needed in the planning process to cope with the energy transition and its challenges [81012].	Tactical & Operational planning
Need to plan, organise and control	As a bureaucratic organisation with regulated operating procedures like DSO, there is a high need to plan, organise and control [3714]. This aspect is noticeable in the many procedures and regulations it has to follow. Also due to the monitoring of the ACM, many aspects of the organisation will be controlled, and will happen according to a set of agreed terms.	Tactical & Operational planning
Other aspects that are not or hardly recognised in the case of DSO.		
Closed system	The environment and context of DSO is not a closed system. It is argued that the organisation relies heavily on the interactions with external actors and environmental factors [3714].	Tactical & Operational planning
Clearly defined roles	In the organisation, there are documents where the roles, responsibilities and tasks of the various functions are properly described, this is in line with bureaucratic and machine-like organisations. However, in practice there are various occasions mentioned where the employees let go of these detailed descriptions [41011]. It is considered that clearly defined roles and responsibilities are important for the planning processes. So, this aspect is partially recognised in the organisation, but in practice should be applied better.	Operational planning
Uniformity	Uniformity is considered an important aspect that can contribute to several aspects, such as efficiency, adaptation to changes, better defined roles [17101114]. At this point it is considered that the uniformity between the branches is situated around 20-30% [10]. The tools they work with also still differ, because there is no system that has all the facets needed to properly construct the planning processes. So at this point uniformity is far from where they want it to be. To be completely uniform may be a bit idealistic, and there are always be certain local needs, but centralised uniformity is considered to be a key objective [178111214].	Tactical & Operational planning

Table 3: An overview of the analysis with the Machine metaphor

Tension fields

As mentioned in the empirical observations there were several features of the organisation identified that coincide with that of a machine. But, three key tension fields can be identified considering the analogy of the machine, specifically in the definition of certain roles and responsibilities, the lack of uniformity in the organisation and the lack of its incorporated forecasting capabilities.

Unclearly defined roles and jobs - Tactical and Operational level

In several interviews the unclarity of functions, roles and jobs within DSO surfaced. This will be shown in three examples found in the data. One of the functions was mentioned in an interview [4]:

"The grid operators have regional offices, which are responsible for a certain region and employ their own people. For example, the engineers are attached to a region, and it differs slightly how they fill it in depending on the location."

Roles are perhaps clearly defined within branches, but they differ per location. Although this relates maybe more to the lack of uniformity, it also applies to a top-down ill-defined description of the roles and jobs in the organisation.

"The executors´ outside work is often underestimated. They often solve things that they come across in the operations, without passing down this knowledge to the planners. They just want the project to operate smoothly, so they sometimes intervene in activities that may not be their responsibility."

Another example, derived from an interview[10], identifies another unclear definition of roles and jobs, which conflicts with the machine analogy, and also identically influences the organisation in how they struggle to maintain in control of the operational planning. Due to the fact that the capacity of the executors is considered to be one of the most important bottlenecks of the organisation, this function should be deployed in the most efficient way[14]. It is assumed that by better defining the roles and jobs in the operation, the executor can smoother direct the emerging work to the appropriate function while maintaining a heavy staffed authority. A respondent[11] mentions another function that is unclearly defined.

"At the moment the concrete implementation of the Workforce Manager (WFM) is not clearly defined, and is also not uniform for every location."

Currently, the outline of the WFM function is quite clear, but the concrete implementation is still lacking, and varies from branch to branch. It is assumed that better defined roles and responsibilities will, in terms of the machine metaphor, increase its uniformity, and make it easier to manage, organise, plan and control the activities of the employees. It may also improve the collaboration and communication between employees if the roles and responsibilities of the functions are better defined.

Lack of uniformity - Tactical and Operational level

A challenge that is mentioned in several interviews are the many differences between the branches within the organisation of DSO. From sec. 2.2 & 5.8 can be derived that the differences between the branches and locations are the result of the many mergers and changes the company has undergone over the years. In an interview [12] an activity to cope with the differences between the branches was discussed. He explained about a consultation group that was created to communicate between the locations, in how they cope with the experienced issues.

[4]Interview with DC
[10]Interview with SL
[14]Interview with MV
[11]Second interview HD
[12]Interview with TS

"This is called ´Planvisie´, which is a consultation group with the other branches considering planning and other related subjects. In which they will look at the differences between the branches, and discuss how they can move forward together. (...) They are trying to achieve uniformity in branches step by step. But it is also an utopia that a completely uniform company will be achieved" [12]

Due to the effects of the energy transition on the workload and the scarcity of personnel, all the branches are required to work more efficiently. According to the statement above, they do try to learn from each other. However, at this point, many of the branches still have their own way of working, their own relationship with external parties and their own consensus. The lack of uniformity makes it difficult to implement organisational change, and it results in less efficiency of the workflows. Besides, organisations can experience more difficulty in organising and controlling the activities which will hinder the planning. The aspect of uniformity is considered to be an important area of the organisation to focus on. The ´Planvisie´ is not the only way that can be used to increase the uniformity of the company. Another aspect where many branches still differ are the tools they work with.

"The tools that the different branches work with still differ. The reason for this is that there is still no all-embracing system that covers all the facets to properly construct a good planning. A change in an IT-system is always a good moment to increase the uniformity of the organisation" [10]

A change in IT-system is considered to be an effective method to increase the uniformity in the organisation [10]. A new IT system can uniform the way of working in an organisation. Although, there are also challenges in successfully implementing IT-changes. For example, it is mentioned by a respondent[8] that in the implementation of the current planning system Flux, there was a lot of resistance experienced. There are currently still people in the company who do not see this IT-system as an improvement, which reconfirms that DSO experiences difficulties in implementing improvements in this area.

Lack of forecasting capabilities - Tactical level
In an interview [11] the respondent elaborated on what is required to improve the forecasting capabilities of the organisation.

"So, what it comes down to is that DSO should make more use of forecasting for the annual work- load. And therefore, it needs to invest in toolings that make those insights reliable, and also create an organisational structure that WFM is properly set up so that the findings and advice of WFM can be smoothly drip down into the operation."

This annual workload prediction is important in matching the capacity with the workload on a tactical level. This procedure is a clear example of machine perspective on the role of planning. It is handled top-down, and implemented further down into the organisation. This hierarchical method assumes that this way of working provides overview and the ability to properly organise the work volume. However, there is an aspect that is assumed to be complex for DSO, namely making predictions. Since, DSO is not (anymore) situated in a stable market, especially when it comes to the amount of requests of customers. Several respondents claim that DSO experiences difficulties in predicting their workload [411]. They also claim that the organisation must undergo several changes to improve its forecasting capabilities.

[12]Interview with TS
[10]Interview with SL
[8]Interview with JE
[4]Interview with DC
[11]Second interview HD

6.1.2 Organism metaphor

6.1.2 Organism metaphor The organism metaphor will be looking for organism-like aspects of the organisation. The indicators of the organism metaphor derived from sec. 4.3 are:*Open system, Human aspects, Contingency theory, Flexibility, Alignment with the environment, and Balance interacting processes*

Organism metaphor

Indicator	*Analysis*	*Type of planning*
The following aspects are to a certain extent recognised within the organisation.		
Open system	This is more applicable in the case of DSO than the closed system of the machine metaphor [14]. Because, the organisation is occupied with aspects like materials, deliveries, internal employees and external parties, such as customers, municipalities, and contractors.	Tactical & Operational planning
Human aspects	Naturally, this is applicable in the case of DSO, the organisation has to deal with many human interactions, such as their employees, the interactions between them, and the interactions with external parties.	Tactical & Operational planning
Contingency theory	There are several situations that are dependent on the internal and external conditions. On the operational level projects may differ in their specific characteristics, such as size, cable length, or location. Also the customer, municipality or contractor may act different. However, in the way that projects are approached, there are little differences mentioned. The main differences in executing the projects arise in coping with the uncertainties and complexities accompanying the project. On a tactical level it is claimed that a pivotal challenge arises in the limits internal and external capacity is able to scale-up [4].	Tactical & Operational planning
Balance interacting processes	This is continuously present in the organisation and especially in tactical planning, where the capacity has to be matched with the workload. And, within the operational projects all the internal and external factors should be in balance to execute the project properly.	Tactical & Operational planning
Other aspects that are not or hardly recognised in the case of DSO.		
Flexibility	Flexibility in the form of flexible planning, is considered important with regard to operational planning due to the influence of uncontrollable factors within the projects [125710]. Of course, in an ideal world the organisation did have incorporated more flexibility into the planning. But currently due to the high workload and capacity issue, they are forced to discard a share of flexibility. Because of the perceived importance of this aspect in the organisation and the high influence of uncontrollable factors, flexibility is considered an essential part of the operational planning.	Operational planning
Prioritisation	Prioritisation is recognised within DSO. Although, it is argued an underdeveloped aspect of the organisation. According to sev- eral respondents there is currently too little and inconsistently prioritisation at DSO [41014]. Currently, two elements decide the priority of customer driven work on the operational level: the quotation date of the project on first-come-first-serve basis and the customer's desired date [23](TS, HD1, JT). Although, given these two mentioned factors, it is assumed that the current prioritisation still falls short with regard to the synergy of the environment of DSO.	Operational planning

Table 4: An overview of the analysis with the Organism metaphor

Tension fields

In this next segment In the interviews there were several points that are considered to be relevant with the organism metaphor.

Limits in internal and external capacity - Tactical level

First one of the current major challenges of the DSO is the issue around their internal and external capacity. In the interview is stated that[4]:

"Due to the energy transition, the workload will only increase at the DSO, while there is a limit to which the capacity of internal and external parties can scale up in the short term. Also, in the long term there is a reasonable limit to this."

When considering the DSO's objectives mentioned in 5.4, the organisation can experience increasing difficulties if the limits of the internal and external capacity is reached. It is argued that the scarcity of technical employees is felt not just within the borders of the DSO, but also by external parties such as contractors [3][4]. Therefore, considering the organism metaphor, it is important that the organisation should be aligned with the environment in which the internal and external conditions are taken into account.

Prioritisation - Tactical level

In several interviews prioritising is mentioned as an important aspect that will become more prominent in the future and is currently considered as an underdeveloped part of the organisation. The interviewee [10] stated that:

"Prioritising becomes increasingly important. In my opinion, we are still at the beginning of the energy transition, and it will all get even more complex with an even bigger workload."

It is expected that with regard to the energy transition, DSO will have to make more and more choices about who the organisation is going to accommodate first and who will have to wait [10][11]. However, this last aspect conflicts with the current institutional regulations that require grid operators to enable customers a non-discriminatory connection and access to the grid. In addition, in an interview [12] it is stated that the importance of prioritisation is currently not on the level it can be.

"Prioritisation is often a neglected part of the process. There is a priority list, in most cases but the way the projects are prioritised vary between people, functions, departments and branches. Within the customer driven work there are two leading factors in the prioritisation, the quotation date on a first-in-first-serve basis and the desired date of the customer."

Prioritisation is considered to be closely linked to the organism metaphor, because it is dependent on internal and external conditions. Although, the current situation falls short with regard to the synergy of the environment of DSO which is mentioned in the quote. Especially on the human relation side of the project, where the story behind a specific project is completely overlooked. Prioritisation can focus on situation specific factors and is therefore considered to be appropriately organised with organism-like aspects. Factors that may be included into the prioritisation are for example: the necessity of the customer on its desired date, whether the customer threatens to go to court, interests that are linked to a certain project or the consequences if a certain project is not delivered on time

[4]Interview with DC
[3]First interview HD
[4]Interview with DC
[10]Interview with SL
[11]Second interview HD
[12]Interview with TS

[11]. For example, the customer may have a high necessity to get connected to the grid because otherwise their business will lose money or even go bankrupt, this can be incorporated into the prioritisation.

Flexibility - Operational level
Flexibility has also been cited as an important aspect of the planning process to cover the uncertainties of the projects. In an interview [10] the following is stated:

"Ideally you run the capacity at 80/90% but now it is more like 100/110% of what the capacity of the organisation can handle. For ideal planning this is not preferred, because you always want to keep flexibility in the planning."

With the increasing workload and the capacity issue, it is stated that moving a project is becoming increasingly difficult because the schedule is so fully planned. Planning hard and far in advance can be connected to the machine-like method which can be applied accurately in a stable environment, but in the setting of DSO with numerous uncertainties, a more convenient approach would be towards the organism metaphor, which integrates greater flexibility.

6.1.3 Brain metaphor

6.1.3 Brain metaphor The brain metaphor will be looking for brain-like aspects of the organisation. The indicators of the brain metaphor derived from sec. 4.3 are:*Information processing, Usage of information, Repeatability, and Distribution of knowledge*

[10]Interview with SL

Brain metaphor

Indicator	*Analysis*	*Type of planning*
The following aspects are to a certain extent recognised within the organisation.		
Repeatability	There are many matching aspects in the way the projects are approached. Although every project has its own characteristics, the steps that are undertaken in every project are comparable [1 28].	Operational planning
Distribution of knowledge	Planners are completely dependent on information from others, it is therefore important that current information is shared between the employees to make the most efficient planning [10 12 14]. Otherwise, planners could make a plan based on old and inaccurate information, that leads to extra work in planning and associated activities. Nevertheless, this aspect is not always done properly [10 12].	Operational planning
Other aspects that are not or hardly recognised in the case of DSO.		
Standardisation	Despite the perceived repeatability of processes, it is mentioned that there is little standardisation in the current processes incorporated. In the interview with a respondent[14] it is stated that DSO is trying to make changes in this direction. But the implementation problems of the organisation, the lack of data and the lack of uniformity between the locations, are making it harder to standardise the processes. Several respondents [9 14] mention problems experienced in the organisation with regard to standardisation; standardisation in one branch is not by definition accepted in other branches too, a process has to meet certain requirements to make sure it really is applicable for standardisation, and which areas of the processes are currently applicable for standardisation is not clear.	Operational planning
Data evaluation, processing and usage	The current project evaluation is mainly limited to a financial check of a project. There is a little learning curve from the available data during and after the projects. Especially with in mind the considered repeatability of the processes, it seems relevant to try to learn from the derived data. Several respondents claim the quality of the data is often insufficient to provide significant insights, as a result of the little data processing skills [11 14]. It is argued that learning from the data can provide better insights into the workload, capacity, bottlenecks or other significant factors [4 7]. Which can be used on the operational level for making more accurate predictions of the workload and available capacity, or may also generate substantive knowledge that can be used for the standardisation of certain processes. On a tactical level, it can help DSO to increase its forecasting capabilities, and make better predictions of the expected workload and required capacity, also it may contribute to the organisation in working proactively.	Tactical & Operational planning

Table 5: An overview of the analysis with the Brain metaphor

Tension fields

In the interviews there are several aspects that can be linked in a positive or negative way to the brain metaphor. Considering the various processes that are influenced by IT systems and the focus on continuous improvement with several improvements

Standardisation - Operational level
According to a respondent[8] there are certain steps that occur in the same way for every project.

"In the end, the work comes down to the same thing. The steps required in a project follow mainly the same route, for example all the projects need to carry out a desk study. (...) In my opinion there is little difference in the approach taken between the workflows and between projects. The only differences are in the characteristics of such projects, such as lead time."

This statement underlines the repeatability of the processes. If several activities of every project are repeatable, it is assumed this allows the possibility of standardisation of processes to a certain extent [9]. Although, the lack of uniformity, the lack of data and the implementation problems with regard to change hinder the ability to standardise the processes.

Data evaluation, processing and usage - Tactical and Operational level
In the interviews several interviewees considered that the usage and evaluation of data is in the earlier stages. This applies to several aspects of the organisation, in an interview[8] the following is stated:

"The project evaluation is a mandatory step in the process. In which the focus lies on the possible differences with the in advance calculated budget. If there are differences, then the project leaders must provide an explanation. The data acquired from the project will be registered, and there is a possibility of retrieving it. But I do not think that happens often, and nothing is done with this."

In line with this statement, it is considered that there are still many steps to gain in the usage and processing of data for the organisation of DSO. In accordance with the analogy of the brain, it is considered that the organisation should do more with the acquired information. For example, according to a respondent[12], the planned workload often does not correspond to the booking behaviour of the project. As a result, the time estimated in advance frequently differs from the time spent. Perhaps if more lessons are learned from the collected data, a better estimate can be given of the actual hours spent on the project. So, a better estimate of the workload can be achieved or at least provide insights into the workload. One of the signs that the usage of data in the organisation is in an introductory phase, is the challenges around the processing of data. In an interview [11] on the subject of data processing is stated that:

"Data processing is set up in a basic fashion with immature IT tools. Next, how the analysis can be applied to match capacity and workload is unclear, in terms of the kind of data that has to be used and how they are going to translate the data into practical terms. With regard to this last part, the organisation also experiences difficulties with working digitally."

In relation to the brain metaphor it can be acknowledged that the organisation is learning in various aspects of data processing. The ability to properly process data is required to use the acquired data adequately. With regard to the brain analogy, it is considered that DSO should have a more structured way of organising, with more room for analysis and reporting. A counter-argument for the use of data is given in the interview with [10].

"Even with the same type of connection, it does not guarantee that those projects will run in the same

[8]Interview with JE
[9]Interview with FA
[8]Interview with JE
[12]Interview with TS
[11]Second interview HD
[10]Interview with SL

way. Variables within the project such as location, length and who the customer is, influence the trajectory of the projects. Therefore, I would rather make an assessment based on experience than on the basis of data."

Although experience would always play a part in assessing or estimating a project, data is considered to also play a part in this. That currently not the whole process from start to finish can be predicted, does not mean that there are several parts of the process in which data can improve the overall efficiency. Data could be a starting point, or it can be used in a supporting manner rather than in a leading way. On which specific areas the data is most appropriate for and what the effectiveness can be, has to be further researched.

6.1.4 Flux and transformation metaphor

6.1.4 Flux and transformation metaphor The flux and transformation metaphor will be looking for flux and transformation-like aspects of the organisation. The indicators of the flux and transformation metaphor derived from sec. 4.3 are: *Change from within, Unpredictability, Embracing theories of autopoiesis, Understanding and managing organisational change and acting proactively*

Flux and transformation metaphor

Indicator	*Analysis*	*Type of planning*
The following aspects are to a certain extent recognised within the organisation.		
Acting proactively	Is an aspect to cope with the vast changing distribution network of DSO, and results in a more efficient use of the capacity and decreases the future workload. This is to a certain extent applied in the organisation, although, there are still many difficulties experienced. It is assumed that acting proactively is dependent on the availability and accuracy of data regarding the spatial development of the electricity distribution network, as well as the forecasting capabilities that include the ability to analyse and make sense of the data. Also, it is assumed that DSO must improve their forecasting capabilities in order to gain a better understanding of the predicted workload. This way they can act on it sooner. Thus, there are still steps to be made in this aspect.	Tactical planning
Unpredictable context	The context of DSO is not very predictable. Due to the energy transition, the environment and the changing conditions of the DSO´s [3714].	Tactical planning
Unpredictable project specific variables	Also, there are some environmental factors that come into play within the construction projects that are unpredictable [34710]. For example, the characteristics of the ground, and the weather can play a role in the progress. Other unpredictable factors mentioned are the volatility of customers, the plans of municipalities and the issuing of permits.	Operational planning
Other aspects that are not or hardly recognised in the case of DSO.		
Problems with implementation of changes	There are often implementation problems experienced with changes. Especially with the average ageing age of its employees and a conservative working environment, it is harder to achieve the many changes required to accompany the energy transition for DSO [12].	Tactical & Operational planning
Autopoiesis	This is very limited recognised in the organisation. Most of the changes are driven by external factors with regard to the energy transition and possibilities.	Tactical & Operational planning

Table 6: An overview of the analysis with the Flux and transformation metaphor

Tension fields

With regard to the flux and transformation metaphor, there are two organisational issues recognised in the data. One is related to the experienced implementation problems of organisational changes within the company and the other is connected to the desired proactive way of acting of the organisation.

Acting proactively - Tactical level

Various interviews stated that a proactive way of acting is an important aspect that DSO has to develop more. This is discussed in an interview with a respondent[11]:

"One of the biggest bottlenecks is that the workload and the available capacity are not in balance. DSO is not particularly predictable in this respect, which is due to the fact that DSO does not yet have sufficient insight into such bottlenecks in a reliable manner. And therefore experience difficulty

[11]Second interview HD

in acting more proactively."

Several respondents claim that the organisation acts too little proactive. Acting proactively also has to do with the forecasting capabilities of the organisation. Another aspect of acting more proactively can be associated with the institutions. This is discussed in an interview[4]:

"The DSO must pay close attention to its cash flows. The energy transition is progressing so fast that DSO wants to act more proactively. But the organisation cannot just rely on expectations, the public money has to be invested adequately."

The step towards acting more proactively has not yet been taken, this is partly thanks to the lack of institutional room in this respect. Because the DSO´s are situated in a regulated environment, it is not easy for them to act proactively. It is a regulated company, where certain agreements about investing their money in the grid have been made with politicians, and where the ACM monitors them. According to a respondent[4] there is currently a political discussion going in The Hague, whether DSO´s should be given more freedom with regard to acting proactively. So, at this moment the future vision of the grid operators is not yet supported by the institutional grounds.

Problems with implementation changes - Tactical level
The implementation problems of the organisation are discussed in an interview[12]:

"For example, the introduction of the new planning system Flux has not gone completely smoothly, where employees preferred to do their work in the old way. If the organisation changes something, then they must be able to convince people that it is better than the old method. People who have been working in the same way for a long time need to be convinced of the new manner."

This example refers to the experienced implementation problems the organisation had with the new planning system. With regard to the flux and transformation metaphor, it is perceived that DSO is still learning in accepting organisational change from within the organisation. Therefore, this makes it difficult to deal with the required changes of the energy transition. In this aspect it is considered that the organisation still needs to take steps in view of its future. Although, this issue is closely linked to the characteristics of their personnel, and you cannot simply change the characteristics of your staff.

6.1.5 Reflection on the images of organisation

Machine metaphor
The main aspects that comply with the machine metaphor within the organisation can be found in their internal processes and in their goals regarding their internal processes, such as predictability, inhibition to fast adaptations, efficiency, and the need for plan, organise and control. Predictability will make it easier to plan. So, the various tasks and phases within a project should be adequately planned. This aspect relates also to the brain metaphor. In that it offers room in using data and possibly standardising processes. To comprehend the energy transition, DSO is required to make certain changes. The aspect of inhibition to fast adaptations makes it harder for the organisation to adapt these proposed changes. This is an important aspect to overcome for the DSO. The main aspects that currently did not comply with the machine metaphor but are considered important for the planning processes, were the definition of roles and responsibilities, and the lack of uniformity and forecasting capabilities. By better defining the roles and jobs in the operation, the emerging work can be deployed to the various functions in the most effective way. Also, it allows for better planning, controlling and managing of the roles and responsibilities. The aspect of uniformity influ- ences several areas of the organisation with regard to planning, and is therefore considered to be an

[4]Interview with DC

[12]Interview with TS

important area of the organisation to focus on. The forecasting capabilities are assumed to provide insights into the workload and capacity on a tactical level. They also are valuable in working proactively.

Organism metaphor
From the analysis with the organism metaphor, the main mentioned similarities can be found in their contextual situation, and is comparable with their reality in which they are located. DSO is located in an open system with various human interactions. It is therefore assumed to be important to include the internal and external conditions of DSO into the planning. Although, the internal and exter- nal conditions are rarely included in the way projects are approached in advance, rather these will be handled during the process. The uncertainties and complexities can be managed by incorporat- ing flexibility into the planning. Although, with the increasing workload and the capacity issue, it is stated that moving a project is becoming increasingly difficult because the schedule is so fully planned. Planning hard and far in advance can be connected to the machine-like method which can be applied accurately in a stable environment, but in the setting of DSO with numerous uncertainties, a more convenient approach would be towards the organism metaphor, which integrates greater flexibility.

Brain metaphor
Many of the similarities with the brain metaphor are connected to the organisation dealing with data and working digitally. Also, it is assumed that the repeatability of the processes allows for more standardisation of processes. Although, the lack of uniformity, the lack of data and the implementation problems with regard to change hinder the ability to standardise the processes. Secondly, although there are also hurdles to overcome in data processing, it is considered that a certain organisational structure change is required. Considering the big steps to be made in this area, it is considered that the use of data can contribute to several areas, such as matching workload and capacity, standardising, working proactively and making predictions. Data processing will contribute to the organisation´s ability to self-organise and develop from within the organisation. Especially in an increasing digital working environment, where more and more companies incorporate a form of proper processing and usage of data, this is argued to be increasingly important.

Flux and transformation metaphor
DSO as an organisation, and with regard to their planning processes, there are some similarities identified with the flux and transformation metaphor. This is correlated with its unpredictable context regarding tactical planning, unpredictable project specific variables regarding operational planning, and proactive way of working in coping with the changing distribution network. However, the process of ongoing change, self-organisation, understanding and managing of organisational change is limited within the organisation. Also, the personnel of the organisation is ageing and there is an old and conservative working environment experienced. It is assumed this contributes to DSO experiencing difficulties in the implementation of organisational change and working proactively.

6.2 Four-layer Model of Williamson

The four-layer model of Williamson approaches the issue from an institutional perspective, in which it focuses on the key institutional challenges that are connected with the perceived issues around planning. It allows the researcher to study and analyse the interactions between the various institutions. Tab. 7 shows the various observed institutions that shape and structure the human behaviour within the planning processes, which will be elaborated in the coming sections.

Four-layer model of Williamson

Level	*Description & Purpose*	*Observed institutions*
Level 1 - The social embeddedness level	Informal institutions that include values, customs, norms, traditions, religion and culture. These institutions are usually present for a long period of time, and the regularity of change is rare. This level often functions as a limitation on the faster moving lower levels with which it has continuous interactions.	Efficiency Safety Reliability Affordability Legality Sustainability Service to customers
Level 2 - The institutional environment	The formal rules, 'rules of the game', such as property rights, laws, legal rules and constitutions. The influence of this level on behaviour can be derived from the incentives and costs of the enforcement of formal rules.	Non-discrimination obligation to system users Connection period Justifiable investments Robustness Monitoring of ACM
Level 3 - The governance structures	The 'play of the game', the institutions that manage the interactions between individuals, such as contract definition and enforcement, and other social agreements. This layer shows the possibilities and the constraints of the agreements between individuals.	Supporting IT-system Definition of the roles and responsibilities Prioritisation Standardisation Data processing Uniformity Forecasting
Level 4 - The economic activities and marginal conditions	This level deals with the individual forces in play. It takes into account the incentives of individuals, where the emphasis lies on getting the marginal conditions right.	Workload Capacity Lead time Data Usage

Table 7: The institutions categorised by the four-layer model that are perceived connected to the issues and challenges around planning

6.2.1 Level 1 - The social embeddedness level

In the observations are several aspects that could be devoted to the social embeddedness level of the organisation, especially the self proclaimed values of the organisation mentioned in sec. 5.4.2 are applicable for this level. The identified institutions on this level are; efficiency, safety, reliability, affordability, legality, sustainability and service to customers.

- *Efficiency* - The general task of the DSO described in sec. 2.3 is to provide an efficient electricity system "under economic conditions" and "due regard to the environment", which refers to both economic and environmental efficiency (art. 25(1)E-Directive). Environmental efficiency is present in the organisation in the form of the efficient use of the environment, which can also be linked to sustainability value [14]. Economic efficiency refers to incorporating efficiency in the internal processes. And will play a role in the suggested improvements with regard to planning of the organisation, where efficiency will always be taken into account when implementing a proposed change.
- *Safety* - Safety is highly valued within the organisation. Safety is linked to the internal work activities arranged by Asset Management. Safety is especially important when certain parts of the network need to be replaced. This value of the company influences the prioritisation, where

[14] Interview with MV

this work activity is uniformly handled with the highest prioritisation. Although, this work still gets shifted around, because this type of work is issued long before safety comes into play. When safety will exactly come into play is difficult to measure, but at some point Asset Management will intervene in the postponement of this work when they consider that safety can no longer be guaranteed.

- *Reliability* - This also is derived from the general task description of the DSO and it is considered to be of great importance. This can be linked to the reliability of the grid. In the case external work increases an increase in complementary internal reliability work is expected, because the grid should be succumbed to a certain level of reliability. Therefore this influences the amount of internal reliability work that will be accompanied with the increase in the external work. This aspect may also be connected to the internal and external interactions of the company. Internally this value may influence the employees to rely on each other, the tools and processes. Externally, it is important for the interactions with other external actors that they can rely on the organisation.

- *Affordability* - This value refers to the extent the asset owner achieves its financial goals. In the case Asset Management commissioned a certain project, the process must be executed in an efficient and affordable way. This impacts the financial aspect of the project. Also, lead times, waiting times, and outsourcing are aspects that influence the financial picture of the project. In the case of a customer driven work, an extra aspect that may be taken into account is the value of getting the connection on the desired date. For example, it may result in financial setbacks if the connection date is delayed.

- *Legality* - DSO is a regulated company that is required to comply with the various rules and regulations set by the policy makers [7]. They are monitored by the ACM that they uphold their obligations. This value influences to what extent DSO strictly follows the procedures, and processes as to how they are regulated.

- *Sustainability* - In the general task description of the DSO, the organisations are upheld to their environment. Sustainability is also mentioned as one of its company values to wield while striving for its strategic goals [57]. With the global climate issues and the ongoing energy transition in mind, it is understandable that DSO gives high priority to sustainability in their business operations.

- *Service to customers* - The DSO is a public service type of organisation, whose purpose is to provide a service to their regional system users. This customer focus will remain an important part of the organisation and will influence its processes. Where the processes will be organised in a way that the customers will be served in a sufficient fashion. Although the customers are becoming increasingly impatient and the organisation may be required to make choices between which customers to serve first, the customer serving duty is valued highly in the company. Therefore aspects such as waiting times of customers, customer relationship, transparency, media attention, and complaints and conflicts with external parties are of importance.

6.2.2 Level 2 - The institutional environment

The second level is referred to as the institutional environment. The DSO is located in a regulated environment, there are several institutions that structure and influence the actions of actors around the planning processes with regard to the rules of the game. In the observations the following institutions are found; non-discrimination obligation to system users, connection period, justifiable investments, robustness, and monitoring of ACM.

[7] Interview with FO

- *Non-discrimination obligation to system users* - The DSO´s are bound to third party access, "in which they are required to provide all system users access to the grid applied objectively and without discrimination" [22]. This institution ensures that all the customers will be served in a non-discriminator and objective way within the possibilities of the grid operator. The DSO may refuse access to the grid in exceptional situation where the capacity of the grid is insufficient to ensure reliability and security. Considering the energy transition where the expectation is that the DSO is required to make more and more choices, which customer will be helped first and which will have to wait, the DSO has no institutional ground to make these decisions. So this institution has influence on the ability to accept or refuse the requests of customers. The result of this is that the incoming workload is less manageable as it is unclear for the organisation which request to fulfil first. Also, the non-discriminator aspect limits the ability to prioritise.

- *Connection period* - In addition the current regulation states a maximum of 18 weeks connection period, in which the customer has to be connected to the grid by the system operator. This connection period is structurally not met, whereby most of the customers are aware of the current market conditions. So, they often book their connection a long period in advance. This way the legislation is not in line with reality. As a result, customers are often flexible in meeting that connection term of 18 weeks. However, they have a strong case if they want to exert pressure on the DSO´s, due to this law. This institution influences the relationship with the customers, in which it provides more power to the customers and more pressure on the DSO.

- *Justifiable investments* - The DSO has to justify its investments. The DSO must be able to justify the money it invests in the grid [4]. Because it is a government owned company, where the public pays the DSO with periodic costs. It is considered that the DSO should invest the public money with little risk. But due to the fast progressing of the energy transition the grid operator wants to act more proactively to be more efficient. Here a clear conflict can be recognised, where there is currently not enough institutional freedom to act proactively.

- *Robustness* - To make sure the DSO manages a grid that is secure, reliable and efficient, it incorporates an overabundance of capacity into the grid. This way in case of an outage it may still be accommodated with the extra capacity of the grid. Although, to ensure this overabundance adds to an increase in workload. Because for example, a customer asks for a connection to the grid in an area with little capacity, not only needs the DSO to serve the customer there, it also needs to construct extra capacity into the ground. However, this formal rule will be adjusted to accommodate the vast increase in the construction of wind and solar parks in the new regulations. For these types of organisations is this an extraordinary decision, because it will go against the values of security, reliability and safety.

- *Monitoring of ACM* - The DSO is controlled and monitored by ACM, so that they adhere to their obligations and act within the allowed restrictions. This will influence the behaviour of a DSO in the way that they must record everything well, also the bookkeeping is strictly monitored as mentioned by [6]. All the above mentioned institutions will be controlled and monitored by the ACM. Because they are heavily regulated and monitored the institutions of this level are decisive for the institutional boundaries in which DSO has to operate. These boundaries are often strictly followed and shape their possibilities.

6.2.3 Level 3 - The governance structures

The third level is dedicated to 'governance structures' of organisations and contracts that coordinate economic transactions that is often referred to as transaction costs economics, also referred to as the

[4]Interview with DC
[6]Interview with MB

play of the game [51]. These aspects of the third level will be elaborated in the analysis with the transaction cost model.

- *Supporting IT-system* - The IT systems help to structure and guide many activities in the operations such as, planning, controlling and evaluating projects. This is an important part of the organisation as it influences several aspects and plays a big part in the workings and organisation of the system and the processes. Due to their importance in various activities, the used tools have to be reliable and comprehensive to fulfil all its requirements. Especially considering planning, where planning is closely linked to acting on the basis of information while taking into account efficiency, predictability and reliability. The current planning system (Flux) is still not considered to be optimal.

- *Defining the roles and responsibilities* - Governance structures are in place to define the roles, functions and jobs of the employees. These descriptions will distribute the responsibilities and activities of the employees. Currently there are certain functions unclearly defined, which results in an unclear distribution of responsibilities and may result in opportunistic behaviour.

- *Prioritisation* - There are governance structures present that guide the prioritisation of projects. This should influence which projects the company will first work on, and categorise the projects on their importance. This creates an overview if the organisation is working on the right projects and helps to make proper planning choices. There is still a lack of tactical guidance on how to prioritise in the operation. Where it is considered that WFM can play an important role in providing insight into prioritisation conflicts[11]. Although, currently the prioritisation methods are incoherently used throughout the organisation. Where the prioritisation is often a neglected part of the process. It differs per location which prioritisation is maintained and also is not always properly applied [10].

- *Standardisation* - Standardisation is a manner to structure certain processes that have similarities in assets, activities and materials. This way the frequency of exchange of these processes will decrease which will result in less transaction costs.

- *Data processing* - With regard to processing and incorporating data DSO is argued to have immature toolings and little knowledge [11]. Also working digitally and how the analysis can be applied to capacity and workload is still unclear. To know what kind of data is required to be used and how they can translate that into practical terms in the operation, is considered to be missing certain structures [11]. The ability to process data influences the usage and quality of data. Which can be of use in other activities such as prioritisation, and standardisation. It also can contribute in providing insights in marginal conditions such as amount of workload, capacity, lead time.

- *Uniformity* - In the organisation there is a lack of uniformity experienced. Resulting in many differences between branches. Due to the many mergers in the history of the company and geographically divided aspects of the branches, there are many differences between the various locations of DSO. These are felt in many activities like their way of working, organising, planning, and prioritising.

- *Forecasting* - It is argued that DSO has a lack of supporting governance structures in its ability to make accurate forecasts, which hinder its way to act proactively [3].

[11]Second interview HD
[10]Interview with SL
[3]First interview HD

6.2.4 Level 4 - Economic activities and marginal conditions

Level 4 deals with economic activities and is concerned with getting the marginal conditions right. With regard to tactical and operational planning the marginal conditions are the workload, capacity, lead time and data usage.

- *Workload* - Workload is the perceived amount of internal and external work. This is a condition that determines the perceived pressure on the current employees. It is important to match workload with sufficient capacity to achieve its completion. In this way it is closely linked to the capacity of the organisation. The workload is currently increasing at DSO.
- *Capacity* - Capacity is the number of people who are able to work in the organisation. In other words the amount of working hours that are available at a certain point in time. Capacity is both used in the tactical as in the operational planning. In the tactical planning it has to match the estimated workload for a given time. In the operational planning, it is used to appoint the capacity of an employee to a certain project.
- *Lead time* - Lead time is the amount of time a certain activity or project takes from start to finish. The determination and estimation of lead times is important to plan the projects operationally. At this point the lead times are determined based on experience and fixed notions. There is little done with data from other projects.
- *Data usage* - There is little data usage. When a project is finished there is a project evaluation, which is primarily a financial project evaluation. If there are major financial differences, then they try to explain this. But respondents[12] state that little is done with the obtained data afterwards. For example, the project evaluation can reflect on the estimated workload from the executor and the booked workload. This data can help to make a better estimation of the workload for a specific executor. Which may be presented in an expanded competency level matrix.

6.2.5 Reflection on the four-layer model

This model allows institutions to be described and integrated into a single framework, and helps to understand the complex interactions and patterns between these institutions. In this approach, institutions serve as a body of rules that controls, guides and limits the behaviour of actors and their interactions, in order to achieve specific goals. But this can be at the expense of other institutions and their corresponding goals. In appendix X are all the interactions and patterns between the institutions represented in a figure. In the next segment are the most important interactions and insights of this model discussed.

Clearly defined roles - The governance structure of the definition of roles and responsibilities within the organisation is connected to several institutions. The reliability of the employees increases by clearly defining the roles of the employees, because it is more clear for the actors that interact with them, what to expect from them and who is responsible for a specific task. Also, this reduces opportunistic behaviour in which every employee can be deployed in the most efficient way. That the roles and responsibilities are not clearly defined can be derived from the fact the organisation exists from a fragmented nature and the lack of uniformity of the organisation. Moreover, clearly defined roles are assumed to provide better insights into the marginal conditions of the internal capacity of DSO.

Forecasting capabilities - Forecasting capabilities can contribute to efficiently managing future workload and capacity. It can influence the future workload by working proactively. At the moment, working proactively is in conflict with justifiable investments and affordability. Because it is not sure

[12] Interview with TS

when and if the made investment will be earned back. Elements that can help the forecasting capabilities of the organisation are data processing, data usage and prioritisation.

Lack of uniformity - The lack of uniformity is a product of the unbundling and fragmentation of the organisation. That leads to unclearly defined roles, different ways of prioritisation, data processing and other activities. A supporting IT system is a way to impact the uniformity of the organisation.

Flexibility - Flexibility is in line with service to customers by managing the projects most effectively in a unstable environment with many uncertainties. Contribution to flexibility can be accomplished through insights in capacity and workload. In which data processing and data usage can add to this. Also, prioritisation can play a role in a flexible planning, in which it can add to make augmented choices and insights in potential slide options in the planning.

Prioritisation - Prioritisation can play a role in the service to customers in the way that incorporates prioritisation for specific customers, although this may be in conflict with the non-discriminator aspect of the organisation, and therefore with the legality aspect of the organisation. Moreover, within prioritisation values such as sustainability, safety and reliability may be included. For example, in the way the organisation can give higher prioritisation to more sustainable projects. Also, the current connection period can have influence on prioritisation. Prioritisation can also play a role in forecasting, by prioritising proactively approach projects. However, currently prioritisation is connected to the lack of uniformity, because there various ways of prioritisation used in the organisation.

Data processing - This governance structure is connected to a supporting IT system, where a proper IT system and data processing can contribute to efficient planning process. Also, it is connected to reliability in the way that employees can better rely on the accurateness of the information given by the system, and rely on the available tools. Moreover, proper data processing can play a role in forecasting, lead time determination, capacity insights and workload insights. And, is connected to the extent data is used within the organisation. With better data processing, more data is considered to be used. Although, it may be in conflict with efficiency due to the more actions and activities it require.

6.3 Transaction Cost Theory

The Transaction Cost Theory will continue to approach the subject from the institutional perspective. The transaction cost model will try to provide specific insights into the functioning of the organisation with regard to its costs.

6.3.1 Observations

In this segment several observations are identified, and their workings analysed in terms of their transaction costs. The factors will be analysed in the way they react to their transaction costs, by their relation with the variables and assumptions of the theory. This will provide explanation into the functioning and managing of these factors. The factors that are discussed are argued as important factors in the planning processes and are situated on the third level of the four-layer model of Williamson [14691014]. This enables a more detailed analysis of some of the factors such as; definition of roles and jobs, uniformity, prioritisation, standardisation, information management, implementation problems,

[1]Interview with JD
[4]Interview with DC
[6]Interview with MB
[9]Interview with FA
[10]Interview with SL
[14]Interview with MV

and competency matrix.

Definition of roles and responsibilities
"The executors´ outside work is often underestimated. They often solve things that they come across in the operations, without passing down this knowledge to the planners. They just want the project to operate smoothly, so they sometimes intervene in activities that may not be their responsibility."

This executor´s decision in the operations may initially reduce transaction costs (bargaining and decision costs) for that one project by executing this opportunistically. However, because the operational decisions can influence other projects, this can lead to problems in the planning and increase transaction costs (Policing and enforcement costs) for other projects. For example, the frequency of exchange increases because there are more actions needed to remedy the impact on the other projects. As the theory explains, it is important that this type of behaviour should be avoided. Because it often results in an overall increase of costs in the long run. In the process of executing opportunistic behaviour, information is not always correctly shared between the employees [10](TS, SL). Thereby, sharing or rather not sharing information can influence other projects, which creates asymmetric information that results in increased transaction costs (Coordination costs). Results in: Less opportunistic behaviour, decrease in frequency of exchange and decrease in asymmetric information

Uniformity
"At the moment the concrete implementation of the Workforce Manager (WFM) is not clearly defined, and is also not uniform for every location."

Greater uniformity and better defined roles reduces transaction costs (coordination costs). Uniformity allows the same tool to be used in the same way, ensuring vision, preventing ambiguity and noise. When everyone knows what to do and everyone is working in the same way, it is easy to tell when someone is behaving opportunistically. Also, this will result in less asymmetric information through the organisation. In addition, if the vision is established centrally and uniformly, with a clear contact person, this will decrease the transaction costs (coordination costs). Each of these factors reduces the transaction costs, as there is less uncertainty and there is less room for opportunistic behaviour. Results in: Less uncertainty, less room for opportunistic behaviour and less asymmetric information

Prioritisation
"Prioritising becomes increasingly important. In my opinion, we are still at the beginning of the energy transition, and will it all get even more complex and an even bigger workload."

More prioritisation and more acting according to prioritisation will have to be achieved through organisational change (Search and information costs). This will decrease uncertainty, in choosing which projects should be executed next. Also, if the whole organisation prioritises and acts on the same level according to the same standards this will decrease asymmetric information and asset specificity. Because the projects follow the same way of prioritisation, this also decreases the room for opportunistic behaviour. Although, this organisational change does require more actions to be executed by the employees, where they need to follow the same prioritisation and act accordingly. Thus, this will increase the frequency of exchange compared with the current way of acting. In the long run it is considered that it will decrease the overall transaction costs. Results in: Less asymmetric information, less uncertainty, frequency of exchange increases, less asset specificity and less opportunistic behaviour

Standardisation
"In the end, the work comes down to the same thing. The steps required in a project follow mainly the same route, for example all the projects need to carry out a desk study. (...) In my opinion there is

[10]Interview with SL

little difference in the approach taken between the workflows and between projects. The only differences are in the characteristics of such projects, such as lead time."[8]

Repeatable activities that are standardised will decrease the transaction costs (search and information costs). In the way that it will result in less asset specificity, because the processes are increased in similarity. Standardisation will also lead to less activities to be taken by their employees, thus it decreases the frequency of exchange. Also, a bound set of rules leaves little room for opportunistic behaviour and results in less time spent on working out the activities thus there is less uncertainty in that part of the process. Results in: Less asset specificity, less frequency of exchange, less room for opportunistic behaviour and less uncertainty

Information management
"Sometimes when a project is delayed, a decision is made between the executor and the engineer to plan it differently. Then the change has been taken care of for them, but the short term planner does not yet have that information. Then the planner makes a choice based on old information when planning a new project. So sharing the new information is definitely important." [12]

Not sharing new information can lead to extra work in planning and associated activities (Policing and enforcement costs). It results in scheduling conflicts, thereby increasing the frequency of exchange [10]. In addition, in this statement the employees acted upon opportunistic behaviour. On the other hand, sharing current information also requires certain administrative actions that in turn lead to additional transaction costs (coordination costs). Often additional information has to be registered and shared again, which can be seen as extra ballast. But planners are completely dependent on information from others, and it is therefore important that current information is shared with each other. On the other hand, you do not want to burden busy employees, such as engineers and executors, too much with administrative work either. Therefore, the organisation has to find a balance in that. Results in: Acted from opportunistic behaviour, decrease asymmetric information and increase frequency of exchange

Competency matrix
"An engineer does appoint a competence level to a certain project, but within the competence levels the employees also differ in how fast they handle projects. A solution could be to expand the competency matrix slightly so that the organisation gets a better insight into the available capacity."[12]

In this matrix employees can observe other employees' competences. This proposed change will give more insights into the specific period of time an employee will need to finish a project and therefore can give more specific insight into the estimated working hours (capacity) of the employees. This could lead to more efficient planning, because estimated working hours and reality would be closer together. For transaction costs this could mean that fewer changes are needed in the planning to fill the gaps that have arisen due to the difference in estimation and reality. So the frequency of exchange decreases, and it also removes some uncertainty from the planning, both of which should lead to reduced transaction costs (policy and enforcement costs). Results in: Less asset specificity, less frequency of exchange and less uncertainty

Permits
"The lead time for permits and requirements set by municipalities is not going in the right direction. The municipalities demand increasingly more and more permits for the construction projects." [8]

[8]Interview with JE
[12]Interview with TS
[10]Interview with SL

With regard to the transaction costs of the projects is this not a good change. More procedures and longer lead times will result in an increase in the frequency of exchange and in higher complexity of the projects that in turn will result in an increase in asset specificity. Thus, the overall transaction costs will increase with this change (Search and information costs). Results in: Increase in frequency of exchange and increase in asset specificity

6.3.2 Reflection on the transaction cost theory

The key findings of the transaction cost theory are classified into two areas; aspects that currently cost significant transaction costs and aspects that can help reduce the transaction costs within the organisation.

The lack of uniformity, unclearly defined roles and responsibilities, and little sharing of accurate and up-to-date information in the operations are all aspects that currently costs significant transaction costs for the organisation. Unclearly defined roles and lack of uniformity leads to opportunistic behaviour, that can influence other projects, and thereby can lead to planning problems and transaction costs. Not sharing new information can lead to extra work in planning and associated activities, which results in asymmetric information. Because planners are completely dependent on information from others, it is therefore important that current information is shared with each other.

Aspects that can reduce the made transaction costs of the organisation include prioritisation, standardisation, increase in uniformity, better defined roles and responsibilities, better information management, and an expansion of the competency matrix. Firstly, better defined roles reduce the transaction costs, which will create transactions with less uncertainty and less room for opportunistic behaviour. Secondly, more uniformity leads to less asymmetric information and less opportunistic behaviour throughout the organisation. Thirdly, prioritisation reduces uncertainty in choosing which projects should be executed next. Also, if the whole organisation prioritises and acts on the same level according to the same standards this will decrease asymmetric information, opportunistic behaviour and asset specificity. Fourthly, because planners are completely dependent on information from others, it is therefore important that current information is shared with each other, in which better information management can help reduce the asymmetric information. Fifthly, standardisation result in less asset specificity. It will also lead to less activities to be taken by their employees, thus it decreases the frequency of exchange, and leaves little room for opportunistic behaviour in the standardised part of the process. Lastly, the expansion of the competency matrix results in a decrease in the frequency of exchange, and it also removes some uncertainty from the planning.

There was also one trend mentioned in the data that is argued to result in an increase in transaction costs. The trend in which the municipalities require more permits to execute a project. Where more permit procedures and longer lead times will result in an increase in the frequency of exchange and in higher complexity of the projects that in turn will result in an increase in asset specificity.

The next step in this study is to connect the outcomes of the case study and the analysis of the analytical framework to the research questions, in the conclusion.

7

Conclusion

The aspiration of this research was to understand the challenges, issues and factors surrounding the operational and tactical planning process of the DSO. To effectively examine this subject an analytical framework is created and a better understanding of the DSO was given in terms of its context, role, activities, organisation, internal processes, and internal & external actors. This was used to provide answers on the four sub questions.

What aspects contribute to the perceived difficulties of the DSO with regard its planning processes?

There are different factors that contribute to the difficulties experienced with planning. As a start, the changing conditions of the DSO and its environment influences the planning. In which the conditions of the DSO´s are changing as a result of the energy transition. One of the repercussions of the transition is a clear increase in the workload of the DSO which is shown in fig. 10. A higher workload coincides with more pressure on the planning, and makes it harder to match the current capacity with the workload. Thereby, on the capacity side there are challenges with the ageing of the current personnel and a scarcity of technically trained people on the job market. This affects both the DSO and the contractors who work for them. Also, it is argued in 5.4.1 that there are limits to what extent the internal and external capacity can be scaled up. Another aspect that influences the planning, especially the operational planning, are the unpredictable project specific variables and complexities of the operations. Some of the project specific variables are uncontrollable, such as the weather, the behaviour from external parties, and ground characteristics. Therefore it can be difficult to maintain the planning and control the activities and interactions hard and far ahead.

What are the internal and external factors that influence the planning and the way the DSO tries to manage these processes?

Several factors are described in sec. 5.8 that contribute to the distribution system operators‘tactical and operational planning challenges. Characteristic tension fields emerged from the analysis, which are represented in several cohesive clusters of factors that are connected with each other at a higher level. The three clusters are historical legacy, operational difficulties and assertive action on workload management.

Cluster 1: Historical legacy

Historically DSO is a semi governmental and regulated company that is formed through various mergers and unbundling of the sector. And, it is claimed that the organisation has a conservative working environment with a relatively old average employee age. One of the implications of the organisation‘s conservative working environment with regard to the managing of planning are the difficulties experienced in implementing organisational reforms. This aspect makes it harder for the organisation to adapt to the proposed changes to the planning process and its underlying interactions required to comprehend the energy transition. Another implication of its working environment and employees, is

the way DSO works digitally with little data processing incorporated in the processes resulting in incomplete data processing and inefficient usage of data and tools. Furthermore, the various mergers have fragmented the company resulting in little uniformity throughout the organisation, which has an impact on several areas of the organisation‘s planning. It leads to aspects such as; unclearly defined roles, different ways of prioritisation, various methods of data processing, difficulties to standardise processes and difficulties in implementing changes. It results also in more opportunistic behaviour and asymmetric information in the organisation. As mentioned the lack of uniformity influences the extent the roles and responsibilities are defined within the organisation. Better defined roles allows for better planning, controlling and managing of the roles and responsibilities. Also, it provides better insights into the internal capacity of DSO with more reliability within the interactions with the employees, less uncertainty and less room for opportunistic behaviour.

Cluster 2: Difficulties in the operations
There are several difficulties in the operations mentioned that correspond with managing planning challenges. In the operations the organisation has to take into account numerous uncertainties, complexities and variables. These variables are often uncontrollable and can affect a specific project, the planning of other projects, and the overall operational planning. Because of the substantial influence of these variables, it is thought that flexibility should be incorporated into the operational planning. However, the organisation is compelled to discard a share of flexibility due to the current high workload and capacity issue. An aspect that can contribute to flexibility in the planning is prioritisation, by allowing the organisation to make more informed decisions and provide insights into prospective slide options in the planning. Although, prioritisation can currently not be executed optimally due to the constraints of the regulatory framework. In which prioritisation can be in conflict with the non-discriminator feature of the regulations, and hence with the legality aspect of the organisation. Also, there is not an uniform method of prioritisation used in the organisation.

Cluster 3: Proactive action on workload management
Acting proactively is an activity of the organisation to manage future workload and thereby reducing the pressure on the planning, although they experience difficulties on this aspect. It is argued that the organisation has insufficient forecasting capabilities, which is valuable in working proactively. Forecasting capabilities are assumed to contribute to efficiently manage future workload and capacity. Factors that can influence the forecasting capabilities are data processing and data usage within the organisation, by providing insights into capacity and workload, increase accuracy of the information and improve reliability of the tools. However, it is argued that the quality of the data resulting from the current little data processing of the organisation, is often insufficient to provide significant insights. Furthermore, it is argued that at the moment working proactively is in conflict with the value of affordability and the regulation feature of justifiable investments. Because it is not sure when and if the proactively made investment will be earned back.

What solutions are currently being considered and implemented in and around the organisation to cope with the planning challenges?

In the research several solutions are discussed to cope with the planning challenges.

Currently solutions linked with planning challenges & factors

Solutions	*Challenges, factors & limitations*
IT system improvements - Firstly, according to respondents, discussions on solving planning challenges frequently devolve into IT system improvements. The IT system structures the behaviour of the various internal actors and plays an important part in managing information. A supporting IT system is also a way to impact the uniformity of the organisation and can contribute to an efficient and reliable planning process. Because it influences the accurateness of the information given by the system and the reliability of the tool.	Increase in uniformity Facilitate planning and communication tools Facilitate data processing & usage Time consuming Expensive Requires significant persuasion Is limited by implementation problems
Prioritisation - Another aspect the organisation is focusing on, making prioritisation more prominent in the future. Prioritisation can contribute to the decision making by making well argumented choices in the requested projects of the operations. This supports the planning in making clear and transparent choices of its activities.	Contribute decision making Can accompany values such as safety, sustainability, and customer service Can play a role in flexible planning & acting proactively Reduces transaction costs Is limited by current institutional regulations
Standardisation - Furthermore, it is proposed that standardisation of processes can be used to improve the planning processes. Standardisation may influence the decision-making by describing how actors are intended to operate in relation to a certain activity. It can result in less asset specificity, uncertainty and opportunistic behaviour within the processes.	Makes processes more efficient and increases productivity Decreases transaction costs Is limited by implementation problems, lack of data and lack of uniformity
Flexibility - Moreover, a recognised solution to cope with the uncertainties and complexities of the environment the organisation executes their projects in, is to incorporate flexibility into the planning. Flexibility by influencing the pressure on the workload contributes to the operational planning in that it impacts the extent the activities and interactions can be controlled.	Covers the complexities and uncertainties of projects Contribute to management of current activities, interactions and projects Better use of available resources In line with customer services Is limited by increasing workload and capacity issue
Acting proactively - Also acting proactively is used in the organisation to cope with the changing distribution network of DSO, that allows for a more efficient capacity use and reduced future workload. Acting proactively is thought to be dependent on the availability and accuracy of specific data, as well as forecasting capabilities that include the ability to analyse and interpret the data.	More efficient use of capacity Decreases future workload Higher investment risk Depended on availability & accuracy of data, and forecasting capabilities In conflict with justifiable investments and affordability
New Energy Act - The regulations from the current legislation are no longer argued to be appropriate for the needs of the DSO. Therefore, there are talks over a New Energy Act. The goal of the New Energy Act is to put European legislation, as well as national climate agreements and other policies, into effect. In the proposals for the New Energy Act, several changes are made that are relevant considering the planning processes and its activities.	More room for prioritisation Reassessment of unconditional obligation of connection Reassessment of maximum connection period Provide DSO's more flexibility in planning

Table 8: The current solutions linked with the intended aspects they solve.

How do the current solutions relate to the suggested improvements of the analysis of this research?

Following the previous question, how do the solutions of the previous question relate to the recommendations deduced from the analysis using the analytical framework. This answer is divided into similarities and differences between the two outcomes.

Similar to the outcomes of the analysis and the current solutions is that both argue that the DSO‘s planning challenges will not be solved by focusing on a single solution. It is a multi-layered problem stretching out in various sectors of the organisation, that will require a set of solutions. Also, it is considered that prioritisation should be given more weight in the organisation. Prioritisation is seen as an important tool to make well argumented choices, increase the uniformity, decrease asymmetric information and uncertainty. It is argued that prioritisation should be handled with more regard to the internal and external conditions of the organisation‘ environment. Moreover, both in the analysis and in the interviews is flexibility in the operational planning suggested as important, due to high influence of unpredictable project specific variables and many uncertainties.

From the analysis are also differences observed compared with the current solutions. For instance, the organisation should be more focused to improve on working digitally, data processing and data usage to create insights. Instead of implementing a new IT system, try to focus on what the system can offer. Although the IT system is an important aspect of the planning processes, if employees do not act on the data or other options the system provides, the organisation can have the best IT system but still operate inefficiently. Furthermore, while the repeatability of the processes allow for more standardisation. But considering the lack of uniformity, lack of knowledge of areas to standardise, little data processing and usage, and the implementation problems within the organisation it is considered that standardisation is currently a bridge too far. Therefore, this is not considered as a priority in dealing with the planning challenges. Moreover, increasing the uniformity of the organisation is considered that it should be more of a priority of the organisation to focus on. In coping with their lack of uniformity is, besides an implementation of a new IT system, not a proper solution mentioned. For example, improvements on this aspect can be achieved by way of better defining roles and creating an uniform method of prioritisation.

In conclusion, the key challenges of the DSO according to the findings of this case are: the increasing workload, the ageing and scarcity of the internal and external capacity combined with limits in which these can be scaled up, and the unpredictable project specific variables and complexities of the operational projects. The main factors that influence the planning processes can be clustered into three groups, the factors that coincide with its historical legacy, experienced difficulties in the operations and ability to working proactively. From the analysis the main solutions to cope with these challenges and factors are to focus on a set of solutions, prioritisation should be made more important, incorporate flexibility into the operations, improve working digitally and data processing skills, make more use of available data, and increase the uniformity of the organisation.

8

Discussion

In this section, academic discussion, the limitations of the research, and further research subjects are discussed. In the discussion the contribution of the study, and the analytical framework and its theories are reflected on. In the next section several limitations of the research are elaborated. Lastly, several further research directions are addressed.

8.1 Discussion

The value of this study to the current scientific literature is that it gives an in-depth insight into the planning challenges of the Dutch DSO. Moreover, the study provided an understanding of the Dutch DSO's context, role, activities, processes and actors all with careful attention to the tactical and operational planning processes. Although several of the identified factors are well known, the value of this research is in that it organises the factors and shows the interrelationship of the factors that influence the operational and/or the tactical planning processes, this has not been observed in previous researches. The insights of this study may steer the perceived planning challenges forward. Which in turn could save time and costs of the DSO in the expansion of the electricity grid and thereby in its objectives to cope with the energy transition.

This research also adds to the current scientific literature by developing an analytical framework that can be utilised to investigate internal elements from an organisational and institutional standpoint. The added value of the research lies in the use of combining the different theories in one framework. The analytical framework, with the combination of the images of organisation, four-layer model and transaction cost theory, provides a new and unique perspective to analyse planning at the DSO's. Due to the complexity of planning, the multi perspective approach was considered essential in comprehending the issues and challenges, and allowed the researcher to properly understand the relationships between the various factors, actors and interactions. By incorporating multiple perspectives, the researcher was required to be open for new ideas and assumptions, which provided room for new insights. Especially, the images of organisation model allowed this to happen. However, a downside is that this multi perspective research approach increased the cognitive load, particularly on the researcher, but also on reviewers and readers. This framework also helped to investigate the subject in a structured way, that goes beyond a superficial observation of the planning processes. The framework allowed to see that the various factors influences each other and hold each other in a strong hold. For example, it showed that the current way of prioritisation is not optimal, and they want to switch to a more personal and selective way of prioritisation to adhere to the value of sustainability. But, the non-discriminator aspect of the regulations and the service to customers value limits the ability to do so. Another example is that DSO is looking to standardise processes, which is difficult due to the lack of uniformity and lack of available data. Although, there are ideas to improve the uniformity, the dynamic environment and implementation problems in turn make it hard to implement these ideas. There is lasting tension in certain areas of the organisation, and it is the question whether they can overcome this with the available current options. In the next section some thoughts are given about

the applicability and usefulness of the used theories.

- Firstly, the images of organisation allowed to incorporate vast amount of perspectives, ideas and subjects using its metaphors. This gave the researcher many possibilities when analysing the organisation. It aided in understanding and identifying several organisational elements that influences the planning issues that DSO faces, using the machine, organism, brain and flux & transformation metaphor. Especially, the machine and organism metaphor resulted in many insights on the general subject of planning. Both these opposite metaphors contained many similarities and could thus be studied correctly in relation to each other. Whereas, the brain and flux & transformation metaphors, as expected, were both useful in analysing a specific part of the planning challenges. However, due to the limited time and size of this theory not all the metaphors were included into the analysis. Therefore, the researcher focused only on certain aspects relative to the used metaphor but ignored aspects that are not covered within this scope. The unused metaphors would have thrown a fresh view from a different perspective on the data. In a further research, the organisational perspective can be examined with more or different metaphors than the one used in this study.

- Secondly, the four-layer model has shown to be useful in structuring the institutions by positioning them at the four different institutional levels. It also showed insights into certain values of the organisation, and regulations that influences the attitudes of actors. The model is easily understood, in which the four levels are clearly articulated, and analysts may rapidly grasp the underlying assumptions of the levels. Moreover, the model provided a deeper understanding of certain behaviours of actors and interactions within the organisation. By incorporating different types of institutions into one framework, it was simple to identify and analyse the relationships between the observed institutions. For example, the lack of uniformity could clearly be traced back to the many mergers and fragmentation of the organisation. Which in turn influences other aspects such as, the definition of roles and responsibilities, prioritisation and data processing. While a supporting IT system could have an impact on the perceived uniformity in the organisation. However, it should be noted that only the institutional related issues could be integrated into the framework. Therefore, the sole use of this framework is argued to be limited in its usefulness. But when combined with the images of organisation model, it demonstrated its value for this study.

- Thirdly, the transaction cost theory provided a better understanding of the specific costs of interactions. It rationalises the use of an interaction. It also helped to explain why certain current processes are in much need of change. For example, unclearly defined roles and lack of uniformity in the organisation showed to generate significant transaction costs which added to the perceived importance of these issues. Nevertheless, the model showed some limitations in its analytical aspects as a model. For instance, it was clear where, why and if the costs were made in certain interactions, although it was still hard to adequately assign a specific value to this due to the broad and vague concept of transaction costs. Thereby, the focus of the theory was more on other variables such as uncertainty, asset specificity and frequency of exchange instead of direct measurements. Also, almost all the examined scientific literature of the operationalisation of the theory was focused on the choice of governance mode, between in-house producing or outsourcing. On that aspect the model showed more links than with its analytical abilities of interactions.

Overall, the analytical framework showed promising features in its ability to capture challenges and internal conflict of institutions, organisational aspects and other factors with regard the planning issues of Dutch DSO's.

8.2 Limitations of the research

This study has several limitations due to the scope of the research, the research approach and other affiliated activities. The limitations that are connected to the scope of the research will be first discussed. Due to the centered direction, this study focused only on one Dutch DSO, DSO, which implies a selection bias. The use of an exploratory one-N case study allows for the collection of insights about a specific situation, where the boundaries of the solely examined case limits the study. It would be interesting to examine other DSO's as well, as the differences in approach adopted by different operators may result in different challenges and factors, and could lead to new insights. Especially, considering that the perceived challenges as an increased workload and capacity issues, as part of the energy transition, can be encountered by other national or even international DSO's as well. A further research could be to include multiple DSO's in a case study, and investigate the differences how the various DSO's cope with the same perceived challenges, allowing them to share expertise and learn from each other. Another limitation is that the focus of this study has been on the internal perspective of the DSO. Beforehand, the study wanted to include the external actors and view the data from a network managerial perspective. But due to the sheer size of the subject and the limited time, the research only was conducted intra-organisationally. As a result there were no direct external parties interviewed such as contractors, and municipalities, with the only exception of energy system experts. A further investigation can be a research that would focus or include external actors around the planning processes of the DSO. As can seen in the fig.9, the external side of the subject is still underexposed. The sole focus on the internal organisation has limited the overall examination of the planning challenges. As the issues resolved around planning at the DSO are complex, where there is much interdependency between parties in a network of actors. The inclusion of both, internal and external aspects can broaden this examination. The proposed theory that would analyse the data from a network managerial perspective was the four core elements of process design by De Bruijn, Ten Heuvelhof and In 'T Veld (2010) 11. This way the analytical framework can be expanded with an externally oriented theory. This may uncover extra challenges, with different factors in play with regard to other actors. As you can see in this research, the DSO as actor has various wants, needs, limitations, institutions with numerous internal and external forces that determine solutions and limit improvements. This could also apply to any of the underexposed external actors. For example, the institutional embedding of a private owned company can result in totally different incentives and limitations. Another limitation of the scope has been that the research only focused on the electricity side of the organisation. Because the gas and electricity side within the organisations could not be seen completely separated from each other. For example, aspects identified in this study that are also related to the gas network include unclearly defined roles and responsibilities, lack of uniformity, standardisation, working digitally, data processing, data usage, and implementation issues with change. Further research on the same subject can be executed in the direction of the gas network or including both the electricity and gas network activities.

Furthermore, the limitations linked to the research approach are handled. Practical constraints such as a limited time and availability, resulted in that only a relatively small number of respondents were included into this study. While admitting that additional respondents presumably would have supplied more data and increased the quality of the data. Although, despite the limited number of interviews, in which many factors were mentioned, there was already considerable overlap that saturated the information with regard to the planning issues of DSO. The research is also influenced by who and on what moment the interviews were conducted. Additionally, interviews with respondents may be unconsciously biased by their own views. However, this perception bias is nearly inescapable in a qualitative research approach with a case study and a small number of interviewees. Another limitation is that the researcher interpreted the data in its own way. The researcher unintentional interpreted the interviews when selecting and classifying the relevant data for the analysis. Furthermore, there was a lot of qualitative data, so it's possible that the researcher overlooked a piece of evidence that could have been relevant to a specific theory. Although, the researcher attempts to be objective some form

of subjectivity is bound to remain, which is called interpretive bias. In this study this bias is tried to be avoided when letting the data be reviewed by peers and the data verified through other sources. Also, a limitation of the study can be pointed to the selection of the data. This is different than the interpretation because this is intentional, this can be called selection bias. In the data analysis a balance was required. On the one hand, the researcher decided what the most relevant data is, so this can be incorporated into the thesis, and give structure and direction to the study. On the other hand, the researcher want to offer value to the information gathered and not overlook crucial points of interest. As a result, it is constantly considered what to include and exclude from the analysis.

8.3 Further research

In the other segments there are already mentioned several suggestions for further research. In this section, some more promising suggestions are discussed. There are several potential influential factors which are considered to be applicable for further research.

For example, standardisation is mentioned several times as a possible solution to improve the planning processes of the organisation. Although, from the analysis the lack of uniformity, little data processing and usage, the implementation problems of organisational change, and the lack of knowledge of areas to standardise it is considered that standardisation is improbable. However, a study can be executed in trying to identify the appropriate parts of the processes that are suited for standardisation. This makes this solution more plausible. Also, in the activity of prioritisation there are still unclear aspects. Prioritisation is currently argued to be an underdeveloped aspect of the organisation, but is expected to be of more importance in the future. There may be further research to set up certain flowcharts about how to prioritise, and which variables are involved in this process. In which there can be a distinction made between prioritising on a tactical and operational level. Where it is made clear when and why a particular prioritising approach should be used. From the perspective of the analytical framework, there can be further research executed. For example, the analytical framework is focused on the internal aspects of an organisation, in which it may be used to examine other empirical internal aspects besides planning. Lastly, a further research can be executed by diving deeper into the new institutional environment, when the new regulations go into effect. It would be interesting to understand the improvements, remaining challenges and other effects the new policies have on the processes of the DSO. It could help to create a clearer picture of where the challenges of the DSO are headed.

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Appendix 1: Interview protocol explorative interviews

Explorative interviews to better understand the processes and challenges and factors that come with it. Likely to link this interview set-up to one organisation and one type of construction project.

- Short introduction of each other.
- Revist how you were connected in the first place.
- Short introduction of the subject.
- After discussing the several themes of the questions, ask the interviewee of their affinity to a certain theme. Start with that theme.
- Start with the questions with a "*" behind it, these are considered to be the most important.
- Deliberately test hypotheses, to try to provoke a reaction or their thoughts on the subject.
- Offer to come back to them later for in-depth interview, further into the study.

Themes:
Organisation

- Hoe wordt een bepaald aanlegproject tegenover een ander project afgewogen om uit te voeren?
- Waarom nemen de netbeheerders niet meer mensen aan, als ze zo te kort komen in bepaalde functies?

Planning

- Wat denk jij aan als ik de term planning zeg met betrekking tot de netbeheerder?*
- Wordt er op het moment goed gepland bij de netbeheerder? Waarom (niet)?*
- Waar is, als je kijkt naar het planningsaspect bij de netbeheerder, nog veel winst te behalen?
- Wat zijn de maatstaven waarmee de prioriteit van een project wordt bepaald?
- In het matchen van capaciteit en werklast, welke factoren spelen hier mee om dit goed te doen? En welk van deze factoren ontbreken er bij de netbeheerder?
- Hoe wordt omgegaan met het verkregen data van een project, qua planning? Worden de project geevalueerd naderhand? En worden er bepaalde leringen uit deze data getrokken voor toekomstige planningen?

Kaders en wetgeving rondom planning

- Waaraan merkt u dat de netbeheerder zich in een gereguleerde omgeving bevindt?*
- Welke regulaties spelen een belangrijke rol bij aanlegprojecten?*

Proces

- Hoe wordt een aanlegproject gerealiseerd?*
- Welke processtappen worden daarin uitgevoerd? Kunt u daar wat meer over vertellen?*
- Wat voor een problemen komen jullie tegen in het realisatieproces?*
- Waar zitten volgens u de spanningen binnen de aanlegprojecten?

Actoren & relaties

- Welke partijen maken deel uit van het aanlegproces?*
- Waar ontstaan wel eens conflicten over tussen actoren?*
- Hoe wordt omgegaan met een externe partij binnen een aanlegproject? Wat verwachten jullie van (partij)? Wat verwachten jullie van elkaar (partij) in termen van planning?

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Appendix 2: Interview protocol in-depth interviews

In-depth interviews were conducted with employees of DSO. So, in the first set of interviews the structure of the in-depth interviews was determined, in the in-depth interviews more detailed data was obtained about specific issues. The interviews with the employees of DSO are conducted with several different functions. In each of the interviews, questions were prepared for the specific functions in the organisation, allowing respondents to talk about their experience in their functions.

- Short introduction of each other.
- Revist how you were connected in the first place.
- Short introduction of the subject.
- Try to get in-depth information of the interviewee in their own expertise.
- Deliberately test hypotheses, to try to provoke a reaction or their thoughts on the subject.
- In the case there is time left in the interview, circle back to the questions of interview protocol 1.

Engineer

- Hoe bepaal jij wat je te doen staat in een project?
- Wat zijn de eerste dingen die worden uitgezocht voordat je verdere stappen onderneemt in het planningsproces?
- Hoe neem je beslissingen over hoe je de projecten gaat plannen?
- Worden de externe partijen ook meegenomen in de besluitvorming? (gemeenten en leveranciers, ook weer in combinatie van de verschillende projecten)
- Waar lopen jullie tegenaan in de besluitvorming rondom planning?
- En is dit dan voor elk project hetzelfde, of zijn er ook verschillende opdrachten die verschillen in het proces hoe die worden benaderd? En is er een classificatie aan te duiden voor verschillende projecten?
- Welke projecten zijn erg specialistisch en hebben veel aandacht nodig, en welke zijn makkelijker en kunnen meer gestandaardiseerd verlopen? Worden projecten met een hoge mate van onzekerheid op een andere manier aangevlogen dan met een lage mate van onzekerheid?
- Hoe prioriteren jullie de verschillende projecten?

Planner

- Wat zijn de bottlenecks/knelpunten die je kan aanduiden in het planningsproces bij de netbeheerder?
- Kan jij mij meenemen in de besluitvorm van de planner op het moment er een project binnenkomt?
- En is dit dan voor elk project hetzelfde, of zijn er ook verschillende opdrachten die verschillen in het proces hoe die worden benaderd? En is er een classificatie aan te duiden voor verschillende projecten? Zitten er bijvoorbeeld verschillen in hoe de 5 verschillende werkstromen worden aangevlogen en ingepland?
- De planner bepaald nu hoe veel werk elke functiegroep krijgt en wanneer die daaraan gaat werken, wat zijn de maatstaven waarop die planner werk toebedeeld aan een functiegroep?
- Wordt er rekening gehouden met aantal projecten die de functiegroep al heeft? Wordt er gekeken naar de inhoud van het project? Wordt er al een schatting gemaakt van de zwaarte van het project? Wat zijn de richtlijnen die de planner hierin aanhoudt? Zijn er richtlijnen?
- In het matchen van capaciteit en werklast, welke factoren spelen hier mee om dit goed te doen? Is de huidige competetie matrix die de functie rollen onder verdelen toereikend genoeg, om de capaciteit inzichtelijk te maken?
- Op het moment dat er in de planning iets verandert, doordat bijvoorbeeld er vervuilde grond wordt aangetroffen en er bepaalde procedures worden gestart, wat zijn dan de handelingen die een KTP moet uitvoeren?
- Komen alle 5 de werkstromen bij de planner te liggen?
- Hoe belangrijk is het delen van actuele informatie tussen de (verschillende functies) engineer en planner tijdens het project, en hoe gaat dat nu in de organisatie?

Workforce manager

- Hoe probeert men meer uniformiteit in de organisatie te krijgen?
- En hoe belangrijk is uniformiteit met betrekking tot planning?
- Hoe wordt er met externe partijen omgegaan binnen de organisatie en wat wordt van hun verwacht?

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Appendix 3: Four core elements of Process Design

Four Core Elements of Process Design
Explanation of the theory

De Bruijn, Ten Heuvelhof and In ´T Veld (2010) develop an approach to analyse the process aspects of negotiated change. The book recognizes three aspects that explain the disappointing experiences with processes of negotiated change. First, the change is often located in a network of dependencies. Change may depend on other parties which makes it harder for one party to impose a change, especially if these other parties are influenced by the change in question. Second, there is no unambiguous substantive solution where problems are often complex. The best solution for one party is rarely the best solution for another party. In other words, each of the involved parties have their own interests and views, which result in a specific best solution. Third, and final aspect, is that many changes are designed via a project approach, which includes: clear objectives, strict problem definitions and precise time schedules. But, due to the dependencies in the network, this is considered to have limited meaning. Other parties have no incentives to accept objectives, problem definitions and time schedules of the initiator when they conflict with their own interests. Therefore, De Bruijn et al. (2010) claim that a process design in a complex network with interdependent actors, a process management approach is preferred over a project approach. Process management as described by De Bruijn et al. (2010) focuses on what is required to design a process and to facilitate decision making in a complex network with interdependent actors. De Bruijn et al. (2010) identify Four Core Elements of Process Design (De Bruijn et al. 2010) which can be used to analyse inter organisational decision making processes. According to this theory, a process design should always adhere to four core elements. These elements include openness in the decision making, the protection of core values of involved parties, the process should show progress and the process should have substance. To facilitate the decision making process, all of these factors should be present to some level.

Variables of the theory
Openness
The first core element of the model is openness: to what extent the decision maker of the process adopts an open attitude. An important notion of this element is that the process should be open to interested parties. De Bruijn et al. (2010) identify three design principles depicted that contribute to the openness of a process:

All relevant parties should be involved in the decision making process
Substantive choices are transformed into process-type agreements
Both process and process management are transparent

Protection of Core Values

The second core element of the process design focuses on the protection of the core values of involved parties. Parties that commit to a process want their interests to be sufficiently addressed. If this is not the case the outcomes of the process might not be in their favour. And because it may be difficult to exit the process at a certain stage, the parties that commit to the process take a certain risk. This may create a perspective of a funnel trap for those parties. Protecting core values of the involved parties focuses on minimising the implied risk parties experience. This contributes to the appeal of the process, making it more likely that participants will contribute in a process where their core values are protected. The design principles associated with this element are:

The core values of parties are protected
Parties commit to the process rather than to the result
Parties may postpone their commitments
The process has exit rules

Progress
The third core element is the notion of progress. Where the first and second core elements are focused on discussion and negotiation, they offer not enough assurance that the process will have sufficient progress and momentum. Having many different parties involved in the process, each with their own demands and interests may cause discussions and conflict. Therefore, the outcome of the first two elements may result in sluggish processes and experience difficulties producing any results. This model suggests several design principles to ensure the progress of the process, and thereby, increasing its chances of success. The design principles that are related to this element are:

Stimulate ´early participation´
The process carries a prospect of gain
There are quick wins
The process is heavily staffed
Conflicts are addressed in the periphery of the process
Tolerance towards ambiguity
Command and control are used to maintain momentum

Substance
The fourth and final core element revolves around substance. This refers to the fact that the process should meet certain substantive quality criteria. In the case the process moves away from its substance, it may fail to achieve its initial objective. The design principles of this element are to make sure that the outcomes of the process can be considered as ´good´. The corresponding design principles to this element include:

The roles of experts and stakeholders are both bundled and unbundled
The process proceeds from substantive variety to selection
The role of expertise in the process

Suitability of the theory
As the issues resolved around planning at the DSO are complex, where there is much interdependency between parties in a network of actors. Both, internally between various functions and areas of the organisation, and externally between various involved actors. Although process management is mainly used to design a process, this part can also be used as a theoretical approach to analyse what elements of a considered good process are present at the examined organisation. DSO the project has to fit in the schedule. Is trying to be prepared for changes. The project has to be executable. The municipality wants everything to go the correct way. Will follow the rules, regulations, and procedures. Not cause troubles for the area. Not influence other projects. Customer wants a connection to the grid, at the

appropriate time. This theory could analyse the process around planning at the DSO, as it shows certain theoretical elements that are considered a good process, and see to what extent these elements are represented in the analysed process. It thereby compares how the process is organised opposite of the model of this book. New insights and information could be acquired when looking at the requirements the model suggests would result in a ´good´ process, where the resistance of involved parties is reduced.