Identifying Critical Success Factors of Climate Mitigation and Adaptation Inclusion in Dutch Road Planning.

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Abstract

99.94% of scientists believe in the effect of CO_2 emissions on climate change. To tackle this, many parts of society must become sustainable. In Dutch road projects this drive for a sustainable transition is noticed in the last few years. Currently, the actions for climate inclusive road projects have not been successful. Climate consideration are limitedly part of the scope of these projects. A lack of understanding on road planning system, and the existence of success and failure factors limits the sustainable transition in road projects. This research explores the existence and workings of critical success factors in Dutch road planning. The exploration and identification of factors is achieved by using a comparative case study approach. Three Dutch road infrastructure project were analysed. The research established three main findings (1) The lack of early (integral) inclusion of climate concerns impedes the success related to climate aspects of a project. (2) The existence of a project climate goal is essential in guaranteeing the constant inclusion of climate concerns and climate related consideration in the planning process. (3) The success of inclusion and translation of climate ambitions into goals depends on the sustainable mind-set of project organisations, political players, stakeholders and public. The findings of this research improve understanding of road planning processes and climate related transition processes. The research elaborates and corroborates critical success factors found in other disciplines. The main findings while only based on three case studies, correspond to the findings in other disciplines.

Key words: Climate, Road planning, Critical success factors

1. Introduction

At this moment 99.94% of scientist agree with the notion that the earth's climate is changing as a result of CO_2 emissions (Powel, 2017). Climate change is often named as the biggest challenge of this generation. The earth's warming will strongly impact live on earth, as weather becomes more hostile, and parts of the earth inhabitable.

Climate concerns have led to the wish for a climate neutral societal transition in several countries. Awareness of climate change and its impacts on our current world are to be embedded in every part of society, in order to fight the aforementioned challenge (IPCC, 2018).

The Dutch government wants to stimulate inclusion of climate concerns in large road infrastructure projects. Dutch roads, traffic and congestion are responsible for 21% of CO_2 emissions in the Netherlands (PBL, 2012). Dutch mobility sector needs to reduce the CO_2 emissions by 10.4 Megatons in 2030 and be CO_2 neutral in 2050 (Ministerie van EZK, 2017).

Large Dutch road infrastructure projects belong to the MIRT, Meerjarenprogramma Infrastructuur, Ruimte en Transport or the multi-annual program infrastructure, spatial development and transport. One of the goals of MIRT is improving mobility in a sustainable manner (Ministerie van I&M, 2016).

Several policies and instruments to favour the inclusion of climate concerns in road infrastructure projects have been introduced in the Netherlands. Policies as: Nationale Klimaatadaptatiestrategie (NAS, 2016) and Klimaatakkoord (Ministerie van EZK, n.d.) and guiding documents as: Handreiking Verduurzaming MIRT (Ministerie van I&W, 2017) and Klimaatneutrale & Klimaatbestendige Netwerken en Projecten (Ministerie van I&M, 2017) are put in place to guide projects to include climate concerns into the project.

The policies and guiding documents are used in Dutch road planning practice. However, this has not resulted in the inclusion of climate considerations in road infrastructure project. The road development sector is not able to translate vague climate ambitions to results. Project organisations, Rijkswaterstaat as public authority on road construction, contractors and consultancies do not yet know how to tackle this problem. Underlying reason is the uncertainty on the workings of the road planning system to the inclusion of climate concerns.

Current scientific knowledge on the workings of a climate transition in road infrastructure is scarce. The relationship between success and failure factors on the inclusion of climate concerns has not been the topic of research. As a result, current planning practice does not know how to approach this problem. Malekpour, Brown, de Haan & Wong (2017) introduce the existence of political, economic, social, institutional, technological, legal and environmental disruptors to sustainable development. Furthermore, Azhoni, Jude & Holman (2018) elaborate on how information, technology, infrastructure, institutional mechanisms and economic resources together with organisations play an essential part in climate adaptation in water management of Dutch water barriers. Specific research on factors in road infrastructure is not found.

More is written on sustainability in spatial development and sustainable/green infrastructure planning. E.g. Sola, Vilhelmson & Larsson (2018) discuss the concept of sustainable accessibility and Puodiziukas, Svarpliene & Braga

(2016) describe the importance of CO_2 reduction in road networks.

Climate can be considered as one of many spatial qualities. As such it needs to compete with other qualities and priorities of a project. While qualities can be supportive of the other interests they are mostly in conflict with one another (Hooimeijer, Kroon, Luttik, 2001). The conflicting priorities between spatial qualities relates to the problem in current inclusion of climate concerns. Therefore, it is important to note that *climate* is not a standalone quality, but a spatial quality like many others. Meaning that successes and failures on other spatial aspects can help identify factors for inclusion of climate concerns.

This research starts off with a broad definition of climate, in the form of sustainability. Sustainable development and the triple bottom line (3Ps) of Elkington (1997) form the basis of most climate policy. The broad and inclusive character of these approaches limits inclusion of climate concerns. As climate concerns are not central in the notion of sustainability, since sustainability struggles with a vast number of aspects and qualities.

To create a more workable concept a further specification of climate concerns into climate mitigation and climate adaptation is done. Climate mitigation focusses on limiting CO_2 emissions into the atmosphere and retrieving CO_2 from the atmosphere, lowering CO_2 concentrations and its impact on climate change. Climate adaptation are measures to make (aspects of) society ready for changing weather in the future.

This research addresses the inclusion of climate mitigation and adaptation in Dutch (MIRT) road infrastructure projects. MIRT projects use a similar set of phases. Of those phases the Planuitwerkingsfase (Planning phase) is deemed the focus of the research. During this phase a road is planned and decisions must be made on place and form of that road (Rijkswaterstaat, 2017). The Planuitwerkingsfase entails an extensive environmental effect study, MER (Milieueffectrapport). Central is assessing the impact of a variant of the solution to the environment (in its broadest form). It is during this phase that climate mitigation and adaptation concerns should be included.

This research uses the concept of critical success factors (CSFs) (Rockart, 1979). Central to CSFs is the vital part a factor plays in the project. These CSFs can be influenced or should be monitored by the project organisation. The factors are critical areas of the project that constitute success.

A successful climate transition in Dutch road infrastructure projects requires clarity on the workings of climate inclusion. Currently, there is no existing research that tackles the inclusion of climate mitigation and adaptation for road infrastructure projects. Therefore, this research answers the following question: "*What critical success factors in the planning process of Dutch MIRT road infrastructure projects affect the inclusion of climate into the project?* This research aims to do two things. (1) Add to the current knowledge on success and failure factors in inclusion of climate concerns in road infrastructure. (2) create understanding of the current problems in Dutch road infrastructure planning, and subsequently create potential solutions to these problems. Furthermore this research tries to answer an additional research question: *"What can be done to facilitate the successful inclusion of climate concerns in Dutch road infrastructure projects?"* With this question the research tries to establish who must intervene where to resolve the current problems of inclusion of climate concerns.

This paper is structured as follows: chapter 2 gives an overview of existing literature on factors and spatial qualities. Chapter 3 discusses methodology. Chapter 4 discusses the results, and chapter 5 ends with a discussion, conclusions and recommendations.

2. Literature review

To identify factors a literature study is performed. The method used is a keyword search in large online databases. The following keywords are used: *Adaptation, Barriers, Climate, Disruptors, Enablers, Green Infrastructure, Infrastructure, Mitigation, Motivators, Road, Sustainability.* These keywords are inserted in different databases: Scopus, Sciencedirect, Web of science, Google Scholar, Google. 43 Documents are retrieved, 33 of which are deemed relevant: 27 scientific papers, 5 reports, 1 inaugural speech.

The literature study does not merely focus on climate mitigation and adaptation factors Factors on other related spatial qualities provide insights as climate concerns can have similar factors.

73 unique success and 86 unique failure factors are obtained belonging to 18 CSFs. The aim of this literature study is two folded. Firstly, the CSFs provide guidance during this research to the Dutch sector. The question is: Which of these CSFs are relevant during inclusion of climate mitigation and adaptation in road infrastructure projects. Secondly, and the findings of this research connect to findings of earlier research. Factors identified in literature can be corroborated by this research. Table 1 shows the 18 CSFs.

Table 1: List of main CSFs of inclusion of climate concerns or sustainability in development identified in the literature. In the top left corner, the factor identified the most times is given followed by the next 17 factors in order of number of times found.

1. Information and knowledge in decision-making	7.Laws and legal standards	13.Governance and possibility monitoring
2. Inclusion in and clarity of project goals and scope	8.Institutional environment	14.Socio-economic development
3.Financial feasibility, financial incentives and budget	9. Form, mind-set and priorities of project organisation	15. Form and restrictions of design requirements
4.Participation and mind-set general public	10. Early inclusion	16. Market inclusion and incentives
5.Perceptions, misconceptions and cognitive barriers	11.Availability of technology	17. Change adaptation
6. Political decision-makers, political environment and policies	12. Participation and mind-set stakeholders	18. Type of contract

Some of the identified CSFs are seen more often than others. The decision is made to further elaborate on the main identified CSFs. On these CSFs several observations are made. The observations speak mostly of sustainability, as mentioned dealing with climate mitigation and adaptation currently means sustainable development. Therefore, most literature is aimed at sustainability.

2.1 Inclusion in and clarity of project goals & scope

The creation of a sustainable project goal helps to create sustainable project management (Kivila, Martinsuo, & Vuorinen, 2017). To make sure that goals on sustainability are formulated and are considered in the whole planning process it is important to deal with this concept early on. Early inclusion of sustainability or climate concerns can help to establish these concerns as a key element of the project (van den Herik, 2015; Kivila et al. 2017). The establishment of a goal in early planning process, embeds that goal in the planning process, causing climate concerns to become an integral part of the project.

2.2 Information and knowledge in decision-making

Information and knowledge on climate change can improve climate awareness, resulting in the need to work sustainable (Lenferink, Tillema, & Arts, 2013; Sözüer & Spang, 2014; van den Herik, 2015; Azhoni et al. 2018; Mees et al. 2018). Information and knowledge will not necessarily create awareness, yet it is a precondition. he early inclusion of sustainability relies on information and awareness on climate change. The priorities of the project organisation are also formed through available knowledge and information.

2.3 Financial feasibility, financial incentives and budget

The tension between priorities as discussed by Samset & Volden (2016) and Mees et al. (2018) is created by a limitation of financial resources, as argued by Malekpour et al. (2017). Competition of priorities influences the decision-making process. That relates to the early inclusion of sustainability goals. The budget follows project goals. Early inclusion of sustainability and embeddedness through a sustainability goal creates space in the budget for sustainability. That limits the tension between sustainability and other priorities and financial feasibility of the project in later phases.

2.4 Participation and mind-set General public and Stakeholders

The influence of the general public and stakeholders is not to be discarded. A broadly supported project and its goals is essential for success (van den Herik, 2015; Malekpour et al., 2017). Awareness of climate change is a precondition of that support. However, awareness still lacks. While information, can have a positive influence on public and stakeholder awareness, possibly achieved through education (Dhakal & Chevalier, 2017), it is not a definite solution for success. Another element in the creation of support, is the connection between project goals and needs of the general public and stakeholders. As decision-makers are mostly political, there is a strong need to satisfy the concerns and needs of the electorate.

2.5 Perceptions, misconceptions and cognitive barriers

The capability of project organisation and political arena for including sustainability in the (early) project stems from awareness. Awareness can increase the sustainable mind-set, the intrinsic need to approach the project solution considering sustainability. That mind-set requires long-term thinking (Lenferink et al., 2013; van den Herik, 2015; Dhakal & Chevalier, 2017; Malekpour et al. 2017; Biresselioglu et al., 2018). Part of the success of inclusion of sustainability can thus be attributed to the workings of the mind. The ability to translate the information and evidence on climate change into awareness of the problem, and subsequently actions in different parts of society.

2.6 Political decision-makers, political environment and policies

The aforementioned political aspect of decision-making is related to early inclusion of sustainability concerns, creation of goals and the translation of stakeholder and public needs and wishes. The view of the ruling political parties is leading in the approach to sustainability (Lah, 2017). The political parties however can be moved as they will want to satisfy public needs and wishes, as it creates their mandate to stay in power. Again, climate awareness is a precondition for sustainable decisions and policies. Unsustainable policies and viewpoints are often founded in a lack of political environmental awareness (Biresselioglu, Nilson, Demir, RØyrvik & Koksvik, 2018).

2.7 Laws and legal standards

That mind-set can be speeded up as sustainability can be embedded in legal frameworks that enforce the inclusion of sustainability (Shaw, Burch, Kristensen, Robinson & Dale, 2014; Dhakal & Chevalier, 2017; Kivila et al., 2017; Malekpour et al., 2017; Jesus & Mendonça, 2018). Laws oblige inclusion of sustainability into the project scope. The problems of awareness, mind-set of the project organisation and stakeholders could be overwritten with the implementation of a legal framework, provided that there is enough awareness and will at the higher levels of government e.g. Ministerie van I&W

2.8 Form, mind-set and priorities of project organisation

The role of the project organisation is vital, as her decisions create the possibilities for early inclusion and embeddedness of sustainability into the project scope. A lack of sustainability priorities at the side of the project organisation limits the relative importance of sustainability in the early planning project (Samset & Volden, 2016; Mees, Tijhuis, & Dieperink, 2018), resulting in limited sustainability goals and a lack of embeddedness of sustainability in the project. The importance

of one team member with a sustainable mind-set, and experience on implementation of sustainability is noted by van den Herik (2015).

3. Methodology

3.1 Comparative case study approach

This research uses a comparative case study approach. Central in a case study approach is the in-depth analysis of a real world phenomenon, and deducing what is causing that phenomenon (Harrison, Birks, Frankling & Mills, 2017). Case studies have the tendency to explain or illuminate decisions made during a certain process in a specific situation (Yin, 2009). In this research that means illuminating the decisions made during the Planuitwerkingsfase of Dutch road projects in including climate mitigation or adaptation. A comparative case study approached is used to gather extra information by comparing different cases. As mentioned, the current literature and knowledge on inclusion of climate or sustainable development is scarce. When that is the case an understanding of the system is best obtained by reviewing and analysing in depth what is happening in that system. This research is explorative in nature.

Three case studies are performed in this research. The chosen cases are Zuidasdok, RijnlandRoute, A16 Rotterdam. The selection of these cases depended on three main criteria: *(1) Project is road project, (2) project is finished or in realisation phase and (3) project is part of MIRT.*

Zuidasdok

Zuidasdok is a combination of spatial development, road infrastructure improvement and public transport improvement in Amsterdam. The current A10 Zuid will be broadened, four to six lanes, and partly routed through a tunnel. Along with that the whole road infrastructure is redeveloped to decrease congestion and improve mobility and accessibility. The spatial quality is improved by creating an integral green space, connecting different functions. The project started in 2012 and is expected to be finished in 2028.

RijnlandRoute

The aim of RijnlandRoute is to redevelop and broaden the A44 and A4 around Leiden and connect them with the N434 that is located in a 2.5 km land tunnel. The connection and broadening must decrease congestion and improve the connection from east to west and west to east. The project started in 2008 and is to be finished in 2022.

A16 Rotterdam

A16 Rotterdam revolves around solving the congestion problems at Rotterdam, around the A20 and A13. The solution is an extension of the A16. The new 2x2 road will be routed through the Lage Bergse Bos. In the region of the Lage Bergse Bos the road will be routed through a land tunnel, which is to be constructed with cut and cover method. The road connects A16 with A13 without using the A20. As a result, the congestion problems on A20 are solved. The tunnel will become an energy neutral tunnel. The project started in 2005 and is expected to be finished in 2024.

3.2 Data collection

For the collection of data and information for the case studies two methods are used. Firstly, desk research to urban planning documents and documents related to the tender procedure. A specific focus on the following documents: *PlanMER, Voorkeursbeslissing, Project-plan, Variantennota, Uitgangspuntendocument, PvE, OTB, Advies Commissie m.e.r., TB.* The Dutch road planning process is similar in all road infrastructure projects. The process is standardised, and the aforementioned documents are used in all projects. That helps to compare different cases.

The documents are retrieved through an internet search to the project. Public planning documents are publicly available, tender documents are not.

Secondly, a set of semi-structured interviews are conducted. For each case several project team members are interviewed. Based on the IPM-model (Rijkswaterstaat, n.d.), the focus is on interviewing: Technisch manager, Omgevingsmanager, Contract manager and Project manager. Other team members involved with either, early planning project or contract management are interviewed. Five interviews were held, 2 for Zuidasdok, 1 for RijnlandRoute and 2 A16 Rotterdam. The interview of RijnlandRoute was held with 3 experts at once, resulting in a list of 7 consulted experts, table 2.

Table 2: List of interviews held during three case studies

Project	Expert
Zuidasdok	Team member contract management
Zuidasdok	Team member Planuitwerkingsfase
RijnlandRoute	Technisch manager
RijnlandRoute	Contract manager
RijnlandRoute	Manager Planning
A16 Rotterdam	Advisor Spatial quality
A16 Rotterdam	Contract manager

As mentioned semi-structured interviews are performed. In the semi-structured interview, a framework of themes helps to guide the conversation, yet it does not limit the conversation to a static set of questions (Wilson, 2014). The findings of the desk research are the source of information to structure part of the interview. The conversation is open to gain new insights on CSFs and inclusion of climate considerations from the expert. Climate mitigation and adaptation are the primary themes used in the interviews. Along with a discussion of the factors found in literature. The interviews also serve as a way to corroborate and explain findings of the desk research.

3.3 Analysis of results

The documents are scanned for climate mitigation and adaptation aspects during the desk research. The scan results in a list of aspects belonging to 7 categories: *Sustainability & Spatial development, CO_2 & Energy, Materials & Waste, Water, Market & Construction, Air quality and Climate resilience.* A few notes on these categories. Sustainability &

Spatial development is not a typical climate aspect, yet this aspect can help to identify sustainability/climate concerns, goals, criteria and an overall sustainable mind-set. As mentioned earlier the sustainable mind-set can be a strong indicator of the success of climate inclusion.

Market & Construction focusses on how climate is part of the tender and challenges to the market, and how it is part of the considerations on construction. Air quality is limited to the impact of greenhouse gasses except CO_2, the approach to air quality can provide insights for the approach to CO_2. Climate resilience, is about being prepared for climate change. It is the purest form of climate adaptation, it is included to analyse whether the concept of climate adaptation or resilience is specifically included, or whether it is merely part of other aspects e.g. water management. Energy & CO_2, Materials & Waste and Water are considered self-explanatory.

The categories, Energy & CO_2, Materials & Waste, Construction and Market and Air quality relate to the climate mitigation part of climate concerns. Water and Climate resilience relate to the climate adaptation part of climate concerns.

The categories are analysed, by creating timelines of each category. The timelines create an overview of when certain aspects are introduced, when they are eliminated and when they are sustained. It also helps to connect earlier ambitions to later measures. The prime focus of this research is to understand how inclusion of climate concerns is achieved. However, it is worth looking at the whole timeline to understand if that inclusion was successful, as that tells something about the impact of a specific moment and way of inclusion on the success.

The timelines result in a list of factors, as it becomes clear what factors impact the introduction, elimination or maintaining of climate mitigation and adaptation elements.

Lastly, the timelines and findings of each case are compared to create a comparative analysis. This comparison helps to strengthen confidence in findings and distinguish missing factors. The comparative analysis is a horizontal analysis (Bartlett & Vavrus, 2017) as the cases are of similar scale and size and happened in a similar timeframe. A horizontal comparison eliminates possible factors that have to do with the scope and size of the projects. The comparative analyses can fairly compare different strategies and existence of factors.

4. Results

Through the case study approach and the analyses 89 positive and 34 negative factors are identified. 7 factors can be considered both positive and negative. 47 factors corroborate the literature findings. The factors belong to 15 overarching factors see table 3. The 13 overarching factors are analysed on their criticality. CSFs are critical when they fall into one of two categories (1) Elements that are essential for the success of a system or project and are in the sphere of influence of the project organisation. (2) Elements that are not necessarily in the sphere of influence but pose an important problem for the success of the project (Boynton & Zmud, 1984).

Table 3: CSFs contributing or disrupting inclusion of climate mitigation and adaptation found in three case studies.

1. Information and knowledge in decision-making	9. Early inclusion
2. Inclusion and clarity in project goal and scope	10. Availability of technology
3. Financial feasibility, financial incentives and budget	11. Participation and mind-set stakeholders
4. Participation and mind-set general public	12. Form and restrictions of design requirements
5. Perceptions, misconceptions and cognitive barriers	13. Market inclusion and incentives
6. Political decision-makers, political environment and policies	14. Type of contract
7. Laws and legal standards	15. Time
8. Form, mind-set and priorities of project organisation	

Of all CSFs one new factor is observed. A part of the (lack of) inclusion of climate concerns in the three case studies is attributed to the time it happened. In all three case studies the start was troublesome. No ambitions or goals concerned with climate were voiced. All three planning processes started around 2010, when climate change was of less concern. All cases show inclusion of climate concerns in later phases, partly as a result of changing perceptions and increasing environmental awareness. This CSF is interesting as it shows that changes in mind-sets, policies etc. over time improve inclusion. The CSF time is not usable as CSF as no actor is able to influence it.

The CSFs and other gained insights help to construct a conceptual model of the situation of inclusion of climate concerns (climate mitigation and climate adaptation). Figure 1 (p. 9) is an abstract representation of that full model. The conceptual model combines the understanding of the Dutch road planning system with the identified CSFs. By analysing the steps to be taken to include climate considerations in the conceptual model, five main problems of the current situation are identified. These problems obstruct current inclusion of climate considerations and the successfulness of project in terms of climate transition. These five main problems are as follows:

4.1 Lack of early inclusion

This research identified the lack of early inclusion of climate mitigation and climate adaptation in road infrastructure projects in line with the findings of van den Herik (2015) and Kivila et al. (2017). Essentially, that means that climate concerns are included later, during the end of the Planning phase or during the contract phase. As a result, the later included elements do not align optimally with earlier decisions. As the place and form of the road (and tunnel) is established the solution space for climate mitigation and adaptation measures has become limited. It is worth to note that the concept of sustainability was found in the projects. That means that the inclusion of sustainability does not necessarily lead to climate concerns in the early project.

4.2 Role of project actors

As figure 1 shows, the early inclusion of climate concerns is impacted by tension between the four main groups of actors, project organisation, political actors, general public and stakeholders. These are the main actors in the process their interests in including climate concerns as part of the project scope is essential for early inclusion. How the project organisation and political players approach the inclusion of climate concerns depends on their own views. As was noticed, project organisations as of now lack the experience and knowledge to do this corresponding with Samset & Volden (2016) and Mees et al. (2018). Their climate priorities themselves are also limited. That has two reasons, firstly the climate mind-set might be unsatisfactory, part of improving that mind-set can be achieved by creating awareness through information. However, it can also be the lack of adequate national and regional policy that creates an ignorance for project organisation and political decision-makers. Improved knowledge and research on climate change and manners to tackle this will not solve unwillingness at the political or project organisational level. It will help the organisations and political players that are willing to include climate concerns.

The difficulty of early inclusion of climate concerns by decision-makers is enhanced by stakeholders and general public. The interests of these two groups influence the priorities of decision-makers. It is however works both ways. As it is the project organisation that involves these actors in the process. As was established in the research project organisation are currently capable of creating public and stakeholder interests for sustainable solutions. This provides opportunities for climate concerns, as it is key for success (van den Herik, 2015; Malekpour et al., 2017).

4.3 Mind-set and cognitive problems

The mind-set of actors is discussed as important as argued by (Shaw et al., 2014; Dhakal & Chevalier, 2017; Kivila et al., 2017; Malekpour et al., 2017; Jesus & Mendonça, 2018). Related to that are two main cognitive hindrances, identified in this research are worth noting. Firstly, the widespread believe that climate concerns are best addressed by the contractor in the later phases of the project, since climate measures are detailed measures that do not have to be addressed during the urban planning process. As a result, the solution space to involve climate mitigation or adaptation measures is limited and the result sub-optimal in terms of climate inclusion. Secondly, the view of doing a sustainable project as opposed to doing a project sustainably. The added value of addressing sustainability in each project is neglected. What is seen there as well is the incapability of Rijkswaterstaat to think of the extra value of inclusion of sustainability or climate concerns in all project. Rijkswaterstaat is the executive branch of the Ministerie van I&W, and is primarily focused on delivering road projects, or in other cases climate mitigatory projects such as wind turbine parks. An interesting note, the research shows that the existence of one or a few human drivers of climate concerns can have a large positive effect on the project.

4.4 Climate goal and competing priorities

If early inclusion of climate concerns (adaptation or mitigation) succeeds, it still needs to be translated into climate goals. The competition of climate goals with other project goals e.g. mobility, liveability and ‘inpassing’ is not easily won. The research shows that sustainability is often a part of other goals, a lower goal or side-effect. As a result, it is not given the same weight, which decreases the impact of that goal in later decision-making processes. the competition with other goals and spatial qualities is not new as shown by Hooimeijer et al. (2001). The relative importance of climate concerns as compared to other goals is important in the trade-off made during decision-making. Observed is that the importance of mobility and liveability is currently much higher than sustainability or climate concerns. Part of the problem, is that the ‘inpassing’ and liveability issues are seen as part of sustainability. as a result, a project can consider itself sustainable without ever addressing climate mitigation or adaptation. However, it also shows the possibilities, liveability is a concern of the public and stakeholders, their involvement impacts the decisions in favour of liveability. From that it can be concluded that if the stakeholders and general public support a spatial quality it can heavily impact the inclusion of such aspect.

4.5 Climate concerns in trade-off and decision-making

Trade-off in decision-making are based on project goals, it is there that a climate project goal is important. Furthermore, early inclusion and a climate goal guarantees a place for climate mitigation and climate adaptation in the budget. The financial feasibility is not to be impeded. Financial aspects do create extra tension in decision-making processes, as the budget is limited and extra (climate) measures can be expensive and in line with the findings of Malekpour et al. (2017). The decisions of the urban planning procedure result in requirements, the solution space, possible climate challenges to the market and the use of instruments to reach those challenges. The research shows that several of the instruments succeed in including climate adaptation or mitigation measures. The contractor is triggered to include such elements in the design. However as mentioned earlier the solution space is narrow and did not foresee measures related to climate concerns. In the end this all leads to a decision for a design, and a design with a certain grade on inclusion of climate concerns.

5. Conclusions and Discussion

5.1 Conclusions

The fundamental problem of climate concerns in road infrastructure projects is the problem of early inclusion. This problem with early inclusion is in line with the findings of van den Herik (2015) and Kivila et al. (2017). It is essential to

understand how this comes to be. There is a gradually increasing wish for sustainable projects and considerations of climate change. As proven by a set of policy documents and guiding documents. Increasingly, collaboration documents are used by project organisation to create shared sustainable visions between actors. However, as of now there is no translation of those visions in goals. This suggests that sustainability can only be embedded in project goals, through the experience and knowledge of the project organisation in early project phases. What is noticed in the research is that this ability is growing, especially with regard to the broader concept of sustainability. However, as of now the connection between sustainability and climate is corrupted. Profit and People aspects of sustainability (based on 3Ps) are often prioritised above the Planet component. Two notes must be made on this. (1) There is logic in that, climate problems are vague, currently small and do not immediately impact society (although the world is currently feeling the first effects). Aspects related to Profit and People are easier noticeable on shorter time frame. (2) Road infrastructure is not special in this. In all sectors the tension between the importance of climate concerns and the subsequent climate mitigation and adaptation measures and other liveability and profitability concerns is felt, consider the enormous struggle between sustainable energy sources and fossil fuel-based energy. A tension that was also described by Samset & Volden (2016) and Mees et al. (2018). And that tension makes it difficult to create early climate project goals, as some actors will not find themselves in that. Furthermore, a road infrastructure project is mainly focussed on resolving mobility issues and therefore climate concerns will not be prioritised over the main project goal.

Where to go from there. This research identifies the main problems in road infrastructure planning and sustainability or climate concerns. In this research climate mitigation and climate adaptation have become separated from sustainability and sustainable development, to illuminate how climate mitigation and adaptation can be achieved. It is difficult to say if that works. On one hand current practice, focussed on sustainability, usually does not address real climate concerns, but remains focussed on People and Profit. On the other hand, the enlarged focus on climate mitigation and climate adaptation does not account for the 'inpassing', meaning how fit these concerns in larger set of goals and objectives. This is where it seems that the true problem lies. Taking on project in a sustainable matter can only achieve real sustainability if it accounts for climate matters and climate solutions can only be achieved if it is in line with other objectives to create support.

This research provides an interesting new contribution to the field of climate change related infrastructural transitions. The existing literature does not yet address the issues in the implementation of sustainability or more specific climate mitigation and climate adaptation measures in road infrastructure. The findings of this research corroborate earlier findings in different yet related disciplines and connects them to road infrastructure planning. The three main contributions are: (1) The identification of problems in the early inclusion of climate concerns, (2) the alignment of climate concerns and other goals and (3) the creation of climate goals. These problems are not problems specific to the field of road planning but relate to other spatial development and climate induced transition projects.

This research also has more practical applications. The main struggle identified is the early inclusion of the concept of climate change within the project scope. This lack of inclusion is mainly attributed to the project organisation and political arena. The research has shown that inclusion of sustainability in project and project goals does not result in climate related solutions. This can be attributed to mind-sets of main actors. Current practice can be enhanced to better include climate concerns into early project planning. However, the success depends highly on the wishes of project owner Rijkswaterstaat. In order to improve the current practice in Dutch road infrastructure planning mind-set of decision-makers must be changed.

5.2 Discussion

The validity of the results of this research are limited by the case study approach. As seen many of the main result correspond with the findings of the literature. That improves reliability of results however to a limited extent. The difference in three case studies already shows that some of the findings only relate to one case. However, the number of interviews conducted is low, only seven. This limits the confidence in the findings, as it are only seven more or less opinions that are considered.

The research takes a pragmatic approach to climate issues. Roads and traffic are currently by definition detrimental to the climate. The idea is: if there must be a road, let it be climate friendly. This research looks at the solutions of the near future, 'tomorrow' so to say. What that means is that the need to create climate friendly roads is intertwined with our current way of mobility. That also means that in these findings can become less relevant in the time after 'tomorrow'. Technological advancement can for instance lead to a society which only uses electric cars, the need for a climate friendly road might be less of an objective, since much of the emission are already resolved. Or roads might become redundant, as new smart green ways of travel are used as substitution. The specific findings on road infrastructure might have become less relevant. However, the findings on the (early) inclusion of climate goals and tension between goals, and within the sustainability concept are relevant for a much broader application.

A last limitation is the analysis of the political decision-making process. This researched focussed on different results of each phase but did not address the political debate leading up to decisions. This process is interesting as it provides more insight in the way priorities and weighing of interests in done.

5.3 Recommendations

On the basis of the conclusions and reflection several recommendations for future research are made. It is recommended to do a quantitative research to CSFs in road planning. The research should include a large sample size of experts, to analyse the perceived significance of CSFs. Furthermore research to the success and workings of early inclusion and goal creation is advised. An ex-post evaluation of the success of collaboration tools in early inclusion can enhance the knowledge of their success, and analyse what it is that makes them a success.

This research used slightly dated case projects. A series of case studies to current projects is advised. This research focussed on the Planuitwerkingsfase, however a focus on the Startfase, that is part of the Planuitwerkingsfase, might give insight in the current success of policies and tools for early inclusion of climate concerns.

Lastly it is suggested to check the CSFs in road planning context of other countries. Are the CSFs specific to the Dutch context, or are can they be applied to a wider context?

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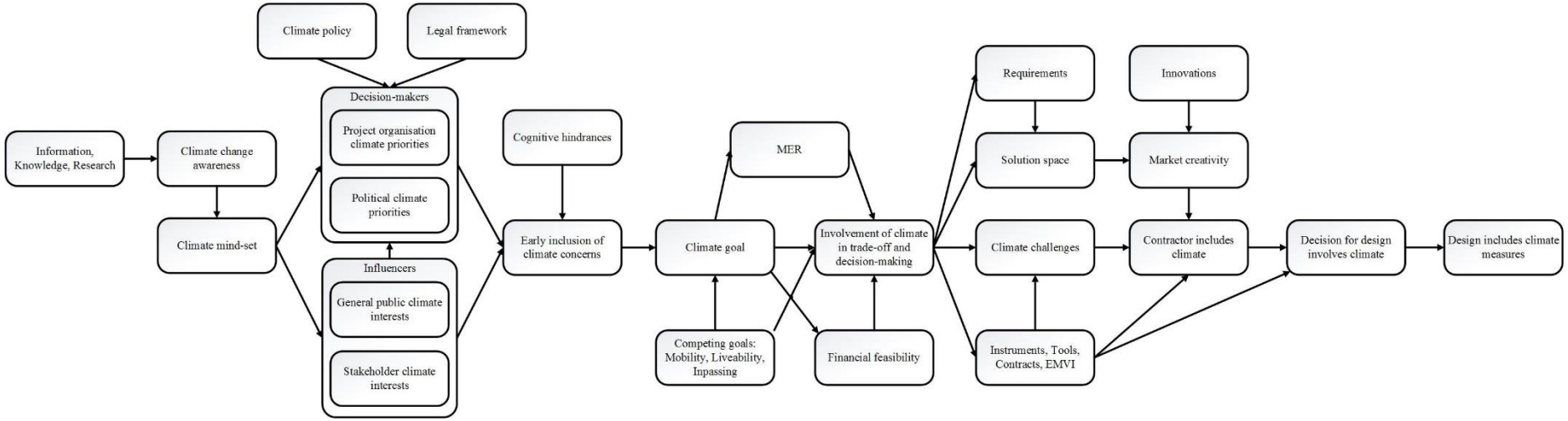

Figure 1: Conceptual model of identified CSFs contributing to the inclusion of climate concerns in Dutch Road infrastructure projects.