



BACHELOR THESIS

PREPARING AN INTERACTIVE PLANNING TOOL FOR USE IN PROJECTS IN INDUSTRIAL AREAS AND BUSINESS PARKS

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Summary

In order to combat the negative effects of climate change, more and more projects are shifting towards the use and implementation of climate change adaptation measures. There are emerging new demands and requirements for innovative ideas which contribute positively to the environment. As such, interactive planning tools are being used in meetings between stakeholders to see in an augmented reality how the way they shape the project affects the land and environment. An example of such an interactive planning tool is STAIN, a tool which ensures that climate change adaptation is achieved by helping stakeholders make a resilient and sustainable design. STAIN is a relatively new tool developed by Royal HaskoningDHV. It has thus far been used in some projects in urban areas or mixed land-use areas, but has only now started to be used in projects in industrial areas and business parks.

This brings us to the aim of this research. This research seeks to prepare STAIN for use in projects in industrial areas and business parks by conducting a literature and empirical research. The research will explore what are the applicable climate change adaptation measures in the designated areas and important things to note when it comes to public-private collaboration in projects and workshops, as these highly affect the outcome of the projects and climate change adaptation.

The research was divided into four phases: literature research, empirical research, comparison of findings from literature and empirical research and synthesis of the final list of recommendations for STAIN.

Literature research was done in three areas: climate change adaptation measures with the focus being on industrial land, important aspects of the public-private collaborations, such as what factors set the tone for the collaboration, how collaboration is achieved, based on what policy guidelines and what how the division of finances and risk affect the end product (the completed project). Through literature research, some CCA measures were identified, but these measures were not exclusive to industrial areas and business parks, but rather more general. Many important findings were made regarding PPPs: these findings were grouped in categories depending on what part of the PPP was affected. Essentially, the biggest issues were a lack of good communication between both sides, private parties and public ones not finding common ground due to them having different priorities and risks (with the municipalities being more controlling/demanding even though the private actors share the most financial risk).

Empirical research considered of reports of projects which included the measures that were chosen for the final product and several interviews with experts. The focus of the analysis of the reports was to identify measures and the focus of the interviews was to obtain the missing context and a broader view on how meetings between public and private actors go. In empirical research, more CCA measures were identified, but unlike in literature research, these measures were more specific and practical. The measures in empirical research were not classified based on the type of measure there were (unlike in literature). On the other side, more practical information could be found through empirical research, such as definitions, effects they had on the environment and which types of actors were more suitable for the measure (private, public or both). As for the findings regarding PPPs, the findings in empirical research largely matched those in literature. The same issues that were found in literature were confirmed by the interviews in empirical research, which made the problems that need attention evident.

Lastly, literature findings and empirical research findings were thoroughly compared (the comparison of the findings of CCA measures and PPPs was done separately). CCA measures were selected for the next stage based on whether they appeared in both literature and empirical cases, or, if otherwise, they were deemed to be a useful measure for achieving CCA. The advice regarding PPPs was constructed from common points from literature and empirical research. In essence, it demonstrated the need for closer collaboration between both parties and a larger strive from the municipalities to provide clearer information and plans to the private actors, as well as the need to try and make regulations less restrictive. The analysis found that raising awareness is often overlooked but very important to do, and that

information should be exchanged more not only between public and private actors within a project, but also between public actors from different regions. Based on these findings, a draft list with recommendations for STAIN was made, which was discussed with an expert of the field. After the validation of the list, the final recommendations were compiled. These consisted of a list of the measures that are to be included in STAIN as possible input for future projects, dividing them into climate change measures and interventions, as well as the four resilience factors which STAIN works with, a detailed description on the changes that can be made on behalf of public and private sector to achieve better and more effective collaboration, and a small section on extra recommendations that could help experience with STAIN better and more informative overall.

Preface

This report, titled "Preparing an interactive planning tool for use in projects in industrial areas and business parks" was made as the graduation assignment for the program of Bachelor Civil Engineering from the University of Twente. The research was commissioned externally from Royal HaskoningDHV. From the first contact with Ms. Micheline Hounjet, which was very positive and interesting from the start, I immediately wanted this to be my assignment. During the assignment, I have gained a lot of new knowledge and insight in how companies work with the constant help and support from Ms. Hounjet.

Unfortunately, office visits and work at locations was not possible due to COVID-19, but nevertheless, I am more than pleased with the whole experience. I would like this opportunity to thank everyone from Royal HaskoningDHV that helped me with the research. I also want to thank my internal supervisor, Ms. Joanne Vinke - de Kruijf, for helped me tremendously with the shaping of the research and elaborate feedback.

Finally, I also want to thank my family and my friends who supported me during this research.

Alesia Frangu,

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List of Abbreviations

BGI: Blue-Green Infrastructure

CCA: Climate Change Adaptation

EU: European Union

MRE: Monitoring, Reporting and Evaluation

NBS: Nature Based Solutions

PPP: Public Private Partnership

SUDS: Sustainable Urban Drainage System(s)

1 Introduction

1.1 Problem Context

Climate change, a major challenge in today's society, is becoming more and more important and a present topic in urban projects (Ten Brinke, 2021; Tyler and Moench, 2012), and increasingly so in the early stages of these projects. This is because of the potential (negative) impacts on infrastructure and possible financial, societal, and economic implications (Schweikert et al., 2015).

At present days, it is widely recognised that climate change adaptation (CCA) in cities is vital when it comes to reducing climate related risks (such as heat stress, flooding, and drought to name a few) (Rauken et al., 2015). CCA as defined by Ten Brinke (2021), is the “physical adjustment of the urban system to accommodate current and future impacts of climate change” (pg. 2). The Netherlands, is also giving more attention to CCA, since larger distress is being caused by climate change related events (Mees et al., 2018; Ten Brinke, 2021).

Projects that are garnering more attention and focus in planning policies, especially when it comes to CA, are projects in industrial lands (Louw and Bontekoning, 2007). Industrial land is defined by Needham and Louw (2006) as “the land used by commercial manufacturing and services (including offices)” (pg. 77). A distinction must be made between industrial land and industrial estates. Industrial estates do not include offices in them. Furthermore, land used by public services is recognized as a separate element and not part of the industrial land, meaning that not all industrial land is on industrial estates and not all land in industrial estates is used as industrial land (Needham and Louw, 2006).

To ensure an effective application of the climate adaptation agenda in a project, different stakeholders and project developers must come together from the very beginning to present their ideas and contribute with their expertise. Not only does this ensure that better collective decisions are taken, but it also increases legitimacy and adds to procedural advantages (McEvoy et al., 2017). This is already recognised on a governmental level. In the latest Spatial Planning Act (Ministerie van VROM, 2006), “collaboration between public actors, societal organisations, citizens and companies is needed to effectively handle problems and to seize opportunities” is recognized as a management shift (Heurkens, 2009, pg. 3). To increase and ameliorate collaboration between stakeholders in the design phase of such projects, interactive planning tools have been and are being increasingly developed (De Bruijn et al., 2018).

Based on the publications by Jägbeck (1994) and De Bruijn et al. (2018), a definition of an interactive planning tool can be constructed. An interactive planning tool is a model (physical or digital) of a real-life setting where the environment depicted in the model can be changed interactively by those involved in the project by making use of knowledge stored in the database of the model or the expertise of the stakeholders involved. Elements added to the model can be tailored, combined, linked and revised so as to construct a preferable solution with the indication of all stakeholders involved, or to gather new knowledge.

One of the recently developed interactive planning tools is the STAIN tool: the tool which this research is about. STAIN is an interactive planning support tool which is employed in workshops where different stakeholders are invited, all who are affected by the design or affect design choices in a project. Through STAIN, stakeholders can all add design elements and visualise the solutions (RHDHV, 2021).

The reason why planning tools such as STAIN are important when it comes to CCA measures is that such a tool ensures the achievement of resilience and sustainable solutions, both of which are closely linked to CCA. Resilience reflects the degree to which a system can absorb an external shock and remain in the same state, as well as its capacity for self-organisation (R. Klein et al., 2003). Here it can be seen that resilience is not enough to achieve climate change measures, since by definition the situation goes

back to its pre-existing state, which is why when it is combined with sustainable actions it results in the desired outcome for CCA (Carter and Connelly, 2016). While resilient design ensures stability and adaptability to unforeseeable events, sustainable design ensures minimal negative environmental costs and an added temporal aspect. Climate change impacts are also temporal, since they develop over time and require different reactions and investments (Schweikert et al., 2015).

1.2 Problem background

Until recently, land for economic activities has been peripheral in planning debates, and this is not the case for land that is strictly designated for economic activity (i.e. industrial lands), but also for mixed-use developments where part of the land is industrial land (Louw and Bontekoning, 2007). About 31% of all employment in the Netherlands stems from industrial estates (Needham and Louw, 2006; Ruimtelijke Planbureau, 2004): it can be deduced from this how important the planning and the way that industrial areas and business parks are handled are. Currently in the Netherlands, policy attention for industrial estates is shifting from an emphasis on quantity to quality (Louw and Bontekoning, 2007). This policy development and the urgent need of CCA measures in cities has prompted the rising demand and requirements for CCA measures in industrial land. It is important to note that the phrase “industrial land” in this report includes industrial areas/estates and business parks.

As mentioned before, stakeholder collaboration is important in urban projects. Good collaboration is not only of particulate importance for STAIN itself, but also the application of CCA measures. Eckersley et al., 2018 reinforce the notion that good collaboration between the private and public sector is extremely important in addressing the challenge of climate change.

Nevertheless, even though good collaboration between public and private actors is of such importance, there are gaps in literature exploring the nature of public-private collaborations in CCA (Tompkins and Eakin, 2012), and thereof a lack of a clear understanding of characteristic traits of these collaborations and process-hindering factors. Furthermore, there is a lack of literature that links different stakeholders and preferred measures for climate adaptation (Adelle and Russel, 2013), and the extent to which they adapt CCA measures, especially when it comes to the private sector (Ten Brinke, 2021; Tompkins and Eakin, 2012). To date, discussion about adaptation and has focused on the public sector, whereas discussion related to the private sector has focused on its potential as a funding source of adaptation (Agrawala et al., 2011). Climate adaptation is a new policy area (J. Klein et al., 2017). Ergo, there is a lack of understanding of implications that current policies and settings might have on CCA and the approach that should be taken to materialise CCA measures.

Another important aspect of CCA is the scale it ought to be applied on. It is essential to address climate change implications at the appropriate level (EEA, 2016). First and foremost, climate change impacts have a localized nature (Torabi et al., 2017), which is why CCA measures should also be applied locally. As such, extra responsibility falls on municipalities for building resilient cities with measures against climate threats (Walsh et al., 2013).

After pinpointing the unclarities and the drivers of action stated above, it is seen that literature research should focus in two main areas: possible CCA measures and public-private partnerships/collaborations. The way with which the literature research was conducted and the conditions set are explained in detail in **SECTION 4**.

1.3 Introduction of STAIN

This section provides an introduction of the interactive planning tool – STAIN – around which the research revolves.

This tool, developed by Royal HaskoningDHV (RHDHV, 2021), is used in planning and urban projects that require resilience and climate change adaptation, where many stakeholders are present.

STAIN starts with a dark map of the city/area in question, upon which stakeholders add potential design choices in different colours. Each colour corresponds to the following resilience factors: “Robust” (pink), “Flexible” (orange), “Integral” (green) and “Redundant” (blue).

Robustness refers to the strength within systems that allows them to continue functioning during a disruption (Index, 2014). **Flexible** refers to measures that deal with the uncertainty of possible changes. **Integral** measures encourage information exchange and the use of multiple mechanisms/systems to build resilience across different scales. **Redundancy** ensures that systems built are efficient and with back-up capabilities when systems fail (Index, 2014).

Integration is therefore proposed between urban systems which contribute to building resilience; particularly within any systems that require information exchange to function effectively. Integration encourages the use of multiple mechanisms or systems working to build resilience at and across different scales (Béné et al, 2012; DfID, 2011; IRWG, 2012).



Figure 1: An example of STAIN’s graphic interface, with some of the possible solutions shown as an example (RHDHV, 2021)

First, different stakeholders explain to each other what they think the issue in an area is, then they discuss together what solutions are needed. Then, they add to the map what they think should be

implemented based on their knowledge and expertise: in other words, the solutions they would want. They can select options from an array of pre-programmed CA measures and possible solutions, such as water storage, road profile adjustment, different types of roofs, and so on. Once an object (representing a solution) is chosen and added to the map (provisionally), the position and scale of the object and the approximate area that is affected by it are determined. Other qualities of the object can also be specified while giving the input for it, such as costs, implementation time, social Impact, and so on (Figure 2).



Figure 2: Specifications of a measure/solution in STAIN

The term of the measure can also be specified with one of the following options: “Existing”, “Short term”, “Middle term”, “Long term” (Figure 3) ¹.

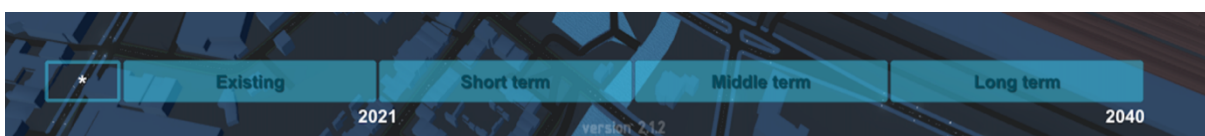


Figure 3: Solution term in STAIN

After all stakeholders are finished with this step, then, the process of finding a combined solution with measures that do not overlap or clash with each other begins, by making use of the visual representation of the elements on the map. The elements added to the map can also be linked to each other, if there is a connection between elements or if they affect each other.

Stakeholders can make various changes at this point to the map, such as altering the position of the solutions to find the best combination and adjusting their size, until all needs are satisfied, and they come to an agreement about the final design.

By making sure through this process that components are not used individually and in an exclusive manner, but rather inclusively alongside other components in a flexible way, resilience is achieved (Tyler

¹ The years have been chosen arbitrarily simply for demonstration purposes. In this case, “2021” represents the start year of the project and “2040” represents the end year. These years can be specified in the opening menu.

and Moench, 2012).

1.4 Research Relevance

Albeit having been used in multiple projects and case studies so far, STAIN has yet to be used in industrial areas and business parks. This is because there is not one universal set of input measures in STAIN for such areas. This is for two reasons. Firstly, STAIN has not been used in projects set in industrial land exclusively, but rather, in cases where there was industrial land, this type of land was mixed with other types of land. Secondly, there are gaps in literature about CCA measures in industrial areas and business parks as well as regarding the use of interactive planning tools such as STAIN, especially when there can be great differences in the power dynamic between public and private actors, a dynamic which affects the chosen measures (Power dynamic between public and private actors in collaborative projects will be explained more in-depth later on).

In the areas where this research focuses on, there are many different private actors alongside public actors. Private actors hold great power as they own a big portion of the land (Ten Brinke, 2021; Van Der Krabben and Buitelaar, 2011), but nevertheless have to comply with the local governments' requirements and wishes, as these are the bodies that hold the legal power (Hobma and Jong, 2016). All these actors have different interests and drivers which affects which measures they lean towards. To add to this, the municipal choice of the way the area will be developed heavily affects the development process (Leväinen and Altes, 2013).

Considering all the above, there is no clear idea about what the actors' interests are and the solutions they yield regarding CCA measures in industrial land which can be used as input for STAIN, nor is there a clear understanding on the development of public-private partnerships in these projects and how this affects the design of the area, which can be used as input for the STAIN workshops with stakeholders.

1.5 Research Aim and Questions

The research aims to explore favoured CCA measures in industrial areas and business parks and policy factors which affect the design process, in order to make a list of recommendations for improving STAIN and adapting it for use in the designated areas.

From the Research Objective, four research questions are derived:

1. *What are preferred CCA measures and important aspects of PPPs (public-private partnerships) in industrial lands according to literature?*
2. *What are the chosen CCA measures and important PPPs aspects in selected completed and on-going projects?*
3. *To what extent are the findings in literature review reflected in the empirical cases?*
4. *What are the recommendations about measures to include in STAIN and what advice can be given for handling communications and workshops?*

The end product of the research will be an elaborate list of recommendations focusing in two directions: (1) the measures that should be added to STAIN for industrial areas and business parks and recommendations about the tool itself (for yielding better results) and (2) recommendations for the STAIN workshops and project development for achieving a better and more understanding collaboration between the different actors.

1.6 Thesis Outline

Figure 4 gives a clear and simplified overview of the research. Based on the research questions, the research has been divided into four phases: each phase corresponding to one research question.

The first part of the research to be discussed is literature research (first phase, pink boxes), which will be grouped in two categories: CCA measures and collaboration dynamics in PPPs. Then, the dissection of the second phase (blue boxes) follows, which consists of collection of empirical data in different forms. The collected empirical data consists of: (1) reports of two completed projects, in which STAIN was not used, (2) the database of the functions in STAIN for an ongoing project, in which STAIN was used during workshops, (3) semi-structured interviews with experts, of whom the first was involved in the first case, the second is an all-around expert in projects in industrial land and the third was involved in the third (ongoing) case. The breakdown of this empirical data is given in more detail in Section 2.2.1. This section ends with a comparison of the findings in literature review and empirical research (third phase, purple boxes). After this, the fourth and final phase (green box) begins, where a final list of recommendations with measures (direct input for the solution database in STAIN) and advice (managerial implications) for STAIN to adapt it for use in industrial areas and business parks.

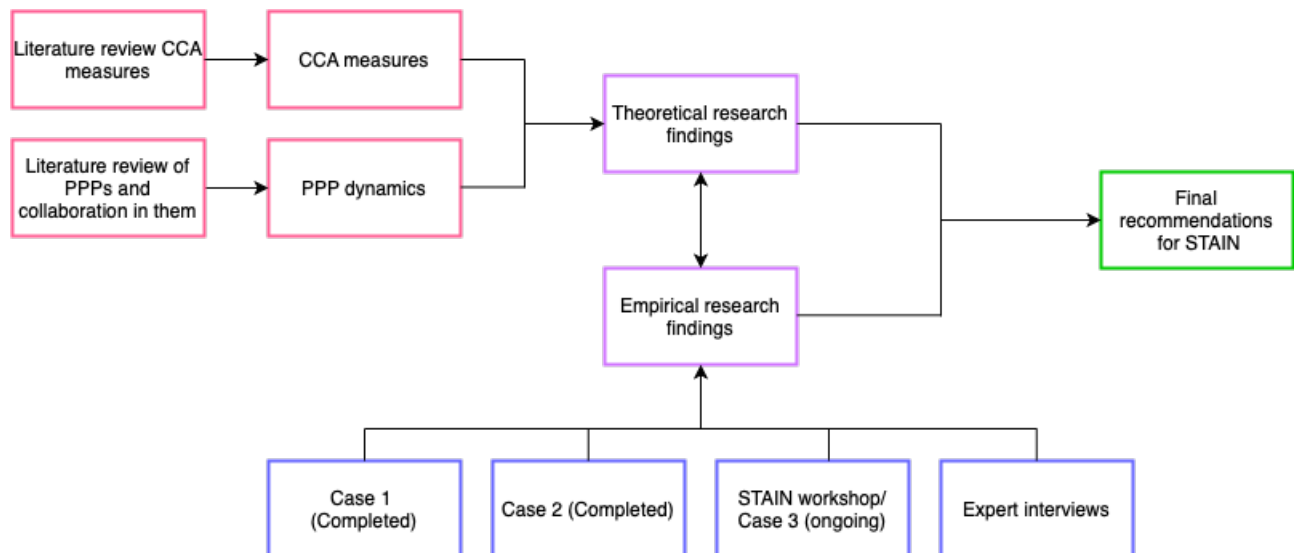


Figure 4: Research overview

The remainder of the report is structured as follows: Section 2 describes the methods used in each phase of the research. Section 3 presents the results of literature research, while Section 4 presents the results of empirical research and the result of the analysis of findings from both literature and empirical research. Section 5 is where discussion and reflection over the research takes place. The report concludes with Section 6, where the conclusion and recommendations for further research are given.

2 Methodology

As explained before, the research consists of four main parts/phases (Figure 4). In this section, the methodology of each of these parts will be elaborated. In Section 2.1, the method and division of literature research is explained. In Section 2.2, the method for the empirical research is described. Section 2.3 shows how these two are compared to one-another. Finally, Section 2.4 describes how the final list of recommendations is synthesised.

2.1 Phase 1 - Literature Review

For the first phase, CCA measures useful for the intended areas and characteristics of PPPs or collaborations in projects where there is industrial land need to be identified. Literature collection for this phase has been divided into two groups: literature about CCA measures and literature about policy and PPPs. For both of these groups, there are three steps followed: Literature Collection, Measure or Collaboration Factor Identification (depending on the group) and Categorization. Each of these steps will be elaborated on separately for both groups. For the selection of papers, search engines/databases such as Google Scholar, ResearchGate and the UTwente library were used, as well as snow-ball sampling.

The collection of literature was done by searching key words and phrases in the search engines mentioned above. The key words and phrases that were used are: "public-private partnerships in the Netherlands", "industrial estates in the Netherlands", "business parks in the Netherlands", "private/public land development in the Netherlands", "industrial area development in the Netherlands", "climate change adaptation", "climate change adaptation measures", "interactive planning tools", "resilience". From these queries, articles that the search engines showed as related to the search were chosen for further examination if they these words/phrases present in the title, abstract, or key words. A total of 95 papers were chosen for further examination to determine whether they were relevant to the research. This was determined by reading the abstract of the papers, and in case of books, by reading the summary or abstracts of individual chapters. After doing this, 46 papers were chosen as relevant for further reading (to identify CCA measures and characteristics of PPPs). An list of the chosen papers can be found in Appendix I.

2.1.1 Literature review - CCA measures

The selection of literature to identify potential CCA measures that are used in industrial land was based on some boundary conditions, to make sure that the measures found are applicable and valid for this research. Literature that does not satisfy the boundary conditions is not used since it would provide useful information in the context of this research.

The boundary conditions selected are: (1) researched CCA measures should be acceptable/supported by the EU and are applicable in the Netherlands, (2) measures should be applicable in STAIN. The focus is on measures that are applied in industrial land, but not exclusively. This is because there are many projects that are not solely concerned with industrial land, but with mixed-use land, where industrial land is part of. In the mixed-use cases, the measures that are preferred in industrial land cases only likely have to be linked or work together with other measures that are not necessarily characteristic for industrial lands.

CCA measures in literature are identified by given examples of such measures in existing research and measures used in case studies presented in the collected articles and reports. The measures are grouped in categories, depending on how they are achieved or constructed, their nature, and their domain. In literature, when concrete examples of CCA measures are given, they are often linked explicitly to one of

these categories. Hence, the identification and categorization of CCA measures in this case goes hand in hand.

2.1.2 Literature Review – Characteristics of PPPs and collaboration within

The selection of literature to identify characteristic traits of PPPs in projects on industrial land and the policy implications that might affect the measures chosen was also based on some boundary conditions, in order to make sure the findings are applicable and consistent in this context. The boundary conditions selected are: (1) policy and the nature of PPPs researched is within the Netherlands, (2) policy and PPP nature researched is focused in industrial areas. The chosen boundary conditions make the scope of this part of literature research purposefully limited, because PPPs are highly affected by a country's legislation (which is why only literature about PPPs in the Netherlands is considered) and because their nature varies depending on where the project takes place (i.e. the intended use of land and its ownership), which is why the focus is on industrial areas. However, where there is not enough information, literature about urban projects and mixed-use land development (within the first boundary condition) is examined, for reasons mentioned above.

Reoccurring themes and important policy that affects decision-making in projects where public and private actors work together are identified. The important identified aspects are then categorised based on their nature and what macro-concepts they can be grouped in (such as for example "Power" or "Finance").

2.2 Phase 2 – Empirical Research

For the second research question empirical research was conducted in order to identify CCA measures used and the development of public-private collaborations in real-life scenarios. The research consisted of collection of data, which was analysed to identify CCA measures and important aspects of the PPPs which is later categorized in a very similar manner to literature research.

The choice of documents for empirical research has been based on arguments found in literature. Case studies serve as the foundation and interviews as the consolidating blocks. Case studies are used as the basis for information gathering in this research because case studies allow for more in-depth analysis than other studies, as well as provide the opportunity to deduct from real life in the needed context (Doornkamp, 2020). Case study methodology is often used in the research of urban planning and management for these reasons (Heurkens, 2009).

Interviews are highly beneficial for obtaining missing context from reports and case studies because they can provide a greater in-depth view from different perspectives and within natural context (Queirós et al., 2017). These interviews were used to validate findings and patterns from the reports. All interviews were held in English and conducted through Microsoft Teams. The interviews were recorded once consent was provided by the interviewees. Audio recordings of the interviews were transcribed using the transcribing software Descript and then manually reviewed and compiled in separate documents, for later referrals during the analysis stage. The interviewees did not deem it necessary for the transcriptions to be sent back to them.

2.2.1 Data collection

In order to get a great understanding within the allocated time frame and limited resources for empirical research, the strategy opted for was to collect different types of data, but as detailed as possible. The

types of data collected for this phase were reports of finished projects, interviews with experts and documentation of a workshop organised with the stakeholders of an on-going project where STAIN was used.

The overview of the documents and input used for empirical research was given in Section 1.6. Now, a more detailed description will be given:

- **Case Study 1:** a report from a completed project in the region of Brabant. The report was obtained from Royal HaskoningDHV. Royal HaskoningDHV was commissioned by a board of municipalities in the region of Brabant to make a website, “Climate Adaptation Brabant”, where visitors of the page can see what climate adaptation measures they can add or build in their property (whether it is a business or a citizen). The measures are filtered based on what the visitor can do considering their occupation. The report entails a list of CCA measures for which the effect they have on climate change impacts (such as flooding), the costs of implementation and other details. STAIN was not used in this project. To gain a better understanding and missing context regarding the report a semi-structured interview has held with a consultant of climate adaptation from Royal HaskoningDHV that was involved in the project.
- **Case Study 2:** a report of a completed project situated in Tilburg about a business park in Kraaiven that explains why entrepreneurs need to include more CCA measures in their property. Along the explanations, the report also lists several CCA measures and gives indications about the same climate change impacts as Case Study 1 and costs. This report also gives an indication of which party is better suited to take the measure (public, private, or both). STAIN was not used in this project.
- **Case Study 3:** The information here was obtained making use of the interview with the person who organised the workshops and the final set of measures which were used in the project, which were found in STAIN. The project was set around the Eindhoven Central Station, with a mixed land-use, part of which was industrial land. In this project there were numerous public and private actors. STAIN was used in three workshops. The project is ongoing.
- **Expert Interviews:** Besides the interviews held for obtaining the missing context and a clearer view of Case Study 1 and 3, an interview was held with an expert in the subject of projects in industrial land. The purpose of this interview was to bridge what is found in literature with what is found in empirical research. The interviews were semi-structured with non-strictly predefined questions.

2.2.2 Data analysis

The CCA measures are directly identifiable from the empirical research since they are listed explicitly in the provided documents, meaning that no new measures besides the ones that are already known or seen are introduced. Important aspects of PPPs on the other hand are deduced from the interviews and workshop dynamics. Attention is given to how collaboration is established between stakeholders, how the communication is held and how these affect the design process of the project or its end product. The CCA measures listed are categorised according to the way they are categorised in literature (depending on their properties and nature). The policy and PPP aspects are categorised akin to how they were categorised in literature research: they are divided in the themes corresponding to the key concepts and their nature.

2.3 Comparison of literature and empirical research

In the third phase of the research, literature findings and empirical findings are compared to one another after all information has been identified and categorised. The results of literature research are used to look at the cases critically by comparing the CCA measures found in literature and in empirical research (which ones are common in both, which are similar and which are only in literature) and by matching the important identified aspects of PPPs in literature to what the interviewees said during empirical research.

Empirical research was made of analysis of reports of completed cases on one hand and exploratory interviews on the other. The focus of the analysis of the reports lay in identifying whether the CCA measures that were used in each report were applicable for the context of this research and how they compared to one another. The measures and ideas that were common for both reports were selected for further analysis and comparison with those found in literature. It was evaluated that since these two projects were on different locations, settings and form, the notions and measures that were found in both represented a good foundation for what is to be included in the list with final recommendations for STAIN (which will make STAIN applicable in projects in industrial areas and business parks regardless on the type of project and location).

For the identification of the CCA measures (all the types of measures except for the soft measures) that were to be added to the draft list with final recommendations for STAIN, the measures selected from the cases were compared with the measures derived from literature. The measures that were present in literature and cases were selected right away for the draft list. The ones that were not common in both were examined separately and their inclusion was determined on whether they could be a CCA measures in such projects and whether they can help (even if not directly) to achieve CCA measures. They were not immediately rejected if there is not a complete match, because these measures are highly dependent on context and project setting and there is not a clear distinction of the CCA measures that are used in industrial land in literature, which is why the decision whether to include a measure or not in the final guideline will be highly affected by empirical findings.

The list of CCA measures found in literature are finally compared side by side with the CCA measures that are selected from the empirical cases (a detailed account on where each measure was found and how it was used from empirical cases has not been given as of confidentiality reasons).

As for the soft measures, what was found in literature was compared to what the interviewees affirmed and what their understanding was in terms of PPPs. The measures found in literature will form the basis of the soft measures included in the list of recommendations, but the context of PPPs obtained from the interviews will serve as the basis of the recommendations about how to make the process altogether better for all parties involved.

2.4 Phase 4 – Final recommendations regarding the application of STAIN in these areas

The final phase of the research takes upon the results of pattern matching in Phase 3 and uses that as the core of the final guideline for STAIN. The final guideline will be divided into three parts, with the first two parts listed below serving as the main body:

- List of CCA measures that should be added to STAIN
- List of recommendations of policy advice for a more rapid and effective implementation of CCA measures and important aspects to keep in consideration during projects and workshops where

STAIN is used based on the results of the comparison of the findings in literature and empirical research regarding PPPs.

- Recommendations about changes to the software that can make STAIN better, more user-friendly and more applicable to more projects (but specifically for ones in industrial areas and business parks), based on empirical research and own experience from using the software.

3 Results Literature Review

3.1 CCA Measures

Based on literature research, it is seen that CCA measures can be categorised in five groups, within which they are identified further on separately (Dobre et al., 2018; EEA, 2013; Kabisch et al., 2017, Ten Brinke, 2021). The four groups are: Grey Infrastructure/measures, Green Infrastructure/measures, Hybrid measures, Soft measures. There are two important things to note here: firstly, in this report green infrastructure refers to both green and blue infrastructure, as these two are often given in this umbrella term in literature. Secondly, in some literature, the term “green infrastructure” encompasses the term “hybrid solutions” and does not clearly differentiate between the two (Depietri and McPhearson, 2017).

Grey infrastructure is defined as “built up, engineered and physical structure(s), often made of concrete or other long-lasting materials, that mediate between the human, built up system and the variability of the meteorological and climatic system” (Depietri and McPhearson, 2017, pg. 97).

Green infrastructure can be defined as nature-based solutions (NBS) that rely primarily on healthy, functioning ecosystems and allow for little or no technological/infrastructure intervention, when drawing upon the work of Emilsson and Ode Sange (2017) and Raymond et al. (2017). Raymond et al. (2017, state that “Green measures are distinguished from grey measures based on their visual and functional qualities” (pg. 20), a statement derived from the work of Davies et al. (2006). **Blue infrastructure**, encompassed in green infrastructure, includes all bodies of waters, including ponds, wetlands, rivers, lakes, streams, estuaries, seas and oceans. Alike green infrastructure, blue infrastructure also relies primarily on healthy ecosystems and has little to no need for technological/infrastructure intervention (Depietri and McPhearson, 2017).

Hybrid measures are combined measures of green and grey infrastructures (Depietri and McPhearson, 2017). These measures allow for some ecosystem functions mediated by technological solutions (Depietri and McPhearson, 2017, adapted from Grimm et al., 2016).

Soft measures are concerned with management, policy and legal approaches (Dobre et al., 2018; EEA, 2013). Findings in literature about soft measures may overlap with findings for PPPs due to their common traits.

The CCA measures found will be grouped according to these categories, but before they are listed and assigned a category, some important general findings about the types of measures listed will be given.

To begin with, perhaps the most important thing to note when it comes to choosing the type of measure, is that grey infrastructure should be avoided where there are possibilities of incorporating hybrid infrastructure or green infrastructure. Grey infrastructure can have a very high environmental cost and high risk of maladaptiveness, which can hinder the achievement of resilience and CCA (Depietri and McPhearson, 2017). An example of maladaptation to climate change is the installation of energy- intensive machines or infrastructures (e.g. desalination plants) (Dawson, 2007). What is more, construction costs of such infrastructure can be extremely high, especially in the case of CCA. Maintenance and restructuring can also have high costs (Bosello et al., 2012).

Nevertheless, grey infrastructures have positive aspects and are sometimes the best and the most efficient solutions. For example, air conditioning and cooling centres will continue to be important for the adaptation to rising temperatures and heat waves and risk reduction (Depietri and McPhearson, 2017). Grey infrastructures do not require an excessive amount of land, are replicable and to some extent controllable, and can be monitored (The Nature Conservancy, 2013), unlike green infrastructure, which generally requires a large amount of land to achieve its purpose, land which is often in short supply in urban areas (Depietri and McPhearson, 2017).

Green and blue infrastructure should be opted for whenever possible, as these have a lost cost to implement and maintain but long-term positive effects on the surroundings. If such measures are implemented correctly and are managed well, they can reduce climate change risks. These measures are also flexible and applicable in a plethora of settings (Jones et al., 2012). There are other reasons to invest in green and blue infrastructure measures. Several studies have linked these types of measures to benefits for both the public and private sectors and citizens (Enzi et al., 2017). Enzi et al. (2017) state that “urban green spaces play a vital role in the sustainable development and cohesion of our society” (pg. 168) based on numerous projects in Europe.

To add to this, several studies show that these measures can help with cooling and other environment disturbances. For instance, studies show that focus should be placed on the inclusion of bodies of water for maximal use of space for urban cooling (Emilsson and Ode Sange, 2017). Individual urban trees can also affect urban temperatures positively (Emilsson and Ode Sange, 2017). Other green measures such as green roofs can help dissolve heat problems significantly (Emilsson and Ode Sange, 2017; Enzi et al., 2017). Green roofs can also buffer noise pollution and living walls, another type of green measure, can reduce noise pollution by between 1 and 10 dB (Pfoser, 2013). This is an especially important property to take into consideration when it comes to industrial areas and business parks, because these areas have to adhere to strict rules about the maximal overall noise levels reached in the premises. Businesses may be turned away in industrial estates for this reason (Dembski, 2013).

However, implementing only green or blue infrastructure in a project is seldom sufficient to tackle the rising impacts of climate change. Depietri and McPhearson (2017) suggest that hybrid approaches ought to be of primary importance in such cases due to their feasibility in limited space, cost effectiveness and greater climate and economic certainty. A depiction of how grey, hybrid and blue/green infrastructure compare to each other can be seen in Table 1.

Table 1: Summary of the three approaches based on their suggested low-medium-high performance with respect to a list of factors found in literature (Adapted from Depietri and McPhearson, 2017)

Aspect	Grey Infrastructure	Green Infrastructure	Hybrid Measures
Feasibility in urban context	High	Low (But highly important and feasible in regional urban areas)	High
Reliability	Medium (Risk not eliminated completely)	Medium (Highly depends on type of hazard)	High
No-regret strategy	(Often) High regret	Low regret	Medium
Resilience and long-term durability	Durable, but can be maladaptive	Medium Can be affected by hazards/ ecosystems and degraded	Medium-High
Reversibility and flexibility	Little, or not reversible	Medium (Depends on type)	Medium
Cost-effectiveness	Low High building costs; value depreciation over time	High Much less expensive and long run compared to grey measures	Medium-High
Other co-benefits	Low (but some medium to high examples exist)	High May enhance long-term resilience to extreme events to local communities	Medium Contributes to services like pollution control and recreation, but depends on the green component

Lastly, there are the soft measures, which are of primary importance to CCA (Depietri and McPhearson, 2017). These measures might not be technical, but they affect the implementation of CCA just as much. The development and drivers of CCA measures are highly dependent on policies and awareness, areas covered by soft measures. Therefore, soft measures affect the process and the climate for collaboration, and hence, the “final products”.

The CCA measures identified in literature will be assigned each to one of the five groups of measures. The measures were picked from a handful of papers, since there was clear list and division of measures in literature. Building upon the work of Davis and Naumann (2017), Dobre et al. (2018), EEA (2013), EEA (2016), Enzi et al. (2017), Geerdink et al. (2015), Kabisch et al. (2017) and Woods Ballard et al. (2015), the following measures were identified (Table 2).

Table 2: CCA measures identified in literature (Davis and Naumann, 2017, Dobre et al., 2018, EEA, 2013, EEA, 2016, Enzi et al., 2017, Geerdink et al., 2015, Kabisch et al., 2017, Woods Ballard et al., 2015)

Grey Infrastructure	Green Infrastructure	Blue Infrastructure	Hybrid measures	Soft measures
Canals, pipes and tunnels of the drainage system	Green roofs	Blue roofs	Bioswales	Warning systems
Wastewater treatment plants	Living walls	Stream restoration	Permeable/porous pavement	Insurance or risk transfer
Water filtration plants	(Urban) Trees	Lakes	Rainwater harvesting systems	Evacuation plans
Desalination	Installation of grass	Ponds	Bioretention systems	Public health and insurance systems improvement
Dyke relocation	Riparian buffers	Lowering of floodplain	Retention ponds	Government incentives
	Wetland restoration	De-poldering	Wetlands	Raising awareness
	Peatland restoration	Deepening of river bed	Detention basins	Urban planning regulation
			Soakways and infiltration basins	Practical guidelines
			Green roofs	Research groups
				Local working groups
				Managing operations

These measures (except for the Soft Measures) collectively belong to Sustainable Urban Drainage Systems (SUDS): SUDS aim minimize downstream flood risk and reduce risk of resultant pollution to urban water bodies by slowing down and reducing the quantity of surface water runoff in an area (Davis and Naumann, 2017).

3.2 PPP dynamics and policy

Findings in literature about PPP dynamics and current policy settings and implications belong to one of the following fields, as mentioned before: Collaboration, Power distribution, Policy and law, Financing, Risk and uncertainty.

The results of literature research for this part are divided according to which of the groups above they belong and are contents of each group are given one by one.

Collaboration

Historically, the Netherlands has always seen private initiatives go along public spatial guidelines in urban planning (Heurkens, 2009). However, there is little academic and practical understanding of the collaboration of public and private actors how they manage private sector-led urban development projects (Heurkens, 2012, Heurkens and Hobma, 2014).

In projects in industrial land in the Netherlands, governmental institutions facilitate and mandate projects (urban developments) and focus on formulating conditions and authorizing them through public law procedures, while private organisations manage the development process and the decision-making during this process (Heurkens, 2009). The public sector is interested in safeguarding public interests in urban development projects, while the private sector is mainly interested in safeguarding the continuation of the firm and making a decent profit (Heurkens, 2012). Other common objectives need to be found within the PPP entity, but this is often hindered by the lack of a clear role description of both sides (Heurkens, 2012), or lack of objective specification in the first place. For example, Ten Brinke (2021) shows that the vast majority of commercial developers do not even see CA as a goal, but rather as “an instrument for creating comfortable, liveable, and high-quality properties and environments” (pg. 11). It is crucial for public and private parties to be transparent about their objectives and expectations (Ten Brinke, 2021), as well as for them to set the principles on which they plan to work together (Geerdink et al., 2015).

Heurkens (2009) argues that PPP models in urban development in the Netherlands “face the challenge of separating tasks, responsibilities, risks, revenues instead of the sharing them” (pg. 5). Heurkens (2012) further elaborates the problems faced in PPP partnerships in the Netherlands. The majority of them face inter-organisational problems. The different parties experience difficulties in combining their internal demands with partnership demands and with joint decision-making.

It is noticeable in practice that the municipality has great influence in decision-making in the design process, but this intensive involvement in this stage has resulted to be one of the major problems for the efficiency of the process (Heurkens, 2009).

The case study examined by Heurkens (2009) showed that task performance and decision made by partners are not made in a cooperative manner, prompting both the governmental body involved and the private side to admit that this led to misconceptions and miscommunication. The private party in this case explained that this situation can be ameliorated through clear task division.

Another important aspect overlooked in terms of achieving an effective development process is the formation of coalitions. Lord et al. (2015) explain that stakeholder coalitions are often an essential precursor to effective coordination in this process. However, the best way to ensure a stable collaboration between different stakeholders is highly context-specific (Lord et al., 2015). A key feature here is the influence that the perception each stakeholder has on their counterparty’s characteristics on the negotiating process. Lord et al. (2015) suggest diffusing the risk of this by using screening techniques, which show the counterparty’s true intentions.

Private participation can boost innovation and efficiency in mainstreaming CCA measures (Mees, 2014). Regarding this, Heurkens (2012) found that “the compromising nature of decisions could possibly harm process and product innovations” (pg. 31). Yescombe (2007) on the other hand, brings attention to the fact that PPP projects are subject to economic and technological changes, but they often lack the flexibility to respond to them.

As a matter of fact, a clear action for private mainstreaming is missing (Schneider, 2014). Since public actors are the predominant initiators and developers of CCA measures, these result mostly in societal benefits rather than profits from private investors (Tompkins and Eakin, 2012). Nevertheless, the analysis done by Ten Brinke (2021) shows that private mainstreaming can be stimulated by various urban development stakeholders by providing rewards to future users/tenants of properties with CCA measures. This analysis also showed that examples of stakeholders that can contribute to stimulating mainstreaming are: banks, health insurance companies, damage insurance companies, municipalities and water boards (Ten Brinke, 2021). Another strategy that can enhance mainstreaming are clearly communicated and formulated CCA expectations (Ten Brinke, 2021). The biggest problems occur when stakeholders are not informed sufficiently (Geerdink et al., 2015). Private actors also believe that incentives are a good way to enhance mainstreaming, although public actors do not share the same sentiment (Ten Brinke, 2021). Experts believe that incentives should be used, but under conditions (Ten Brinke, 2021).

Ten Brinke (2021) also finds that “informing, educating, and inspiring investors and developers about the necessity and possibilities of [CCA] is essential” (pg. 15), as well as informing and educating citizens and consumers. Incentives can be effective for raising awareness among citizens and consumers (Ten Brinke, 2021). Awareness amongst citizens and consumers is crucial for them to participate in CCA (EEA, 2016). Ricardo-AEA, 2013 notes that technical terms such as “adaptation” can pose a barrier and local terms and examples should be used instead. On the other side, people’s everyday knowledge can be used as another source of information (EEA, 2016).

Overall, investors and developers are aware of the professional value of CCA measures (Ten Brinke, 2021), but the general notion seems to be that the technical specification of CCA measures are rarely of interest among consumers and the focus is on aesthetics and perceived value that can be obtained through private adaptation of CCA measures (specifically company image) (Ten Brinke, 2021).

Effective stakeholder collaboration starts by finding common interests and common ground (Geerdink et al., 2015). To do this, communication is key. Geerdink et al. (2015) identify four levels of communication: (1) Content, (2) Process & structure, (3) Relations & atmosphere and (4) Emotions. In practice, the first two are given thought, but it is important to consider the last two as well (Geerdink et al., 2015). Alongside effective collaboration, innovative collaboration is key: this further enhances the capacities of cities to address CCA (EEA, 2016).

However, CCA crosses sectors and affects all levels of governance: different levels need to work together, and stakeholders need to be involved more actively (EEA, 2016). Nevertheless, a mounting number of research shows that governmental bodies need to inform private stakeholders more in order for them to get involved more actively. For instance, even though governments may have digital portals and tools that contain useful information about CCA, these are not known well from private and other stakeholders (EEA, 2016). It is not enough presenting the information online: providers have to get in contact with potential users.

Power distribution

The municipal choice of how an area will be developed is crucial in the development process (Leväinen and Altes, 2013). In the Netherlands, PPPs are shifting towards having more inclusion from the private sector. This is largely due to financial reasons, competencies, and availability of means (Heurkens, 2009).

Municipalities are now choosing to share risk and delegating it to the private sector because they rely heavily on the engagement of the private sector to effectively integrate CCA measures. This is because (1) the majority of land in urban areas (50-70%) is owned by private parties, (2) there are budget restrictions for municipalities meaning that they cannot bear too much risk and (3) implementation of CA measures and innovation cannot be done without the private sector (Ten Brinke, 2021).

The Ministry of Economic Affairs has changed its policy and wants much more involvement from commercial developers in supplying industrial land and buildings (Ministerie Economische Zaken, 2004; Needham and Louw, 2006). The public sector has reduced its functions and is moving from a command role towards an accommodation role: the public sector is no longer the centre of decision-making (Korthals Altes, 2002). However, the public sector maintains its role as the animator of the development where there is great potential (O'Brien et al., 2020). Even though there is an effort to change the perception of the role the public sector has in these projects, developers still believe the municipalities to have the central role in the development process. Lord et al. (2015) show that as a result of this belief, the landowners in a project had only contacted the municipality about their plot: none had pondered on alternative visions of redevelopment.

Boelens (2010) argues that governments need to reposition themselves in PPPs. The public sector needs to be accepted as part of an actor network rather than being positioned hierarchically outside the network. Non-public actors perceive the municipalities to act as “many-headed monsters” in practice as they create policy and subject these actors to demands without properly considering feasibility and effectiveness (Ten Brinke, 2021).

Lastly, an important observation to note is that regulations should constrict only the development process (the “how”), but not the exact interpretation (the “what”). This should be left to the market to decide upon (Ten Brinke, 2021).

Policy and law

Current policy settings can hinder the collaboration and development process. The general notion is that legislation is too limited and restrictive to development. Furthermore, practice has shown that the efforts made to comply with legislation divert all energy for the development process to complying with rules, instead of focusing on quality (Dembski, 2013).

However, where the responsible parties decide to make changes in legislation, the decision on what changes to make is not as rational and straightforward as actors (be it public or private ones) might think it is. This is because they view the situation from different perspectives (Needham and Louw, 2006). Public bodies have to be specifically critical when it comes to policy formation: governmental bodies have in the past shown tendency to get locked in suboptimal systems when the future action is unclear (Woodlief, 1998). Policies for industrial land are locked into current models, with no to little adjustments made for the effects of policy which aims to intensify industrial land use (Needham and Louw, 2006). Regulations should be devised together with market parties to ensure realistic demands and understanding on both sides (Ten Brinke, 2021).

Research has thus far focused on discussing CCA in terms of policy integration rather than the integration of CCA in urban planning (Ten Brinke, 2021). Not only this, but it has been concentrated on the adaptation of CCA by the public sector, leaving private adaptation largely unexposed (in research and policy) (Ten Brinke, 2021). Molenveld et al. (2020) request in turn a firmer role of local governmental bodies in using policy to increase private CA mainstreaming. Ten Brinke (2021) supports this by showing that CCA is largely a governmental challenge, not a technical one. Handgraaf and Dekker (2019) show that municipalities use their legal instruments to a minimum extent, so improvements can be made. Municipalities need to acknowledge amongst other things that stakeholders can contribute as well to

making scientific research applicable for them and policy makers (Geerdink et al., 2015). Instead, local governments prefer referring to knowledge published by governmental organisations (Dannevig and Aall, 2015). Current governance of adaptation seldom offers ways for stakeholders to take part systematically and meaningfully (EEA, 2016).

Developers, however, have a preference for uniform policy: that is, policy according to them should preferably be at the national level instead of the myriad of different regional regulations and constraints or expectations (Ten Brinke, 2021). This is supported by the findings of the EEA (2016), who states that “coherence across different levels of governance is important for planning and implementing local adaptation actions” (pg. 49). This does not mean that governance at local level should be left unattended. A survey conducted by Aylett (2015) shows different municipalities engage in adaptation in very different extents. Good governance tailored to local adaptation needs, as EEA (2016) shows, is necessary for the implementation of CCA measures at local level.

Another strategy that can help the integration of CCA measures is developing a planning document that outlines key impacts, action domains, prioritised adaptation actions, important policies related to adaptation and possibly relevant criteria. Although this overview can significantly help mainstreaming, cities have rarely taken this approach. In order to make sure that the adaptation process is going in the right direction, the process of Monitoring, Reporting and Evaluation (MRE) provides the necessary feedback and enables gaps to be discovered and adjustments to be made (EEA, 2016).

Financing

Municipalities have important planning powers, more important than those of national governments, but they have limited financial powers (Hobma and Jong, 2016). As briefly mentioned above, economic factors are a very affluent in PPP dynamics and decision making. In traditional development projects, the municipalities would acquire all land, so division of costs, benefits and risk was not an issue (Dembski, 2013). In present settings, this is no longer the case: new balances have to be found now that PPPs are more dynamic and more complex. This shift is pronounced by the fact that (according to policy documents) municipalities put emphasis on quality and private parties control financial risks in general (Leväinen and Altes, 2013).

There are however disagreements on financial aspects between the public and private actors. While private parties do not expect significant monetary benefits from mainstreaming (Ten Brinke, 2021), a common issue is that private actors feel that cooperation is difficult because public actors do not have the same financial urgency that private ones do (Leväinen and Altes, 2013).

Decision making can be improved by making an economic case. An economic case evaluates different options and approaches (coping, incremental, transformational) and identifies which make economic sense (EEA, 2016). Cities seldom use such economic cases, and they are rarely used as decision criteria (EEA, 2016). Economic cases need sufficient information from monitoring and sufficient political willingness for action (ADEME, 2013).

Lastly, few cities include adaptation as a standard part of the municipal budget or designated financing schemes at the moment (EEA, 2016).

Risk and uncertainty

Risk is a key aspect of the development process, but developers are largely concerned with risk management when it comes to converting development potential to profit (O'Brien et al., 2020). Converting uncertainty to risk is an important market function (Van der Krabben, 1995) but it is less associated

with planning. Planning must address a number of different risks related to development. The inter-relationships between market risk control and public interests are nevertheless under-explored (O'Brien et al., 2020).

There are several techniques that the public sector can take in regards to private development to reduce risk, such as delivery of accurate market information, policy stability, implementation of demonstration projects, management incentives, more engagement in such activities, project conception, development plan preparation and generation of transaction costs (O'Brien et al., 2020). Implementation for instance, ought to consider the relative costs and benefits for a given action, as well as managing uncertainty-related difficulties (Raymond et al., 2017). In terms of CCA measures, sometimes, there can be uncertainty about the values and benefits a NBS brings, particularly among urban planners and decision-makers (Kaczorowska et al., 2016).

A way to add certainty according to the case studies studied by Gielen and Tasan-Kok (2010) is to use indicative plans. Indicative plans indicate an idea or the intent that the municipalities have about how they want certain area to be developed. These plans create an idea of expectations and hence some certainty about future building possibilities. However, in the same cases studied by Gielen and Tasan-Kok (2010), there was seldom any certainty about who would cover what cost.

Summary of findings

Here, a summary of the findings in literature about PPPs is given. To begin with, one of the most important things that literature pointed out when it comes to PPPs is that both public and private sides need to actively work together to find a common ground in the beginning of the partnership (Geerdink et al., 2015) and form coalitions (Lord et al., 2015). What makes this difficult is that there are misconceptions and miscommunication from both sides (Heurkens, 2009; Ten Brinke, 2021). To balance the situation more, there needs to be more inclusion of the private sector (Schneider, 2014). Even though there is an effort to include the private sector more and make the collaboration more balanced (Ministerie Economische Zaken, 2004; Needham and Louw, 2006), municipalities still hold the central role (O'Brien et al., 2020), and this has drawbacks since municipalities can pose more restrictions than necessary to private actors, which hinder CCA. Another drawback is legislation, which is perceived to be too limited and restrictive by private actors (Dembski, 2013). Developers show a preference for uniform policy amongst other things (Ten Brinke, 2021). Municipalities on the other hand need to make planning documents that outline key impacts, actions and policies, so that private actors have a clearer view (EEA, 2016).

Economic factors are also very affluent in decision making. In PPPs, private actors control and undertake financial risks (Leväinen and Altes, 2013) because municipalities have limited financial powers (Hobma and Jong, 2016). A common issue when it comes to financial matters is that public actors do not have the same financial urgency that private actors have (Leväinen and Altes, 2013), which makes cooperation difficult. To add to this, only few cities include adaptation as a standard part of the municipal budget (EEA, 2016), which makes the risk and uncertainty higher for companies. Municipalities however can help reduce the risk and uncertainty in PPPs by undertaking several actions, such as providing accurate market information, policy stability, taking incentives, making indicative plans (for the area of the project) and providing transaction costs, to name a few (Gielen and Tasan-Kok, 2010; O'Brien et al., 2020).

4 Results of Empirical Research

In this section, the results of the analysis of the cases and the interviews are given. These results are then compared to literature findings, which yields a draft list of recommendations with measures and advice for making STAIN suitable for projects in industrial land. First, the findings in case studies regarding CCA measures are given, which are then compared to what was found in literature. Next, the findings from interviews and case studies about PPPs are given and compared to what was found in literature. The section ends with a draft list of recommendations for STAIN, which contains the CCA measures and PPP advice selected from the analysis of literature and empirical research.

4.1 CCA measures

In the report of the first case examined, a matrix was first given with nineteen measures (without diving into more specific examples), and the effect they have on the area when it comes to flooding, heat, drought, biodiversity, as well as an approximation of their application costs. It is noted in the report that the measures listed in the matrix are accompanied with a general description: every business park and industrial building is different and thus the implementation of the measure in practice can vary depending on the setting. Another advice found on the report is that in industrial land space is often scarce, and as such not all CCA measures can be implemented. Afterwards, each measure listed in the matrix is dissected by giving examples for each, conditions, benefits, effects on the environment and implementation costs. However, the type of measure that these examples are is not distinguished (i.e. grey, green/blue infrastructure, hybrid or soft measure). Also, definitions of the examples and measures are rarely present in the report.

In the report of the second case examined, the measures are divided in four main groups based on what the measures target (such as greenery and sewers system). Each of these groups contains a list of CCA measures along with their effect on flooding, heat, drought, biodiversity and an approximation of the construction costs, as well as an indication of which kind of actor is more suitable to implement the measure (public, private or both) and an indication of how suitable it is specifically for the area in question. Since the suitability is given for a specific area, this detail will not be taken in consideration for the analysis later on. Unlike the first report, this one has definitions and explanations for all the measures that are given. As such, the definitions for the measures chosen for the list will be largely based on this report. However, the type of measure that the options listed are was not distinguished in this report either. Therefore, the determination of whether a measure belongs to the grey/green/blue infrastructure or hybrid/soft measure will be based on literature only. This report ends with some notes on the collaboration between public-private actors and practical advice to make the collaboration more effective. This part of the report provides useful insights for the analysis of PPPs in the practical cases.

For the last case, the practical information consisted of the measures found in the STAIN file for the project. As such, only the measures present in the database could be extracted, and there were no definitions. However in this case, there were measures listed that were not particularly CCA measures, but if incorporated in the project when necessary, could help achieve CCA. These functions could be identified more accurately as interventions rather than CCA measures. If a similar distinction is observed on the measures selected after the analysis of the measures found in literature and empirical research, then this distinction will be included in the final list of recommendations.

The most noticeable thing when it comes to how CCA measures listed in literature compare to those listed in empirical cases is that in literature, the measures are more general than in actual cases, where they are much quite specific, and a large number of the measures listed are serve more as a "means to an end", compared to the measures in cases which are actual (direct) CCA measures. What is meant

by "means to an end" is that these measures are not directly CCA measures per se, but in the grand scheme of a project, if incorporated in the design help achieve CCA. In empirical cases, most of the CCA measures belong individually in this category and affect CCA directly. To take an example, "Dyke relocation", a measure found in literature, is not a CCA measure per se, but when done in a certain setting, it can help with the incorporation of other (CCA) measures and contribute positively to climate change. "Green walls" on the other hand, found in empirical cases, are considered a CCA measure by itself.

Another aspect to point out is that often there were nomenclature discrepancies between the same measures found in literature and in empirical research, or some of the measures found in literature were not the exact same as the ones from the cases, but very similar. For instance, "living walls" in literature were called "Green walls" in empirical cases, although they were referring to the same measure. Another example is "installation of grass" from literature and "greening of plot" from the cases. They are not exactly the same thing, as "installation of grass" is more ambiguous (in terms of where it is done: in private or public property), however, "greening of plot" is the same measure, albeit less ambiguous (since this is done on private property).

To add to this last point, where literature has a measure that is somewhat ambiguous or nonspecific, empirical cases have more options that can be connected to the said same measure in literature. Taking the same example again, "greening of plot" and "public greenery" (also found in empirical cases) are both measures that are essentially "installation of grass" or greenery, however, one is done on private property and the other on public one. Such a distinction would be quite important in the list of measures for STAIN.

Selection of CCA measures from literature and cases

In the table below, the list of CCA measures found in literature and presented previously are compared side by side with the CCA measures that were selected from the empirical cases.

The green cells on each column indicate that a measure can be found in both literature and empirical cases with the same name or that, as explained before, the name and use it has in literature corresponds to or is related to its equivalent(s) in empirical cases. In some cases, one measure found in literature can be connected to more than one measure from the cases. For instance, "Canals, pipes and tunnels of drainage systems" translate to the different types of disconnection of rainwater, which is done in order to relieve pressure from the drainage system in the case of an extreme event (i.e. flooding). In other cases, literature and empirical cases refer to the same concept but with different names: such is the case with "living walls" and "green walls". In other cases, such as "detention basins", this is also present in empirical cases, but in more alternatives, such as those belonging to "open water basins". To add to the last point, in the case of "open water basins" and "disconnection of rainwater" (empirical cases), these are further divided in more specific measures in the reports examined. For simplicity and since this level of detail is not present in the findings from literature, these sub-divisions were not presented in this table, but will be further elaborated upon later on.

It can be seen however that a distinction of what type of measure it is (grey/green/blue infrastructure, hybrid/soft measure) is not included in the table. This is because, as explained before, such a distinction was not done in any of the empirical cases. For simplicity and for a clearer comparison, this information has been left out of this table, however, this detail will be given for the selected measures in the list of recommendations. For the measures where a clear indication of what type of measure it is cannot be pinpointed (essentially for the measures that are found only in empirical research) an educated guess is made based on similar measures, the materials that are needed to implement the measure or its impact on the environment.

Table 3: CCA measures found in literature and empirical cases. Green cells on each column indicate that a measure can be found in both literature and empirical cases with the same name or that the name and use it has in literature corresponds to or is related to its equivalent(s) in empirical cases

Literature	Empirical Cases
Bioretention systems	Above ground drainage towards canal
	Adjustment of levee embankment
Bioswales	Blue roofs
Blue roofs	Blue-Green infrastructure
Canals, pipes and tunnels of drainage systems	Building water protection
De-poldering	Cooling of indoor climate
	Critical infrastructure
Deepening of river bed	Disconnection of rainwater
Desalination	Disconnection of rainwater from the roof (by means of a rain barrel)
Detention basins	Disconnection of rainwater sewers (and connecting the roofs to the rainwater sewers)
Dyke relocation	Drought tolerant planting
	Enlarging sewage capacity
Green roofs	Green boundary walls
Green roofs	Green lawns
Installation of grass	Green roofs
Lakes	Green walls/facades
Living walls	Green/blue verges
Lowering of floodplain	Greening of plot
Peatland restoration	Lower green areas on plots
	Multifunctional levee
Permeable/porous pavement	Open water basins
Ponds	Permeable pavement
Rainwater harvesting systems	Public green spaces/Public greenery
Retention ponds	Relieve constructions of rainwater drains
	Road profile adjustment
Riparian buffers	Shading the building
Soakways and infiltration basins	Swales
Stream restoration	Temporary nature
Trees	Trees
Wastewater treatment plants	Use of colour materials (high albedo)
	Water flow redirection
Water filtration plants	Water protection for loading pit/ sensitive production at height
Wetland restoration	Water squares
Wetlands	Water storage soil
	Water-storing roads

The measures that are found in both literature and cases are: green/blue roofs, greening of plot, greening of walls/façade, permeable/porous pavement, swales, urban trees, open water basins and retention systems (ponds are also included in here), canals and disconnection of rainwater. These measures will be automatically included in the draft list with recommendations. The rest of the measures are chosen based on whether they fit the intended projects of this research and whether they can be useful in achieving CCA overall or whether they can be combined with other CCA measures. As for the remaining measures, an explanation will be given for each of them as to why or why not they were chosen for the draft list of recommendations.

Starting with the measures found in the empirical cases, the measures which will **not** be added to the list of recommendations are:

- **Relieve constructions of rainwater drains:** This is because such a measure can be included in a more specific and employable way with the measures categorized under "disconnection rainwater".
- **Water protection for loading pit:** This is because this is also part of "building water protection".

The remaining measures from empirical cases will all be included in the draft list of recommendations, since, according to the reports analysed, they were highly effective in achieving CCA while being highly beneficial (especially long-term) and having suitable costs of implementation (more details on such aspects to follow). In addition, these measures can be implemented different regions and are accepted to a great extent by both public and private actors.

For the measures from literature, the ones that will **not** be added are:

- **De-poldering:** While it can be useful in another context, in the Netherlands, and especially in industrial land, de-poldering is rare since such subjects are vital for flood defenses and are regulated strictly. The need for such a measure was also not seen anywhere in empirical research
- **Desalination:** This measure would be beneficial in coastal areas and where there are large bodies however, which is not the case with industrial land.
- **Lakes:** (Artificial) lakes are significantly large bodies of water and require a lot of land, but in industrial areas, land is scarce and is sought to be used as much as possible and in an optimal. Also, since industrial land is owned by many different private stakeholders in the Netherlands, the implementation of such a measure becomes almost impossible, since they would not be willing to sacrifice a lot of land when they do not get enough benefits from the measure in return.
- **Riparian buffers:** These also require a large piece of land and are placed next to rivers and lakes to increase water quality. As with lakes, land would be scarce for such measure and it would be rare for it to be implemented in industrial land. However, a buffer of such could be useful in a smaller and more natural way. The measure that will serve such a role is "Temporary nature", which can essentially act as a buffer in such a setting.
- **Wastewater treatment plants:** This measure was not seen in any of the empirical cases. This is possibly due to the fact that this is part of the sewage system, for which there were other measures listed. This measure does not contribute to achieving CCA in projects in the context of industrial land.
- **Water filtration plants:** This measure was also not seen in any of the empirical cases, possibly because this is also a part of the sewage system and because it would normally not be done in an industrial areas and business parks.

The remaining measures (deepening of river bed, dyke relocation, lowering of floodplain, peatland restoration, stream restoration, wetlands and wetland restoration) will all be added to the draft list, since they can all be combined with other measures to achieve CCA (with the exception of "wetlands", which itself is a direct CCA measure).

4.2 Soft measures

In order to synthesize the recommendations for PPP dynamics and for improving the collaboration and communication between stakeholders during the STAIN workshops, interviewees were asked about what they thought of the current dynamics, common bottlenecks and issues faced in collaborations between the public and private sector in projects in industrial land, and what they thought should be done in order to improve the situation.

Important characteristics of public-private collaboration echoed in all of them and the general belief seemed to be that while PPPs have taken a positive step forward in recent years, there is still much room for improvement. The important findings from the interviews, which are supported by findings in literature and are materialised in the form of the soft measures derived from literature, are as follows.

Firstly, a real collaboration between municipalities and companies is lacking. Municipalities tend to act strictly and want to have the upper hand (Interview 1 & 3). Regulators will get most of what they want/need in a project while private companies are asked to oblige to the requirements they set for them without much dialogue. Municipalities often "forget" to think about the company perspective and how they see things, and most importantly, what could be interesting for companies, which leads to a dissatisfied private sector. As a consequence of this, companies are not asked enough about their feedback on the restrictions that are imposed on them which can significantly affect the implementation of CCA measures. Municipalities should ask companies about what they want and how they are willing to achieve CCA before making a product. After all, it is important to remember that private actors are the largest financial contributors: the municipality is unable to carry on with its plans if the private sector is left dissatisfied and pulls out of agreements (Interview 2).

Every party has different goals and expectations from a project. This is why good communication and collaboration is vital - otherwise conflicts will rise, as parties (especially private ones and public ones) often do not understand each other (Interview 2 & 3). Every party also wants their wish fulfilled, indicating that inclusive dialogue should be practiced from the beginning of the project in order to find the common ground first and then move forward (Interview 1). Dialogue is also important because neither companies, nor municipalities, know everything: the gaps can be closed by close collaboration and information sharing (not only between these public and private actors in a project, but also across municipalities in different regions, something which is now lacking) (Interview 2).

An action that would make understanding each other better would be the draft of a proposal for the project by the municipality, which should send it to all the involved stakeholders and collaborators prior to the initiation of the workshops. A proposal form would inform companies about the ideas and intentions that the municipality has, and can serve as the basis for the workshops, which makes the whole design process more efficient (Interview 1).

Companies are more aware of CCA measures than municipalities tend to believe (Interview 2 & 3). Companies express the legislation to be a problem, as they perceive it to be lacking behind. and hindering the implementation of CCA measures by their side. Municipalities should pay more attention to the innovative ideas companies have and go for more, even if unexplored, options, instead of waiting for the perfect match (Interview 2).

Another important point is that there should be more awareness and more initiative taken by municipal-

ities to bring awareness to companies and the general public. Companies and people do not know where to get the necessary information for them to implement CCA measures (Interview 2). There should be a communication plan managed by the municipality, which would optimally include a list of companies in the region (unrelated to the project), whom companies involved in the project can contact if they need to collaborate in order to implement the CCA measure(s). People living the affected areas should also be contacted by the parties involved in the project, as they can give feedback and provide useful knowledge from experience (Interview 1 & 2). Nevertheless, collaboration was better overall and parties were more "equal" when STAIN was used in the sessions, indicating that such planning tools contribute positively in decision making and dialogue establishment and ought to be incorporated more in the design phase of projects (Interview 3).

As for the measures found in literature, they will all be included in the draft list of recommendations (except for "public health and insurance systems improvement", because this is not useful in the context of this research), but only some of them can be added as explicit commands in STAIN: the rest will be part of the advice given for the improvement of PPPs and workshops. The soft measures included in the draft list of recommendations are warning systems and evacuation routes (instead of putting evacuation plans in STAIN, it is more useful to demonstrate evacuation routes in a project).

4.3 Final Recommendations for STAIN

4.3.1 CCA measures

In this section, the results of the analysis between literature research and empirical research are synthesised as a draft list of recommendations. This list is compiled based on the arguments given above and the already chosen measures. In order to validate the draft list of recommendations and to check whether measures were missing or to be removed, a semi-structured interview was held with a leading expert in Water Resilient Cities from Royal HaskoningDHV. As a result of the interview, some measures were added and removed and the names of some were changed to be more accurately representative of the measure. All these changes will be elaborated upon one by one.

To begin with, the list was "divided" in two groups of measures: CCA measures and Interventions (other CCA measures, those that are not such a measure per se, but can help indirectly, as mentioned before). More detailed explanations for the measures can be found in the final list of recommendations (Appendix IV) Changes done to the draft list of recommendations are listed in Appendix III.

In addition to the measures listed which were obtained from literature and empirical research, an extra command will be added under the name "OTHER". This is a "free" measure which can be tailored as workshop participants see fit if a solution is not present in the list of measures or if they want to add more specific details.

Below, the measures selected for the final list of recommendations are given. They are classified according to the four resilience factors that are used in STAIN, since in STAIN, they are shown according to the resilience factor they belong to (this is the first input of the measure). The measures that can be considered as interventions could only be classified for two resilience factors ("robust" and "flexible"), which is why the other two are not seen on the table.

Table 4: CCA measures classification

CCA Measures	Robust	Flexible	Integral		Redundant
	Lowered embankment	Use of colour materials	Green streets	Green boundary walls	Ponds
	Flood-proof building	Interior gardens	Green/Blue/Purple roofs	Drought resistant plants	Lagoon
	Measures	Interior green walls	Water square	Flood resistant plants	Retention pond
	Swales		Multifunctional levee	Public greenery	Canals
			Open space	Green walls/façades	Semi-paved areas
			Rain gardens	Trees with canopy and tree pits	Water storage subsurface
					Water-storing roads
					Rainwater harvesting

Table 5: Interventions classification

Interventions	Robust		Flexible
	Water flow redirection	Dike relocation	Critical infrastructure
	Road profile adjustment	Lowering of floodplains	Warning systems
	Enlarging sewage capacity	Peatland restoration	Evacuation routes
	Adjustment of levee embankment	Stream restoration	
	Disconnection of rainwater	Wetland restoration	
	Deepening or river bed		

In the table below, all the measures selected for the final list of recommendations are distinguished between one-another based on the type of measure they are: grey/green/blue infrastructure or hybrid/soft measure. Note once again that these are commands for STAIN: there are other soft measures, but those are part of the advice regarding PPPs and will not be an input for the software itself, which is why they are not included in this table.

4.3.2 Policy advice

Policy advice has been devised from the findings from literature and empirical research, as there were many similarities and common themes between the two. The advice is as follows:

Strive for a real and dynamic collaboration, by establishing dialogue from the very beginning and pushing different parties to try and think things from the other’s perspective. Begin the dialogue by working towards finding the **common ground**.

Indicate to municipalities that they need to be **less strict** with their requirements and put more **trust** on companies, and ask them about feedback. Companies are often more aware of CCA measures than municipalities believe and it is legislation that hinders them more often than not.

Neither companies, nor municipalities know everything: **close collaboration and information sharing** between the two and across municipalities boosts the performance of all those involved and contributes in innovation.

Table 6: Classification according to the type of measure it is of the measures in the list of recommendations for STAIN

Grey infrastructure	Green infrastructure	Blue infrastructure	Hybrid measure	Soft measure
Flood-proof building	Drought resistant plants	Green/Blue/Purple roofs	Indoor climate	Critical infrastructure
Multi-functional levee	Flood resistant plants	Ponds	Lowered embankment	Evacuation routes
Canals	Green boundary walls	Retention ponds	Rainwater harvesting	Warning systems
Water storage subsurface	Green walls/facades	Lagoon	Semi-paved areas	
Adjustment of levee embankment	Green/Blue/Purple roofs	Water squares	Swales	
Deepening of river bed	(Natural) Open space	Stream restoration	Use of colour materials (high albedo)	
Dike relocation	Public greenery	Water flow redirection	Water-storing roads	
Disconnection of rainwater	Rain gardens		Wetlands	
Enlarging sewage capacity	Trees with canopy and tree pits		Wetland restoration	
Road profile adjustment	Peatland restoration			

Municipalities should send private actors a **proposal** before the project starts, so that they get a better understanding of their perspective and intentions. This proposal can serve as a basis for the first workshop(s).

Municipalities should take great care of assuring that they are **bringing awareness** not only to the private actors participating in the project (by providing necessary contacts and information for them to carry on with the implementation of CCA measures and **practical guidelines**), but also to the general public, which can provide useful feedback and knowledge from experience. **Research groups** and **local working groups** could highly benefit from this.

Governmental bodies should encourage companies to implement more CCA measures by giving **incentives** and by optimising **urban planning regulations**. Both parties however need to make sure that there is well-functioning system of **managing the operations** done within the project so as to prevent unnecessary conflicts from rising and pro-longed projects, and to strengthen trust and quality of the final product.

5 Discussion

In this section, possible pitfalls will be discussed in order to assess whether all results are reliable and if not, which ones need further attention. The aim of this discussion is to assess the strengths and weaknesses of this research.

5.1 Literature findings

To begin with, the first phase of the research, literature research, was where most obstacles were faced. As the topic of this research is a new and emerging topic in academia, there were significant gaps in literature. The gaps in literature were not only evident in articles that explored different key aspects of this research together (such as how interactive planning tools affect the collaboration between public and private actors or how what CCA measures are opted for in industrial land by public and private actors respectively), but also on individual key concepts (such as CCA measures in industrial land in the Netherlands). Besides the mentioned gaps in literature, literature about CCA measures, although developed to a great extent in itself and very informative, it does not distinguish the CCA measures for different land uses. Literature about CCA measures could only be found in a generalised form for Europe and only with some examples for the Netherlands, which was also the case for when literature was sought for the distinction of CCA measures in industrial land and others. As such, there is a possibility that the CCA measures derived from literature are not the best choice and there are missing ones.

Similarly, research for PPP dynamics and the use of interactive planning tools faced the same bottlenecks. There were gaps in literature specifically when it comes to PPP dynamics in industrial land in the Netherlands. As for the use of interactive planning tools and how they affected the design process, literature about this topic was the most limited one by a great margin, signifying that the importance of such planning tools and their effect in projects had to be deduced from empirical research to a great extent. These all could add to the uncertainty of the final product (the list of recommendations).

5.2 Empirical findings

Moving forwards with empirical research, albeit having encountered substantially less obstacles than empirical research, there were some minor details that are to be discussed. Firstly, the reports analysed were translated from Dutch to English using the DeepL software. As such, some information could have been mistranslated, although the chances for this happening and moreover affecting the analysis are almost none, as the translations were read through at the time of translation and no considerable mistranslations were found to the author's knowledge.

The two reports had similarities but also differences between them. The most notable difference was the structure, where the second report was more concise and focused more on the explanation of each chosen measure whereas the first report gave many options but sometimes without a clear division or explanation of how the measure was to be used or implemented. Secondly, some of the names of the measures in both reports differed, although they were referring to the same thing or very similar ones. However, this was not an issue that affected the measures chosen from these two reports since they were explained well and the better name for a measure in such cases could be deduced from the explanations.

As for the PPP part of the empirical research, the drawback was that the findings from the interviews focused only on the collaboration part and the power distribution. Policy implications of current legislation were touched upon only in one interview, whereas the other parts of interest were not elaborated upon. As such, the findings of empirical research regarding PPPs largely of the collaboration between the public and private actors and how that can be improved, leaving policy and law, financing and risk

and uncertainty largely unaccounted for, which would otherwise provide very useful context for further research and more points of advice for the final list of recommendations.

As for the last case of empirical research, initially, this was intended to be a workshop held during this research, to have a direct encounter with how the workshops worked and how the actors selected and discussed measures. However, this was not possible in the end due to problems between the actors. Instead, another ongoing case was used for the analysis, but this one had done the STAIN workshops already. The input for the analysis from this case was the list of measures used in the workshops and one of the interviews. The list of measures used in this case was significantly different from the measures listed in the two reports, which made a selection of measures out of all three cases much harder. There is a possibility that potentially useful measures did not make it through the selection round.

5.3 Internal validity

When it came to comparing findings in literature and in empirical research, the biggest issue was the discrepancies between the two. Literature research had more general measures and had more interventions whereas empirical cases had a case-on-case approach and more specific considering they were to be directly applicable in the context useful to this research. As such, there were difficulties in assessing which measure was to be chosen or disregarded, since there was no concrete guarantee that the choice was right (except for when the measures appeared both in literature and empirical cases). Another issue was the lack of classification of the measures in empirical cases according to the type they are (grey/green/blue infrastructure or hybrid/soft measure) or the resilience factor they can be grouped in ("robust", "flexible", "integral" and "redundant"). This made classifying the measures in both ways difficult, since for most of them, there was no indication how they could be classified as. The classification is an educated guess, meaning that some measures could be wrongly classified according to the type of measure they are or their resilience factor.

5.4 External validity

Nevertheless, these uncertainties could be reduced by validating the draft list of measures with an expert of the field. What the expert said corresponded to the measures selected from the analysis of the findings in literature and empirical research, implying that the draft list had a strong foundation. What could not be validated through this interview however was the classification of the measures according to the type they are and the resilience factor they correspond to, meaning that there is still uncertainty regarding these two classifications and groupings.

This research has bridged the gaps in existing literature about CCA measures and PPPs in industrial land in the Netherlands, and most importantly, how these are interconnected. It also showed that using interactive planning tools in the design phase of projects is beneficial and helpful. Further research could be done into the optimal CCA measures in industrial land and the extent of how willing the public and private actors are to undertake these measures.

6 Conclusion and Recommendations

Interactive planning tools such as STAIN are now an emerging tool in projects of high significance and size. This research went to show that such tools ought to be more widespread and that they can be used in a plethora of settings. Industrial areas and business parks are no exceptions.

The aim of the research was to explore favoured CCA measures in industrial areas and business parks and policy factors which affect the design process, in order to make a list of recommendations for improving STAIN and adapting it for use in the designated areas. On the basis of literature review, identified information was pieced together from different papers and books the CCA measures that can be used in all projects in industrial land in the Netherlands, as well as the necessary measures that can be taken for largely improving the collaboration between the public and private actors and the quality of such projects. As such, the research has bridged some of the gaps in existing literature about CCA measures and PPPs in industrial land in the Netherlands, and most importantly, how these are interconnected. It also showed that using interactive planning tools in the design phase of projects is beneficial and helpful.

Empirical cases and interviews with experts were analysed and compared to the findings in literature to devise a final list of recommendations for STAIN. The list can make STAIN usable in all projects in industrial areas or business parks, regardless of the region they are situated, shifting in this way from a case-to-case basis to a more structured strategy, with less uncertainties.

The final product, the list of recommendations, consists of two large parts, namely the list of CCA measures and interventions and the other the advice regarding public and private collaboration and workshops, as well as a smaller part with general advice that could improve the experience with STAIN for every user, regardless of how familiar they are with it. The CCA measures are distinguished first according to the way they achieve CCA: whether they do it directly or indirectly. They can be found under the name "CCA measure" and "Intervention" respectively in the list of recommendations (Appendix IV). Furthermore, these measures are classified as grey/green/blue infrastructure or hybrid/soft measure based on the classification done for CCA measures in literature, as well as according to which resilience factor they belong to ("robust", "flexible", "integral" and "redundant"). The resilience factor is the first and main input in STAIN for a measure, which is why this classification is important for the measures. As for the advice regarding PPPs, the main points echoed in both literature and empirical research are that both sides should have an open communication and dynamic collaboration. They should find a common ground early and work together by exchanging information and trying to see things from the other party's perspective. Governmental bodies could largely help the process by bringing more awareness, providing necessary information, taking incentives and most importantly, by being less strict with their requirements towards private companies.

Further research could be done into the optimal CCA measures in industrial land and the extent of how willing the public and private actors are to undertake these measures, as well as into how STAIN can be further improved and tailored depending on different needs in order to maximise its input in a project and in order for it to help discussion and brainstorming as much as possible, while being easy to understand and operate.

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Appendix I - Research Papers Overview

Below, a list of the papers read for this research is given.

Tyler & Moench (2012): A framework for urban climate resilience.

Schweikert (2015): A Sustainability Framework To Prioritize Proactive Climate Change Adaptation Investments For Impacts On Road Infrastructure Using A Data-Driven Approach.

Runhaar et al. (2012): Adaptation to climate change-related risks in Dutch urban areas: stimuli and barriers.

Hamilton & Akbar (2010): Assessing the Environmental Co-Benefits of Climate Change Actions,

Brink et al. (2015): Cascades of green: A review of ecosystem-based adaptation in urban areas.

Adelle & Russel (2013): Climate Policy Integration: a Case of Déjà Vu?

Buitelaar (2010): Cracks in the myth: challenges to land policy in the Netherlands.

Falkenbach et al. (2010): Environmental Sustainability: Drivers for the Real Estate Investor.

Ahern (2011): From fail-safe to safe-to-fail: Sustainability and resilience in the new urban world.

Doornkamp (2020): How flood projects influence urban flood resilience. A case study from Christchurch, New Zealand.

Van Der Krabben & Buitelaar (2011): Industrial Land and Property Markets: Market Processes, Market Institutions and Market Outcomes: The Dutch Case.

Klein et al. (2017): Local authorities and the engagement of private actors in climate change adaptation.

Uittenbroek et al. (2012): Mainstreaming climate adaptation into urban planning: overcoming barriers, seizing opportunities and evaluating the results in two Dutch case studies.

Rauken et al. (2015): Mainstreaming climate change adaptation at the local level.

Tompkins & Eakin (2012): Managing private and public adaptation to climate change.

De Bruijn et al. (2018): Methods and Tools Supporting Urban Resilience Planning: Experiences from Cork, Ireland.

Voinov et al. (2015): Modelling with stakeholders - Next generation.

McEvoy et al. (2017): Planning support tools and their effects in participatory urban adaptation workshops.

Agrawala et al. (2011): Private Sector Engagement in Adaptation to Climate Change.

Lambin & Thorlakson (2018): Sustainability Standards: Interactions Between Private Actors, Civil Society, and Governments.

Eckersley et al. (2018): Sustainable development in cities: collaborating to improve urban climate resilience and develop the business case for adaptation.

Tennekes et al. (2014): Out of the Comfort Zone: Institutional Context and the Scope for Legitimate Climate Adaptation Policy.

Schweikert et al. (2017): The triple bottom line: bringing a sustainability framework to prioritize climate

change investments for infrastructure planning.

Vinke - de Kruijf et al. (2018): Wider learning outcomes of European climate change adaptation projects: A Qualitative Comparative Analysis.

Dembski (2013): Case Study Amsterdam Buiksloterham, the Netherlands: The Challenge of Planning Organic Transformation.

Leväinen & Korthals Altes (2005): Public Private Partnership in Land Development Contracts – A Comparative Study in Finland and in the Netherlands.

Heurkens (2009): Changing public and private roles in urban area development in the Netherlands.

Gielen & Tasan-Kok (2010): Flexibility in Planning and the Consequences for Public-value Capturing in UK, Spain and the Netherlands.

O'Brien et al. (2020): How do planners manage risk in alternative land development models? An institutional analysis of land development in the Netherlands.

Needham & Louw (2006): Institutional Economics and Policies for Changing Land Markets: The Case of Industrial Estates in the Netherlands.

Korthals Altes (2002): Local Government and the Decentralisation of Urban Regeneration Policies in The Netherlands.

Priemus & Schutte-Postma (2009): Notes on the Particulate Matter Standards in the European Union and the Netherlands.

Lord et al. (2015): Planning as 'market maker': How planning is used to stimulate development in Germany, France and The Netherlands.

Louw & Bontekoning (2007): Planning in industrial land in the Netherlands: its rationales and consequences.

Heurkens (2012): Private Sector-led Urban Development Projects: Management, Partnerships & Effects in the Netherlands and the UK.

Heurkens & Hobma (2014): Private Sector-led Urban Development Projects: Comparative Insights from Planning Practices in the Netherlands and the UK.

Van Der Krabben & Jacobs (2012): Public land development as a strategic tool for redevelopment: Reflections on the Dutch experience.

Kabisch et al. (2017) (editors): Nature-based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice.

Ten Brinke (2021): Mainstreaming climate adaptation in private urban development projects.

Raymond et al. (2017): A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas.

EEA (2013): Adaptation in Europe: Addressing risks and opportunities from climate change in the context of socio-economic developments.

Geerdink et al. (2015): RESIN Actor Analysis for Urban Climate Adaptation: Methods and Tools in support of Stakeholder Analysis and Involvement.

Carter & Conelly (2016): RESIN Conceptual Framework.

Dobre et al. (2018): Stormwater management in transition: The influence of technical and governance attributes in the case of Brussels, Belgium.

Henstra (2016): The tools of climate adaptation policy: analysing instruments and instrument selection.

EEA (2016): Urban adaptation to climate change in Europe 2016 Transforming cities in a changing climate.

Appendix II - Interview Questions

Questions were prepared for the interviews beforehand, however, these were not followed strictly and instead the direction of the interview was followed so as to give more room to the interviewed persons to say more. Depending on what the interviewed person would say, the question order would change or new questions would arise altogether, and likewise be removed. Below, the questions asked during the interview can be found. It must be noted that the interviewed persons have given information on their own accord about different aspects even when not directly asked about them, which is why there are not more detailed questions. In some instances, words in square brackets are found in the questions. This is to show that the words in these brackets were not explicitly said during the interview because they were understood from the context or the question built upon the last thing said by the interviewee. However, they have been included here, because without them the question would be difficult to understand.

Interview 1

This interview was held with a consultant of climate adaptation from Royal HaskoningDHV. The interviewee was involved in Case Study 1 of empirical research. The aim was to obtain context regarding the report of this case and the missing information about the PPP dynamics and problems in this project.

1. Who were the actors involved?
2. Were there any other private actors?
3. There was not much involvement from private actors?
4. Is this why the website was chosen as the product?
5. Have the people you interviewed, the companies, seen the website?
6. Who worked on making the website?
7. What were the steps followed to make the list of measures?
8. The companies approved of the measures as well?
9. How familiar were the other actors with climate change adaptation (CCA) measures?
10. Were there a lot of conflicts or prolonged disagreements between the actors?
11. Were there any context-specific factors that affected the chosen measures?
12. Did certain factors that are specific for that region affect the choices or the project development?
13. Could these measures potentially be applied to other regions?
14. Did the different actors become more open towards more types of measures as the project progressed or were they just stuck on their beliefs from the very beginning?

15. When did the whole process take place and how long did it last for?
16. Will the private companies later on have more of an active say, or it would continue to be the municipality council?

Interview 2

This interview was held with a consultant of environment, energy and sustainability from Royal HaskoningDHV. The interviewee was not involved in any of the case studies of the empirical research, but was highly experienced in projects in industrial areas and business parks. The aim was to obtain general information regarding PPP dynamics in projects in these areas from her experience and inquire common problems in such projects.

1. Which actors are involved most in projects in industrial areas in general, private or public ones?
2. For a project where there are both public and private actors, which ones develop the projects most or contribute the most?
3. How is the collaboration between the actors established? What steps are taken?
4. Do public actors put a lot of constraints on private actors when they work together?
5. What are the measures that actors typically aim for especially when it comes to climate change adaptation (CCA) in the final product?
6. How is the final product or measure evaluated? How is it chosen or is it based just on what the actors agree on?
7. Is there a system to check whether the measure will be profitable or useful for the companies later on?
8. How long do projects in industrial areas typically take?
9. Is there an indication of how land should or will be used in projects like this at the starting point?

Interview 3

This interview was held with a project member from Case Study 3 from Royal HaskoningDHV. The aim was to obtain context regarding this case and information about the PPP dynamics and problems in this project, as well as to find out how STAIN being used in the workshop affected the process and how it compared to the cases where STAIN was not used in the project.

1. Who were the actors involved?
2. Were there more private or public actors?
3. How much of a role did public and private actors play respectively?
4. Who had the most weight [public or private actors] in decision-making?
5. What were the steps followed to make a list of measures and what was done by the actors during the workshop?
6. Were there any context-specific factors that affected the chosen measures? So, were the measures affected by where they were going to be implemented?

7. Were there any conflicts between the actors?
8. How familiar were different actors with climate change adaptation measures and resilient design before working together?
9. Were private actors were familiar with these measures or the public actors?
10. Did the public actors become more open towards the ideas that the private actors had as the sessions progressed, or were they stuck on their beliefs?
11. Was there an indication of how land was supposed to be used in the project at the very starting point by the municipality?
12. There were not any more concrete plans that the developers were also made aware of?
13. When did the process [of the whole project] take place?
14. How long did the project take?
15. In how many workshops was STAIN used?

Appendix III - Validation of the list

The part about CCA measures of the draft list of recommendations was validated by holding a semi-structured interview with a leading expert in Water Resilient Cities from Royal HaskoningDHV. As a result, some measures were added or removed and the names of some were changed to be more accurately representative of the measure. Changes done to the draft list are listed below:

- "Lagoons" and "Lowered embankment" were added to the types of "open water basins" (which include ponds, retention ponds, and canals). Lowered embankments are beneficial because they act as an inundation area which can be flooded on purpose to avoid flooding in buildings.
- "Purple roofs" were added to the types of Green/Blue roofs (extensive/intensive green roof and blue roof). These are a mix of blue and green roofs.
- More specific types of semi-paved areas (permeable pavement) were added to this umbrella term, namely "Gravel", "Stone combined with greenery" and "In combination with infiltration".
- Water storage soil was renamed "Water storage subsurface" because the previous name implied that water is stored in whichever part of the soil, when in fact, it is stored between the groundwater table and surface in the unsaturated part of the soil.
- Temporary nature was renamed "(Natural) Open space".
- Blue/Green verges were renamed as "Green streets" in compliance with it belonging as a measure to what is internationally known as Blue-Green Infrastructure (BGI).
- Greening of plots was renamed "rain gardens", because the performance of a green lawn is not particularly high, but when shrubs and trees are added and thus takes the form of a rain garden, more water is held and is able to infiltrate.
- Trees were renamed as "Trees with Canopy and Tree pits", since the specification of a canopy ensures shading is provided by the tree and the addition of a tree pit helps with water infiltration.
- "Flood resistant plants" was added to the list.
- Building water protection was renamed "Flood-proof building". The water protection system and flood management are integrated in the building.
- Indoor climate was further subdivided into "Interior gardens" and "Green walls".
- "Rainwater harvesting" was added to the list.
- Disconnection of rainwater and its subdivisions were moved to the "Intervention" groups of measures, since these are an intervention rather than a direct CCA measure.
- Enlarge pumping capacity was removed from the list, since this is not really feasible and even if the system was redone, it would only mitigate the problem and make it worse for the years to come.

Appendix IV - List of Recommendations for STAIN

The final and complete list of recommendations for making STAIN suitable for use in projects in industrial areas and business parks is given here. The list is divided in three parts: List of CCA measures and interventions that should be added in STAIN; list of recommendations for policy to achieve a more effective collaboration and lastly a few further recommendations about the software which can improve the interaction with its users.

6.1 List of measures and interventions

Here, all the measures that are advised for inclusion in STAIN will be listed and an explanation will be given when needed. First, the CCA measures are given and then the interventions.

CCA Measures

Drought resistant plants are as the name suggests, are plants and trees that can withstand drought. They reduce the cost of maintenance, management and replacement of plants. Measure can be taken by public and private actors. Costs²: 2-14 per m².

Flood resistant plants have similar traits to drought resistant plants, except for an opposite extreme scenario. Measure can be taken by public and private actors. Costs: 2-14 per m².

Flood-proof building: Different measures taken to prevent building from being flooded, such as a raised ground level for loading bays and storage areas. Measure can be taken by private actors. Costs: depends on application.

Green boundary walls are green fences that divide private property. This measure can be achieved by adding plants next to a normal fence and plants that grow against the fence frame. This measure reduces water nuisance, cools the area and is visually pleasing. Measure can be taken by private actors. Costs: 10-20 per m².

Green streets are streets where the roadside is lowered and where grass strips are often added so that there is extra space for water in the lowered part. Measure can be taken by public actors. Costs: 50 per m².

Green walls/facades are facades or walls on the outer part of the building where plants can grow against the wall in small holes in the stones. They cool down the building and the surrounding environment and are visually attractive. However, this measure requires more maintenance than regular greenery. Measure can be taken by private actors. Costs: 300-600 per m².

Green/Blue roofs: These are roofs covered with moss/sedum/grass/herbs. In cases of large precipitation, the roof retains water for longer and drains it more slowly, which reduces pressure on the water system. On top of this, such roofs contribute positively to micro-climate by reducing heat. Measure can be taken by private actors. There are four types of green/blue roofs:

- **Extensive green roofs:** these are roofs with only moss and/or sedum. They are applied to existing building roofs.
- **Intensive green roofs:** these are roofs with grass or gardens. They can be covered with grass/herbs but they can also serve as a park on a building.

²All costs are given in euros

- **Blue roofs:** these are roofs on which a layer of water can be collected.
- **Purple roofs:** these roofs are a combination of green and blue roofs.

Indoor climate: Within a building, optimisations can be made to improve indoor climate. Measures belonging to indoor climate can significantly improve the working environment and energy save. Measure can be taken by private actors. There are two main types of measures for indoor climate:

- **Interior green gardens:** akin to a normal garden, but adapted for indoors.
- **Interior green walls:** similar to outdoor green walls.

Multi-functional levee is an embankment constructed to withstand flooding but with open space built atop it, reserved for residential or commercial use. Measure can be taken by public actors.

(Natural) Open space is nature that is left to grow spontaneously without human intervention in open areas. This measure is highly suitable for land reserved for building in the future. This measure needs almost no maintenance and management. Measure can be taken by public and private actors. Costs: 0.15 euro/m² per year.

Open water basins are measures that help collect water and ensure that it slowly sinks to the ground. Measure can be taken by public and private actors. Costs depend on the type of measure. There are five types included in this list:

- **Ponds**, which can be relatively small. They can be put in public or private area.
- **Retention ponds**, which can be placed in public areas. These are specifically made for water catchment. This water can be repurposed.
- **Lagoon**, another measure that can be placed in public area and requires a larger area.
- **Canals** which are very important and widespread in the Netherlands. They are the the connections to the water systems. Canals are especially important in and near polders.
- **Lowered embankment:** an inundation area that is lowered on purpose, so that it can be flooded if need be to prevent nearby buildings from being flooded.

Public greenery: public spaces can be greener, for example by replacing a paved remaining space of a park with green. This measure reduces heat, helps with water storage and looks more attractive. However, there is often not enough space to use this measure to a great extent in industrial land. Measure can be taken by public actors. Costs: 2-14 per m².

Rain gardens: Extra greenery, which includes trees that offer shade and shrubs, can be implemented on private property. This measure helps with micro-climate and water infiltration in the soil. Costs: 2-14 per m²

Rainwater harvesting: a system of collecting and storing rainwater so that it can later be used for non-potable water demands, in order to lower the use of potable water, which is of better quality and more expensive. The collected rainwater can also be used for irrigation in dry periods. Measure can be taken by public and private actors in collaboration.

Semi-paved areas: Paved areas (such as parking places) can be reduced and replaced with semi-paved areas which consist of permeable/porous pavement, where greenery can grow between the stones and cracks. Measure can be taken by public and private actors. In the case of private property, companies

can make an inventory of effective surface (for services and buildings). The non-effective surface can be turned into greenery with this as a way. Costs: 15 per m². There are three main types of this measure:

- **Gravel**
- **Open stones:** where grass can grow in open spaces
- **In combination with infiltration system**

Swales are large green strips where water can be buffered. They are highly beneficial in absorbing water during events of heavy rainfall, which relieves the pressure from the sewage system. The water in this case can infiltrate the soil or be connected to stormwater sewers (depending on the infiltration capacity of the terrain). Measure can be taken by public actors. Costs: 20-50 per m².

Trees with canopy and tree pits: Such trees can be placed in small areas where green can be added. They help with water retention (canopy) and infiltration (tree pits). Trees as such can also be placed by the sides of the road and remove drainage altogether if possible (since the infiltration to the soil is done by the tree pit). Measure can be taken by public actors mostly, but also private actors.

Use of colour materials (high albedo): albedo is a material of light colour, which is highly suitable for roofs, but also applicable on roads, so that there are more sun-reflecting roads than heat absorbing ones (as is the case with asphalt roads). This measure can also be used by companies when they want to choose a CCA measure for the roof, but the structure is not structurally sound enough to place a green roof. Due to its reflecting abilities, this measure provides cooling. Measure can be taken by private actors (but in some cases public ones as well). Costs: 50-100 per m².

Water squares have as a main purpose the collection of rainwater, but are also aesthetically pleasing. Measure can be taken by public actors.

Water storage subsurface: An infiltration facility placed between the surface and the groundwater table which makes use of the unsaturated part of the soil to store rainwater. In cases of extreme rainfall, the soil can store more water. Measure can be taken by public and private actors. Costs depend on the type of measure chosen. The two main ways and most widespread ones of implementing this measure are:

- **Retention crates:** these are engineered "crates" made of plastic or nature-based materials that store water below the surface by buffering rainwater underground. They can also be connected to the rainwater sewage system.
- **Rockflow:** this is a highly absorbent material which enable the soil to soak a large amount of water.

Water-storing roads are roads with an underlying water buffer, which allows for dual land use. When the road profile is lowered, water can remain on the street instead of flowing towards buildings. This measure is combined with multi-functional infrastructure. Measure can be taken by public actors.

Wetlands are areas where water covers the soil or is found at the surface for the whole year or periods of it. Wetlands are useful in treating polluted runoff (from extensive roads and public places) and regulating water quality. Measure can be taken by public actors.

Interventions

Possible interventions include:

- **Adjustment of levee embankment**
- **Critical infrastructure:** a command which can be used to demonstrate where there is infrastructure in critical condition or "sensitive" infrastructure (such as old building of value)
- **Deepening of river bed:** can reduce flood risk
- **Dike relocation**
- **Disconnection of rainwater** can relieve pressure from the sewage system and provide useful non-potable water. There are three main ways to do this:
 - **Disconnection rainwater from the roof:** disconnection of the drainpipe to collect rainwater in a barrel. However, effect is limited in comparison to the other two types. Measure can be taken by private actors. Costs: 10-100 per m².
 - **Disconnection of rainwater sewers:** disconnecting hard surfaces from rainwater and constructing rainwater sewers instead prevents polluted water from ending in the streets during heavy rainfall. This rainwater would be suitable for discharge into surface water. The measure is most effective if the roofs of buildings are also connected to the rainwater sewers. Measure can be taken by public and private actors.
 - **Relief structures** (rainwater drains): a system which separates rainwater from waste water until it reaches the mixed sewage system. Measure can be taken by private actors.
- **Enlarging sewage capacity**
- **Evacuation routes**
- **Lowering of floodplain**
- **Peatland restoration**
- **Road profile adjustment:** not to be confused with CCA interventions done or incorporated with roads. This command indicated whether a road layout needs to change in order for it to better fit the project.
- **Stream restoration**
- **Warning systems**
- **Water flow redirection**
- **Wetland restoration**

Finally, the "OTHER" command will give the possibility to workshop participants to tailor a measure as they see fit (in case of highly specific ideas/requirements) if the intended solution is not part of the list of available measures.

An overview of the measures and which resilience factor they correspond to is given below:

Table 7: CCA Measures classification

CCA Measures	Robust	Flexible	Integral		Redundant
	Lowered embankment	Use of colour materials	Green streets	Green boundary walls	Ponds
	Flood-proof building	Interior gardens	Green/Blue/Purple roofs	Drought resistant plants	Lagoon
	Measures	Interior green walls	Water square	Flood resistant plants	Retention pond
	Swales		Multifunctional levee	Public greenery	Canals
			Open space	Green walls/façades	Semi-paved areas
			Rain gardens	Trees with canopy and tree pits	Water storage subsurface
					Water-storing roads
					Rainwater harvesting

Table 8: Interventions classification

Interventions	Robust		Flexible
	Water flow redirection	Dike relocation	Critical infrastructure
	Road profile adjustment	Lowering of floodplains	Warning systems
	Enlarging sewage capacity	Peatland restoration	Evacuation routes
	Adjustment of levee embankment	Stream restoration	
	Disconnection of rainwater	Wetland restoration	
	Deepening or river bed		

6.2 Policy advice

Policy advice has been devised from the findings from literature and empirical research, as there were many similarities and common themes between the two. The advice is as follows:

Strive for a real and dynamic collaboration, by establishing dialogue from the very beginning and pushing different parties to try and think things from the other’s perspective. Begin the dialogue by working towards finding the **common ground**.

Indicate to municipalities that they need to be **less strict** with their requirements and put more **trust** on companies, and ask them about feedback. Companies are often more aware of CCA measures than municipalities believe and it is legislation that hinders them more often than not.

Neither companies, nor municipalities know everything: **close collaboration and information sharing** between the two and across municipalities boosts the performance of all those involved and contributes in innovation.

Municipalities should send private actors a **proposal** before the project starts, so that they get a better understanding of their perspective and intentions. This proposal can serve as a basis for the first workshop(s).

Municipalities should take great care of assuring that they are **bringing awareness** not only to the private actors participating in the project (by providing necessary contacts and information for them to

Table 9: Classification according to the type of measure it is of the measures in the list of recommendations for STAIN

Grey infrastructure	Green infrastructure	Blue infrastructure	Hybrid measure	Soft measure
Flood-proof building	Drought resistant plants	Green/Blue/Purple roofs	Indoor climate	Critical infrastructure
Multi-functional levee	Flood resistant plants	Ponds	Lowered embankment	Evacuation routes
Canals	Green boundary walls	Retention ponds	Rainwater harvesting	Warning systems
Water storage subsurface	Green walls/facades	Lagoon	Semi-paved areas	
Adjustment of levee embankment	Green/Blue/Purple roofs	Water squares	Swales	
Deepening of river bed	(Natural) Open space	Stream restoration	Use of colour materials (high albedo)	
Dike relocation	Public greenery	Water flow redirection	Water-storing roads	
Disconnection of rainwater	Rain gardens		Wetlands	
Enlarging sewage capacity	Trees with canopy and tree pits		Wetland restoration	
Road profile adjustment	Peatland restoration			

carry on with the implementation of CCA measures and **practical guidelines**), but also to the general public, which can provide useful feedback and knowledge from experience. **Research groups** and **local working groups** could highly benefit from this.

Governmental bodies should encourage companies to implement more CCA measures by giving **incentives** and by optimising **urban planning regulations**. Both parties however need to make sure that there is well-functioning system of **managing the operations** done within the project so as to prevent unnecessary conflicts from rising and pro-longed projects, and to strengthen trust and quality of the final product.

6.3 Further recommendations

In this part, some further (small) recommendations will be given which the author believes can make the experience with STAIN better for any user, regardless of how familiar they are with it, or the measures they are exploring.

To begin with, a checkbox could be added to show whether a measure falls under the grey, green or blue infrastructure or hybrid or soft measures, in order to get a better understanding of its long-lasting effects and impact on the environment and the ecosystem.

A toggle window could be added which pops up when a measure implemented on the map is clicked. Since only the influence area of the measure is shown directly on the map, this toggle window would

provide the missing context. The toggle window could also show a description box for the measure and/or a picture as an example. The measure is described in more detail and how it is intended to be used or by which party here. The description box could be a beneficial addition to the input commands (for when a new measure is added to the map) as well.

A command could be added with which the "term" of the measures (from short to long term) can be distinguished and shown only when this command is enabled, to get a better understanding of the longevity of the measure and payback.

Another input variable which could be added is the "Actual Area", which, unlike the influence area of a measure which is the radius where the effects of the measure are felt or seen, "actual area" would be the closest possible approximation of the physical space that the measure will take.