MAINSTREAMING PRIVATE CLIMATE ADAPTATION: AN EXPLORATION OF BUSINESS PERSPECTIVES

MAINSTREAMING PRIVATE CLIMATE ADAPTATION: AN EXPLORATION OF BUSINESS PERSPECTIVES

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Emma I. Castaños

Student number: 4772040

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Graduation committee:

Chairperson	: Dr.ir. B. (Bert) Enserink, Policy Analysis
First Supervisor	: Dr. H.G. (Haiko) van der Voort, Organization & Governance
Advisor	: ir. E. (Eva) Nieuwenhuis, Organization & Governance (TPM) and Water Management (CT)
External Supervisor	: ir. S. (Sabrina) Helmyr, Arcadis

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SUMMARY

The climate is changing, and the resulting effects impact human systems and services. Climate change adaptation is a response to climate change and its effects, which involves attempting to reduce negative effects via technological or behavioral changes. The Dutch spatial adaptation plan (DPRA) identifies four extreme weather events as a result of climate change that are of most concern for the Netherlands: sea level rise, heavy rainfall, drought, and heat waves. These climate stressors have the potential to cause wide-scale damage and interruption. In response, the DPRA aims to encourage local-level spatial (climate change) adaptation.

At the local level, the complexities and dilemmas of implementing climate change adaptation become apparent. At this level of granularity, the actors who experience benefits as a result of adaptation are not always the same ones who are making the time or financial investment in adaptation. This creates a dilemma for municipalities: they have received the mandate from the national government to become more climate adaptive, and they are dependent on the cooperation of other actors, who may not perceive the same problem, to fulfill these goals.

In particular, the private sector is an actor group that can offer important opportunities to make advances in climate change adaptation. In the Netherlands, land designated for business and industrial use makes up an important part of the urban landscape, approximately 1/6 of the built environment. This means that, successful activation of businesses to become more climate adaptive could lead to adaptation benefits that affect a major portion of the built landscape. At the same time, businesses, especially those located on business parks, are disproportionately vulnerable to potential climate change effects due to the impervious and heat-trapping nature of their built environment, meaning that adaptation in these areas could significantly decrease exposure to effects of climate change.

This research aims to explore businesses' perspectives on climate change adaptation in the Netherlands in order to make policy recommendations on the basis of the following logical sequence. Municipalities are interested in engaging businesses to become more climate adaptive, which implies a need for insight into businesses' motivations on the issue. The motivations of businesses to become climate adaptive are complex and vary across individual businesses. A more nuanced understanding of the variety of business perspectives on climate change adaptation can improve the use of policy instruments by tailoring them to specific businesses' needs.

The Q-methodology will be used to make a systematic exploration of businesses' perspectives in order to answer the research question : *How can engagement by businesses to adapt to a changing climate be increased?*.

The results of this research support the hypothesis that businesses have diverse viewpoints about the problem recognition and solution possibilities for climate change adaptation. Two main perspectives are supported by the statistical analysis, while three ad-

ditional perspectives were interpreted for their practical relevance. The main profiles revealed by the research are “Strike the iron while it’s hot" and “Seeing the problem, but not solutions." They agree that climate adaptation is necessary, and their motivation to take action can be characterized as intrinsic. This is an important deviation from a dominant characterization of businesses in the literature, who are described as only valuing financial returns. These two main profiles show that lack of awareness is not preventing climate change adaptation; rather, the convenience of combining adaptation measures with planned work and the effort of distilling information and identifying feasible solutions could be preventing climate adaptation action.

Based on these results, this research recommends a reëvaluation of the use of municipal policy instruments. The importance of subsidies was widely rejected by this respondent group, suggesting that financial returns alone are not enough to convince a business to become more climate adaptive. Further research testing other financial instruments, such as tax breaks or low-rent loans, could refine this conclusion. It is not recommended that governments default to regulatory instruments, as some profiles already indicate a willingness to become more climate adaptive; however, other profiles (in the case of this respondent group, a minority) indicate that regulation is a key motivation to take action on environmental issues. Ultimately, the research results demonstrate that many “soft" policy instruments are available, and potentially effective to address climate change adaptation.

The research results are relevant for local governments, such as municipalities and water boards, as well as business park managers, who are responsible for adhering to policy from local governments. The results can be used to increase awareness within governmental organizations of the various values and considerations that affect business decisions. They can be used to structure ongoing risk-dialogues (as part of the DPRA activities), for example, by asking participants to what extent they identify with any of the profiles, if at all. Using an open question such as this one to begin a dialogue can facilitate a content-based and value-rich discussion. The framework of barriers can also be used in dialogues for businesses and municipalities to jointly identify barriers to climate change adaptation. Some of the solutions to barriers suggested by this study are: the creation of targeted impact analysis per location or sector, emphasizing potential gains and opportunities, and guiding adaptation action by providing consultation on adaptation measures that are “no-regret" and also carbon-reducing, for example. Barriers identified in collaboration with businesses could provide specific action items unique to a municipality.

This research makes two important contributions. First, there is a theoretical contribution: this research goes beyond a dominant characterization of businesses and their motivations. Through empirical validation this research demonstrates that a more nuanced understanding of businesses is possible. The result is a novel conceptualization of business perspectives on climate change adaptation. Second, this research makes a methodological contribution by validating the use of an online Q-methodology study, the combination of both guided and unguided Q-sort data collection techniques, and the use of alternate (primed) ranking.

PREFACE

Before you lies the master thesis “Mainstreaming private climate adaptation: an exploration of business perspectives," the basis of which is data collected via interviews and surveys. It has been written to fulfill the final graduation requirement of the Engineering and Policy Analysis master program at the Technical University of Delft. I was engaged in researching and writing this thesis from February to August 2020. The project was undertaken in collaboration with Arcadis, where I completed a graduation internship.

I would like to thank my supervisors, Haiko, Bert, Eva, and Sabrina, for their guidance and support during this research process and unprecedented work from home experience. Thank you for the freedom to explore this topic and the feedback that helped me continuously improve upon my work. I also want to thank all the respondents, without their cooperation I would not have been able to conduct this analysis. The respondents were open, enthusiastic, and flexible, and I thank them for that.

To my colleagues: I would like to thank you for your cooperation as well. Vera, thank you for brainstorming with me and for always giving practical advice. Derjan, Marius, Claudia, thank you for your insights and your help with the preparation of my interview materials. Freya, Maarten, and my other colleagues who reviewed to my intermediate results, thank you for your questions, feedback, and enthusiasm. It was helpful and instructive to work with all of you.

I also benefited from the unwavering support of my friends and family. Thank you for showing interest and support during this thesis research. Thank you, Greeult and Marja, for welcoming me into your home and helping give some structure to the early and uncertain weeks of this research. And to my two special Delftenaars: Amerens, thank you for your friendship and encouragement, and Jelle, thank you your companionship, patience, and dedication. You both made this possible.

To Mom and Father, thank you for everything. Thank you for giving me the possibility and the freedom to come study in the Netherlands and for never doubting that I can do whatever I set my mind to. To Carmen and Sebastian, I’m so lucky to have you two as siblings. Thank you for making me laugh and always supporting me from afar. Oma en oom Cees, bedankt voor jullie steun, interesse, en zorg. Ik ben dankbaar dat ik mijn tijd in Nederland met jullie kan doorbrengen.

Emma I. Castaños
Delft, August 2020

1

INTRODUCTION

This chapter will introduce the problem context, scope definition, knowledge gap, and research objectives.

1

The changing climate has effects with serious potential consequences for business parks in the Netherlands. There is a need for an empirical exploration of their own evaluation of the situation and arguments for climate change adaptation in order for municipalities to achieve their climate proofing and water robustness goals.

1.1. CLIMATE CHANGE EFFECTS IN THE NETHERLANDS

In the Netherlands, extreme weather events, such as heat waves, drought, and heavy downpour[1], are being exacerbated by climate change [4, 42]. The adverse effects of these extreme weather events are severe. Northwestern European cities in particular suffer from the Urban Heat Island effect, which worsens the effects of heat waves, a leading cause of climate-related mortality [29, 34]. In addition, rising average daily temperatures have ramifications for human health and productivity measures [47]. Climate change also increases the risk of river and coastal flooding, which has repercussions for transport systems, especially rail systems, and cities, which tend to be co-located with zones that are vulnerable to flooding [29].

And urban, pluvial flooding as a result of extreme rainfall or “cloudbursts" are not uncommon in the Netherlands. On 28 july 2014, an extreme rainfall event in Amsterdam resulted in parts of the A10 highway being closed and flights at Schiphol airport being cancelled [61]. In a damage analysis completed after the event, it was discovered that the median home damage was 1,200 euros and that there was a negative correlation with build-year and amount of damage [23]. Thus, despite “relatively high levels of climate-preparedness" [29, p. 306] in the European region, increasing frequency and intensity of extreme weather events means that further action is needed to maintain and increase this preparedness [28, 29]. This preparedness for the effects of a changing climate is needed to decrease future damage, which could reach up to 70 billion euros by the year 2050 [24].

1.1.1. DUTCH NATIONAL SPATIAL ADAPTATION PLAN

In the Netherlands, the national program “Deltaplan Ruimtelijke Adaptatite" (hereafter referred to as DPRA) has identified sea level rise, drought, heat waves, and pluvial flooding at the extreme weather events most likely to impact the Netherlands.

As part of the DPRA, various activities are taking place: namely extreme weather event “stress tests" and risk dialogues. A complete overview of the activities (in Dutch) can be seen in fig. 1.1.

At the national level in the Netherlands, the government has set an spatial adaptation agenda with the DPRA, which states that by 2050 the Netherlands will be robust against water and climate-proof [38, 39]. As a first step, all municipalities are required to identify their vulnerabilities to extreme weather events [41]. This decentralized approach to spatial adaptation follows from the DPRA acknowledgement that different regions within the Netherlands will face the effects of climate change to various degrees [24].

While the information provided by the Dutch government uses the term *spatial* adaptation, section 1.2.1 will explain how they are actually referring to *climate change* adap-

[1] According to the Dutch Meteorological Institute (KNMI), heavy downpour is defined as rainfall greater than 25 millimeter of rain in an hour.

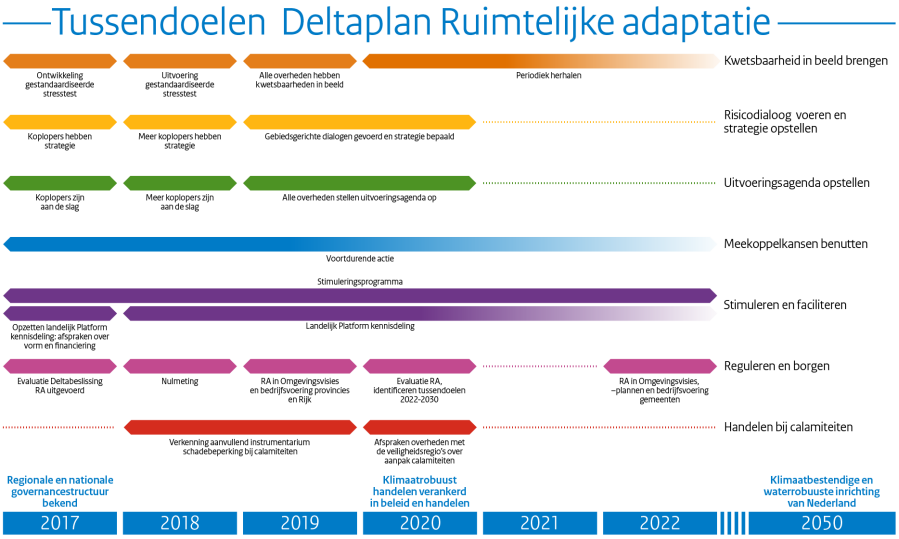

Figure 1.1: Intermediate goals and activities for the DPRA, from Deltacommissaris (2018)

tation, and what that is.

1.2. THE CHALLENGE OF CONCEPTUALIZING CLIMATE CHANGE

Global, anthropogenic climate change is a complex and uncertain issue that can be difficult to conceptualize for a number of reasons.

The processes that cause climate change take place over *long time scales*. Due to climate inertia, we are currently feeling the warming effects of greenhouse gas emissions that were released decades ago [78].

Further, the processes that cause climate change involves various *reinforcing feedback loops*. The thawing of permafrost as a result of rising temperatures releases additional methane and carbon dioxide into the atmosphere, contributing to the greenhouse gas effect (thereby contributing to the increase of climate change). The loss of sea ice coverage (and glaciers) reduces their contribution to the albedo effect, which reflects the solar radiation from the sun away from Earth (thereby detracting from their decrease of climate change) [59].

Meanwhile, the effects of climate change manifest over the *short- and long-term* at *local, regional, and global physical scales*. These effects range from changing weather patterns, which can cause heavy rainfall at a local scale, to the sea-level rise, which increases coastal risks at a global scale [1, 49, 88].

The effects of climate change also introduce *reinforcing feedback loops*. Heat waves in the summer can lead to increased use of air conditioners, which consume more electricity, contributing to the release of greenhouse gases.

In addition, *uncertainty* around and generated by climate change is high. Despite

the development of global climate pathway scenarios by the Intergovernmental Panel on Climate Change (IPCC), there remains uncertainty about which of (and when) the possible future scenarios will occur. This uncertainty of the scenarios themselves is further compounded by the uncertainty of the resulting effects the scenarios will have on human systems, services, and societies.

1.2.1. RESPONSE: MITIGATION & ADAPTATION

In response to anthropogenic climate change, there are two main types of responses: climate change mitigation and climate change adaptation. The relationship between these activities and climate change are shown in fig. 1.2. At the beginning of the relationship (on the left in fig. 1.2) is the intervention “climate change mitigation" and at the end of the relationship (on the right in fig. 1.2) is the intervention “climate change adaptation."

Figure 1.2: A conceptual distinction between climate change mitigation and adaptation, source: author

Climate change mitigation (or “mitigation" and in Dutch, “tegengaan van klimaatverandering", which is klimaatmitigatie) involves “efforts to reduce or prevent emission of greenhouse gases" [82]. This can take the form of using renewable or “clean" energy or decreasing energy demand, whether by changing behavior or using more energy efficient technologies [82].

Climate change adaptation (or “adaptation" and in Dutch, “aanpassen aan klimaatverandering", which is klimaatadaptatie) refers to “anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause" [27]. These measures can include “technological measures, ecosystem-based measures and measures addressing behavioural changes" [30, p. 2]. Importantly, adaptation also requires dealing with the physical and temporal uncertainty associated with extreme events [46].

Mitigation tends to be associated with the energy transition, and increasing energy efficiency, while adaptation manifests in the spatial domain, and tends to deal with the built environment. In the Netherlands, the DPRA is an example of how the spatial planning aspects of adaptation lead to its separation from the energy transition aspects of mitigation, see table 1.1.

Table 1.1: Examples of how climate change mitigation and adaptation are addressed in separate policies at national and super-national levels

	Mitigation	**Adaptation**
European Union	2030 Climate and energy framework	EU strategy on adaptation to climate change, Climate-ADAPT program
the Netherlands	National Energy and Climate Plan (NECP)	Nationaal Klimaatadaptatiestrategie (NAS) 2016, Deltaplan Ruimtelijke Adaptatie (DPRA) 2018

1.3. SCOPE DEFINITION

Given the various dimensions and scales of climate change, the following sections will scope the area of focus for this research, describing the rationale for selecting climate change adaptation, local-level approach, and targeting the private sector.

1.3.1. ADAPTATION

While there are arguments to be made for the coupling of mitigation and adaptation activities , for the scope of this study they will be considered separate issues. Adaptation is necessary because of the long-term nature of climate change, as described in section 1.2. Even with a complete societal transition to sustainable energy and a drastic decrease in energy demand, the effects of climate change will continue to be felt for decades, if not centuries, to come [78].

This is supported by the assumption that from purely a financial point of view, cost-benefit analyses for mitigation differ from adaptation, with the effect that to some extent, climate mitigation activities (e.g. installing solar panels) are already mainstreamed. Further, the scoping of the DPRA ambitions in the Netherlands creates a strong frame of reference for a focus on adaptation.

1.3.2. LOCAL-LEVEL

As defined by the DPRA, local-level governments such as municipalities are to take charge on implementing sufficient adaptation in their jurisdiction.

This onus presents an immediate challenge for municipalities: how can they encourage climate change adaptation in their municipality without creating undue cost or burden? This challenge exists because the regions where municipalities want to influence climate adaptation activity are owned and used by various other stakeholders. To name them broadly: private citizens and private businesses.

While a municipality can renovate a public park to be more climate adaptive, there are requirements that ensure they consult with local residents who make use of the park or live nearby. This creates dependency of the municipality on residents. Further, in order to achieve adaptation on non-public land, the municipality has even less direct leverage and instead has to rely on policy instruments to achieve their goals. This creates dependency of the municipality on the owners of private land, such as businesses.

This latter example results in a version of the agency problem (or, the principal-agent

problem), which is that businesses (the agent), by choosing to become climate adaptive or not, affect the goals of the municipalities where they are located (the principal). At the local-scale this dilemma becomes evident. In addition, because the DPRA emphasizes adaptation at the local level, it is natural for this research to focus on local-level adaptation.

1.3.3. BUSINESS PARKS

There is need for climate adaptation activity by private citizens, however this stakeholder group is designated as out of scope for this research. It is argued that there is a greater need for adaptation by businesses, and that they present an interesting chance to explore whether climate adaptation is evaluated by businesses as something interesting or feasible.

In urban areas, zones designated for business and industrial use constitute a considerable portion of urban areas, see fig. 1.3 for a visualization of industrial land use in Amsterdam. These business and industrial zones tend to be disproportionately paved and impervious surfaces, which decreases an area's resilience to extreme rain events and heat waves. These areas also account for a significant portion of the urban footprint: business parts make up approximately 81,500 hectares of land in the Netherlands [44]. Climate change adaptation is needed in industrial and business areas (hereafter referred to as business parks) in order to meet the DPRA stress test targets defined for extreme rainfall, for example.

1.4. KNOWLEDGE GAP

In order to achieve the goal of the DPRA for the Netherlands to be water robust and climate proof by 2050, the government has defined a decentralized, local-level approach. Organizations such as municipalities, water boards, and business park managers are attempting to increase the climate-proofing of businesses in their areas as part of the plan.

Climate change adaptation is needed on business parks. Business parks' vulnerability to the effects of climate change are exacerbated by their physical features (e.g. impervious surfaces, materials that retain heat). Furthermore, the effects of climate change not only have potential ramifications for businesses in terms of physical damage, but also the interruption of processes and services. Yet, business remain a challenge stakeholder group to engage on climate change adaptation. Thus, an in-depth examination of businesses' own opinions on the need for climate change adaptation in the Netherlands, at the local-level and in the context of the DPRA is needed.

This research will fill this gap, and offer local governments and practitioners insight into how businesses perceive the effects, urgency, and need for climate change adaptation, and how they view the roles of involved actors in a potential solution. The different perspectives that exist within the private sector will be studied, defined, and used to develop an understanding of what kind of actions by local governments could be useful in encouraging businesses to become more climate adaptive.

1.5. RESEARCH QUESTIONS

In order to address the research gap, the following research question has been defined.

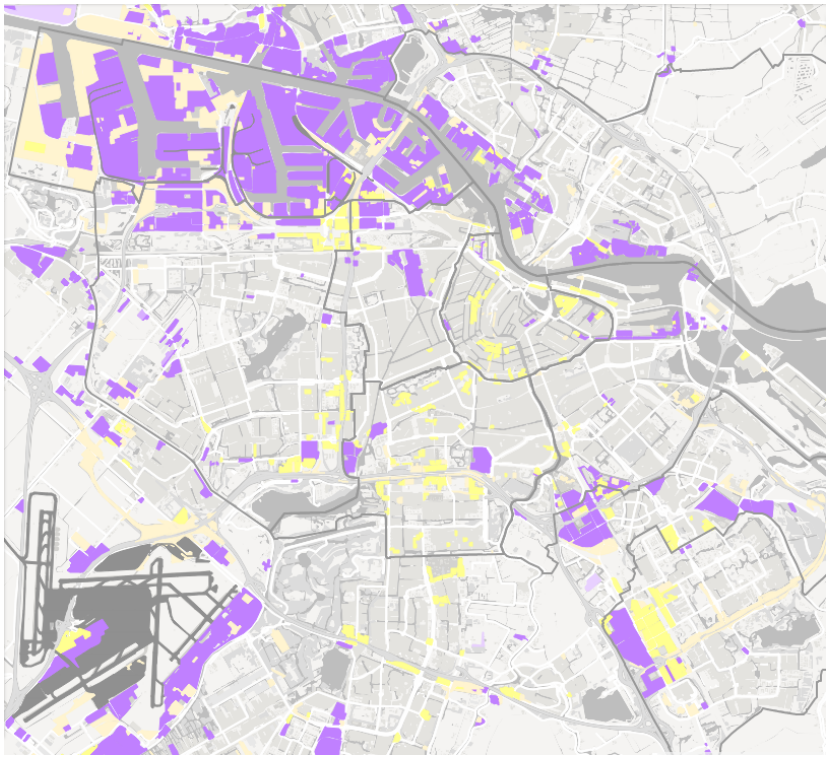

Figure 1.3: Business office (yellow) and industrial (purple) areas in Amsterdam, Schiphol airport (dark grey), from City of Amsterdam (2017)

How can engagement by businesses to adapt to a changing climate be increased?

1.6. RESEARCH OBJECTIVES

The aim of this research is to study the perspectives that businesses have about climate change and adaptation: how do they define the problem (if they do), what do they see as costs and benefits of investing in climate adaptation, and what do they expect from other stakeholders, such as their insurer or the municipality themselves? By interviewing businesses directly, this study will create a new framework for conceptualizing various business perspectives on climate change adaptation.

The aim of this study is to explore various business perspectives on climate change adaptation and fill in the knowledge gap that surrounds business' own evaluation of the argument for and feasibility of climate change adaptation. The hypothesis is that businesses are not a homogeneous group, and while they have some perspectives in common, they might also differ on different aspects of their perspective on climate change adaptation. This research aims to develop strategies for municipalities to increase business engagement with climate change adaptation based on a more nuanced understand-

ing of the potential perspectives that businesses currently have.

1.7. STUDY RELEVANCE

In order to achieve increased climate change adaptation across an urban area, various initiatives will have to take place at sub-city levels. This means that the cooperation of private stakeholders, including businesses, is needed. Indeed, many municipal climate strategies express the need for engaging the private sector in adaptation efforts [35, 50, 51].

Given the ongoing activities as part of the DPRA, this study is of particular relevance for organizations such as municipalities, water boards, and business park managers. In order for the Netherlands to collectively meet the goals of becoming climate proof and water robust, specific targets have been set, such as the requirement to have storage capacity for 60mm of rainfall to prevent direct entry into the municipal drainage system. These goals require the participation of businesses in order to meet them in buisness parks.

Some municipalities have expressed their perception that there is a gap between their problem definition and the problem definition of businesses with respect to the need for climate adaptation. Local governments need strategies to engage with the private sector about climate change adaptation. As such, this research will contribute to the ongoing outreach and policy-making activities by local governments in the Netherlands as a result of the DPRA.

This research attempts to address key institutional and governance issues of the problem of climate change in a complex, dynamic, multi-actor setting. The insights generated will be useful for policy-makers, municipalities, and business parks that are interested in becoming more climate-proof, especially in accordance with the DPRA.

1.8. REPORT STRUCTURE

This report will continue with further definition of the study (chapter 2), a review of relevant theory in preparation for interviews with businesses (chapter 3 and chapter 4), the methodology of which is described in the following chapter (chapter 5). The interview analysis results (chapter 6) will be used to develop strategies (chapter 7) to increase climate adaptation by businesses. A discussion (chapter 8) and conclusion (chapter 9) will follow.

2

STUDY DEFINITION

This chapter will describe the research approach used to fulfill the research aims.

Based on the knowledge gap and research aims defined in the previous chapter, this chapter will describe in more detail how the sub-research questions relate to each other and how the research aims will be fulfilled during this research.

2

2.1. RESEARCH QUESTIONS

The following sub-research questions have been formulated in order to support the answering of the main research question.

What are the potential consequences for businesses as a result of a changing climate? This will explore the potential effects of climate change on business operations in order to contribute to a risk-based perspective on climate change adaptation.

What factors might influence the evaluation of the business case for climate adaptation? This will explore the potential costs and benefits of climate change adaptation for businesses in order to contribute to a business case perspective on climate change adaptation.

Who are the stakeholders that can affect business' engagement with climate adaptation, and how do they influence businesses? This will explore the actors and potential roles they can fill or actions they can take that might affect businesses' engagement with climate change adaptation.

What perspectives do businesses have on their role in climate adaptation? This will use the findings from the previous three sub-questions to test to what extent these factors and expectations of actors affect businesses' perception of their role in climate change adaptation. This will result in a typology of business perspectives on their role in climate change adaptation.

What strategies to encourage climate adaptation can be used to target the different types of businesses, based on their perspectives? This will use the perspectives developed by the previous sub-question as a basis for recommending different strategies to increase climate change adaptation by businesses.

2.2. RESEARCH APPROACH

In order to address the sub-research questions and, ultimately, the main research question, the research approach shown in fig. 2.1 will take place.

First, two main areas of exploratory literature research will take place, this will be research about decision-making by a "rational" actor and research about decision-making by a networked actor. The former will focus on decision-making literature that considers businesses to be a "rational" actor, interested in reducing their own risks or making investments using a business case evaluation. The latter will focus on the influences of networks and relationships on businesses' engagement with climate change adaptation.

The exploration of these two frames are important for capturing a variety of positions that might influence a businesses' interest in climate change adaptation. This will consist of positions about advantages and disadvantages of adaptation, potential vulnerabilities for businesses, barriers and incentives, and actors and their potential roles

in solutions. Thus, both lines of reasoning are explored and combined in preparation for interviews.

Then, interviewing will be conducted with businesses in order to uncover the potential perspectives businesses have on their role in climate change adaptation. The findings from the previous sub-questions will be used to uncover how the advantages and disadvantages of climate change adaptation, and the roles and responsibilities associated with local level governance, determine business' views on climate change adaptation. The Q-methodology [12, 73] has been selected to allow for a quantitative correlation of this subjective data, and is explained in more detail in chapter 5.

Finally, the findings from the first four sub-questions will be used to develop recommendations for the activation of businesses in the area of climate change adaptation.

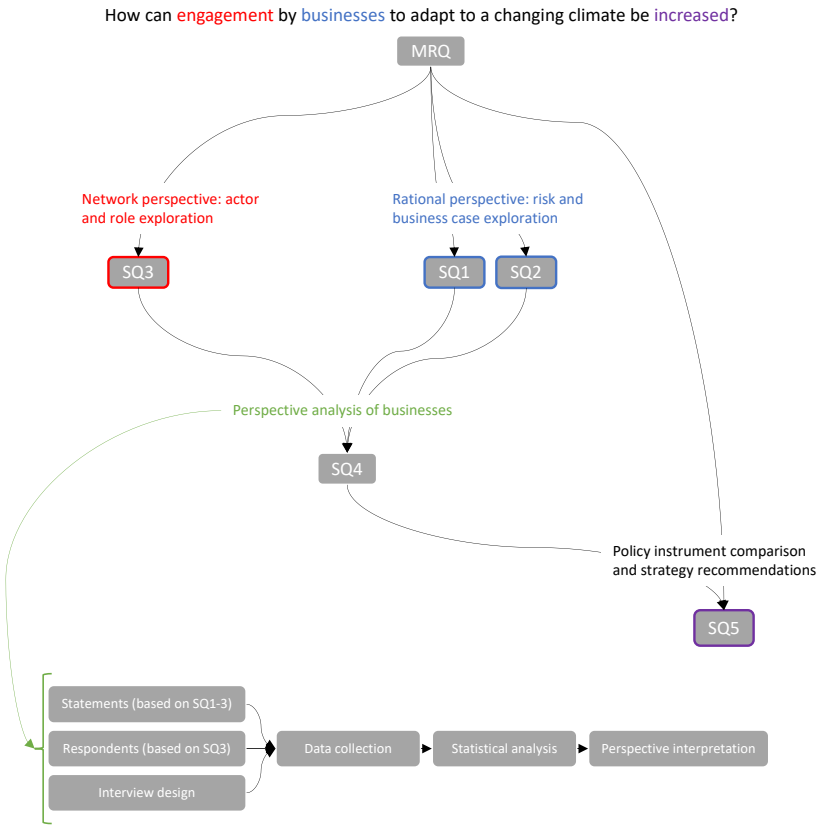

Figure 2.1: A conceptual representation of the relationships between the sub-research questions, source: author

2.3. DATA COLLECTION

Based on the conceptual diagram that shows the relationship between the sub-research questions, a more detailed description of the data collection methods per question will be explained in the following sections. The theoretical questions (sub-questions 1-3) will be answered via desk research (presented in chapter 3 and chapter 4). The application of the Q-methodology (discussed at length in chapter 5) will be used to answer sub-question 4 (presented in chapter 6). A synthesis of desk research and previous sub-research question findings will be used to answer sub-question 5 (presented in chapter 7). A summary of the data requirements and the planned collection methods is shown in table 2.1.

Table 2.1: Summary of sub-research questions

Sub-question	Chapter	Data or Information	Collection method
1	3	Climate change effects, business vulnerabilities, and potential consequences	Desk research
2	3	Advantages and disadvantages of climate change adaptation	Desk research
3	4	Actors and roles	Desk research
4	5-6	Application of the Q-methodology for perspective analysis	Interviews
5	7	Policy instrument comparison and recommendations	Desk research

SUB-QUESTION 1

What are the potential consequences for businesses as a result of a changing climate?

This sub-question requires information about the potential effects of extreme weather events. The data sources for this sub-question include literature that describes the effects of climate change in the northern European region and a review of business' operations, value chain, and supply chain to identify business' vulnerabilities to climate change effects. The research method will consist of desk research and will result in an overview of potential consequences of climate change for businesses.

The method to complete the desk research for this sub-question is as follows. To find scholarly articles, the search terms "climate change adaptation" AND "private sector" in various combinations with terms such as "risk*," "risk management," or "risk assessment*" were used in the Web of Science database. Further, to find publications by governments or other organizations, similar terms were used in an internet search engine (Google). The top 20 results sorted by relevancy were scanned, and based on the abstract or introduction, papers were selected for further reading and analysis.

SUB-QUESTION 2

What factors might influence the evaluation of the business case for climate adaptation?

This sub-question requires a literature review of climate change adaptation, and the argumentation for and against action by businesses. The potential data sources for this sub-question include articles, interviews, blogs, reports, and published literature. The research methods will consist of desk research, which will result in an overview of potential advantages and disadvantages of climate change. This desk research will favor documented advantages and disadvantages and might exclude advantages and disadvantages from individuals without a platform for publication.

The method to complete the desk research for this sub-question is as follows. To find scholarly articles, the search terms “climate change adaptation" AND “private sector" in various combinations with terms such as “business case," “benefit*," or “cost*" were used in the Web of Science database. Further, to find publications by governments or other organizations, similar terms were used in an internet search engine (Google). The top 20 results sorted by relevancy were scanned, and based on the abstract or introduction, papers were selected for further reading and analysis.

SUB-QUESTION 3

Who are the stakeholders that can affect business' engagement with climate adaptation, and how do they influence businesses?

This sub-question requires a review of the stakeholders that interact with business' and what their potential role with respect to climate adaptation might be. The potential data sources are government publications, reports, as well as general internet searches. The main research method for this question will be desk research, which will favor formal results (i.e. those that are formally documented, probably in written form).

The method to complete the desk research for this sub-question is as follows. To find scholarly articles, the search terms “climate change adaptation" AND “private sector" in various combinations with terms such as “incentive*," “motivation*," or “barrier*" were used in the Web of Science database. Further, to find publications by governments or other organizations, similar terms were used in an internet search engine (Google). The top 20 results sorted by relevancy were scanned, and based on the abstract or introduction, papers were selected for further reading and analysis.

To search for information about business parks in the Netherlands, the search term (in Dutch) “business park" AND terms such as “climate adaptation" or “extreme weather." This resulted in brochures and reports about business parks and their publicly stated views on various aspects of climate adaptation.

SUB-QUESTION 4

What perspectives do businesses have on their role in climate adaptation?

In preparation to answer this sub-question using the Q-methodology [12, 73, 87], some specific preparatory materials are needed. They include a set of statements that cover the topic of interest, a group of participants that represent a population of interest, and a the specific interview design. The full explanation of the methods used to prepare these components are in chapter 5.

During interviews with participants, they will complete a sorting activity where they rank order the set of prepared statements according to their level of agreement or disagreement, with the goal of answering the interview question *How do you see the role of*

business in climate change adaptation. This is the data that is to be collected for answering this sub question. The collected data will be analyzed using factor analysis, which will then be used to create a typology of businesses organized by their perception on their role in climate change adaptation.

For this study, a set of 22 statements were prepared and 14 people who either work at businesses on business parks, are business park managers, or are knowledgeable thereof, were interviewed. More information can be found in chapter 5.

SUB-QUESTION 5

What strategies to encourage climate adaptation can be used to target the different types of businesses, based on their perspectives?

The findings from the previous sub-questions will be used to develop a set of strategies for governmental actors interested in encouraging climate adaptation by businesses. This analysis requires desk research for an overview of potential policy instruments for engagement strategies. The framework created while answering sub-research question 4 will also be used.

When combined, these will create a set of recommendations per profile, which is the answer to sub-question 5 and ultimately leads to answering the main research question. The results will be verified with a panel of practitioners in order to asses to what extent the profiles and recommendations are realistic.

3

THEORY: THE RATIONAL ACTOR

This chapter will enter the frame of “rational" decision-making and explore what factors might affect investment decisions from a business’ point of view.

This chapter will enter the frame of conceptualizing a “rational" actor and explore what factors might affect investment decisions from “rational" business’ point of view. In order to do so, we will enter the frame of a risk management activities by businesses. This is under the assumption that climate change effects can pose risks to businesses, so this chapter will explore the potential risks that insufficient climate change adaptation can lead to for businesses. Then we will enter the frame of a business case, and consider the costs, benefits, threats, and opportunities that businesses potentially perceive when they consider climate adaptation.

3.1. ENTERING THE “RATIONAL" FRAME

An underlying paradigm of businesses is that their main goal is to achieve “reasonable, relatively quick and predictable returns at acceptable risk" [56]. This means that by some, businesses in the context of climate adaptation are interpreted as “economic agents that maximise their profits or welfare in the light of climatic risk” [20]. It is assumed within this frame, that businesses do not act out of altruism, but “in response to the personal benefits and costs that are incurred from changing climates" [40, 67]. We will not limit our exploration to financial costs and benefits alone. The following sections will enter into the “rational" frame to explore the factors that might influence an actor in this setting.

The literature suggests that businesses conceptualized as rational actors value a few different factors. When considering business case assessments, they value an economic rationale, with expected (financial) benefits. When considering risk assessment and reduction, businesses value specific predictions for a near future with low uncertainties. Businesses also value their status quo, and are interested in protecting both their physical assets and their logistical arrangements. Finally, the literature suggests that businesses who have previously experienced loss, react rationally with ‘self-help.’ These factors are summarized in table 3.1.

Table 3.1: The potential motivations in the rational frame

Factors that influence rational actors
Economic rationale [40]
Expected benefits, strong business case [21, 40]
Specific impacts and projections [70]
Near-term results with lower uncertainties [37]
Risk assessment, risk reduction [36, 68]
Exposure assessment, limit financial exposure [37, 79]
Protect assets [79]
Value chain perspective [70]
Previous experience with losses, adaptation as reactive ’self-help’ [64, 79]

These factors tend have a quantitative nature, and suggest that risks, impacts, bene-

fits, costs, etc. that can be quantified are valued more highly during business decision-making. In the exploration of these factors that follows, the research will focus on two main areas, known in the literature for being quantifiable measures that impact business decision-making. They are risk assessment and management theories and business case evaluation. In this exploration, an attempt will be made to include non-quantifiable factors as well, when possible, in order explore whether less easily quantifiable factors, such as risks and benefits, also can affect business decision-making.

These risks and costs and benefits are explored throughout this chapter to answer the first and second sub-research questions. They will be also used in the development of the interview data collection materials (see chapter 5) to measure to what extent the businesses perceive that climate change effects and the option of climate change adaptation fit in these frames of thinking.

3.2. EXPLORING CLIMATE CHANGE CONSEQUENCES FOR BUSINESSES

This section will first explore the short and long-term effects of climate change for the North-Western European region, and categorize those risks based on their proximity to core business operations, translating the climate effects into potential consequences for businesses.

3.2.1. SHORT- AND LONG-TERM EFFECTS OF CLIMATE CHANGE

The global average temperature is increasing, which, in turn affects many of Earth's natural systems, and manifests in various potential short- and long-term changes. These long-term changes, such as gradual climate trends, and short-term changes, such as more fluctuation in local weather, are summarized in table 3.2.

Table 3.2: Examples of short- and long-term changes in weather and climate

Long-term changes	**Short-term changes**
Increasing climatic variability [1, 2]	Increased volatility and extreme weather [2]
Rising global temperatures [1, 88]	Increased incidence and severity of storms [1, 49, 88]
Warmer and wetter winters [49]	Increased incidence of (flash) floods [1, 88]
Hotter and drier summers [49]	Increased incidence and severity of heat waves [1, 49]
Loss of glaciers and permafrost [88]	Increasing frequency and intensity of drought [1, 88]
Rising sea levels [1, 88]	Increased frequency and severity of sea storm surges [1]

3.2.2. LOCATIONS OF BUSINESS VULNERABILITIES

Independent of climate and weather changes, business operations and assets are vulnerable to interruption or changes in their environment. These vulnerabilities can originate from various aspects of the business life cycle. Businesses can be vulnerable to: physical damage, supply chain interruption, raw material availability, product demand, logistical issues, reputational changes, regulatory forces, and financial problems [2]. These vulnerabilities can be organized based on their centrality to the business itself, resulting in three tiers of vulnerability: core, value, and network vulnerabilities [77].

Core business vulnerabilities include physical assets, production processes, or operation and management, as a result of a company's local exposure to climate impacts such as heat stress, water scarcity, and extreme weather events [56, 77]. Value chain vulnerabilities include natural resources and raw materials, workforce and communities, customers and demand for goods and services, and other inputs into production [56, 77]. Broader network vulnerabilities include utilities, such as water and electricity, customers' access to product, government-supplied services, and (disruptions to) supply chain [56, 77]. These vulnerability locations are summarized in fig. 3.1.

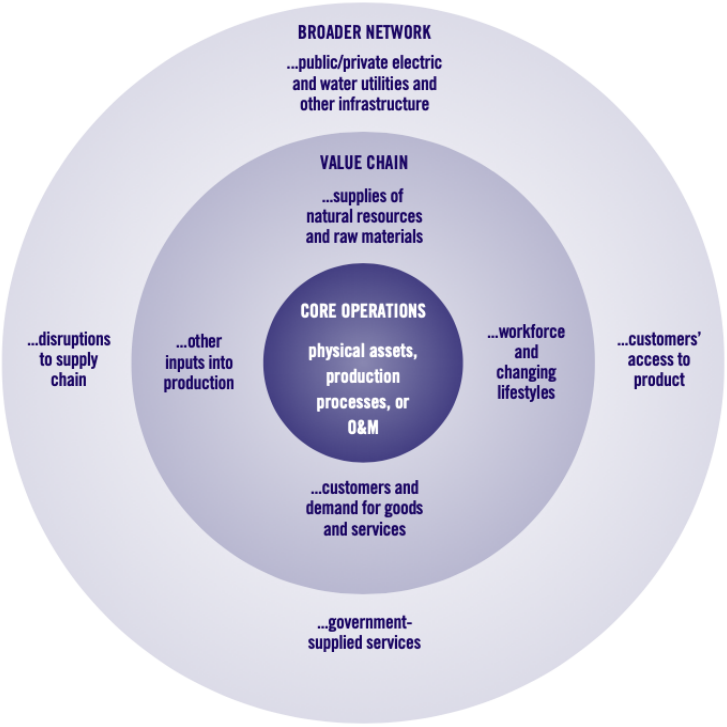

Figure 3.1: The "Risk disk" as conceptualized by Sussman et al. (2011)

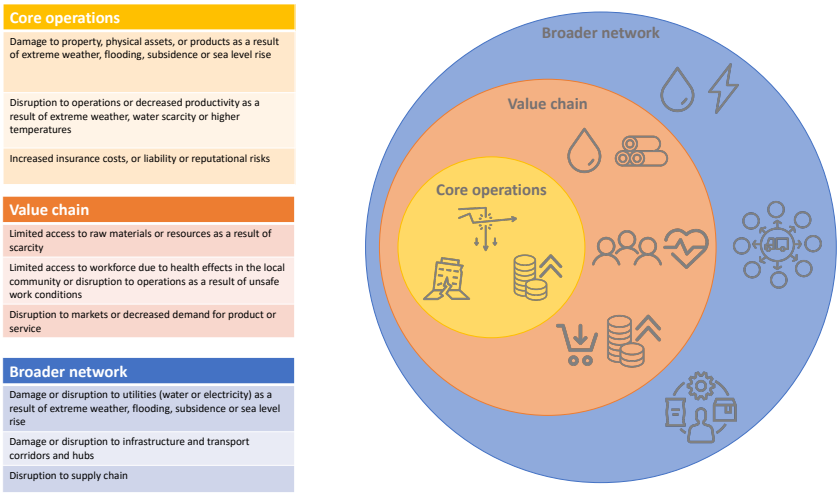

Figure 3.2: Visual summary of the potential climate change consequences for businesses

3.2.3. POTENTIAL CLIMATE CONSEQUENCES FOR BUSINESS

In this subsection, the potential long- and short-term changes mentioned in section 3.2.1 are translated to potential consequences for businesses, and organized based on the potential consequences' proximity to core business operations, as suggested in section 3.2.2. This literature review shows that at various levels of proximity to the business, the potential consequences for climate change effects on the businesses translate to damage to property, disruption to processes, and limited access to necessary resources. These consequences are further described in the following text and table, and are summarized in fig. 3.2.

The potential consequences that businesses face to their core operations include damage to property, physical assets or products. Further, they might face disruption to their operations, as a direct result of extreme weather or due to decreases performance of their assets. Their core operations might also be affected by increased reputational and liability risks, as well as insurance costs. A non-exhaustive, but representative list of potential consequences mentioned by the literature for core business operations are shown in table 3.3.

These consequences tend to focus on damage to physical property owned by businesses, which might suggest a reactive or a preventive role for climate change adaptation by businesses who face this consequence. They also suggest disruption to operations as a result of heat waves or drought are likely for some businesses, such as those in the manufacturing industry. The climate change effects of heat waves and drought are insidious and pervasive, and its possible that businesses who face these consequences have yet to recognize these consequences, or if they already do, they recognize the need for a systemic response.

Within a business' value chain, they might face disruption due to a shortage of raw materials, water (which is often used as a coolant), or their workforce, if the community

Table 3.3: Potential climate change consequences to businesses' core operations

Potential consequences for core operations
Damage to property as a result of extreme weather, flooding, subsidence or sea level rise [58, 88]
Damage to physical assets as a result of extreme weather or sea level rise [58]
Damage to products as a result of extreme weather [88]
Disruption to operations as a result of extreme weather [58, 88]
Disruption or decreased productivity of physical assets as a result of water scarcity [58]
Disruption or decreased productivity of physical assets as a result of higher temperatures [58]
Increased insurance costs and liability risks [58, 88]
Increased reputational risks [88]

is experiencing negative health effects due to a changing climate. Their businesses could potentially be interrupted due to unsafe work conditions as well. Finally, they might face decreased demand for or decreased quality of their product or service. A non-exhaustive, but representative list of potential consequences mentioned by the literature for business value chains are shown in table 3.4.

These consequences tend to focus on disruption to production processes, suggesting that businesses in the manufacturing or similar sectors will be more sensitive to value chain consequences. However, effects on product demand or product quality as a result of climate change effects are difficult to predict, and it is unclear how this might affect businesses' decision-making about adaptation.

Table 3.4: Potential climate change consequences to businesses' value chain

Potential consequences for value chain
Limited access to raw materials as a result of higher temperatures or sea level rise [88]
Limited production due to temperature and water quality and availability [88]
Limited access to workforce due to health effects in the local community (e.g. outside of work) [58, 88]
Disruption to operations as a result of unsafe conditions for the workforce to operate [58]
Disruption to markets or decreased demand for product or service [58, 88]
Increased cost of resources as a result of competition due to scarcity [58]
Decreased quality of product or service [88]

At the broader network level, businesses are might face disruption to water and electricity supply, and disruption to transport networks and infrastructure. Finally, the business supply chains themselves could potentially face interruption, including for example, disruptions to international shipping. A non-exhaustive, but representative list of potential consequences mentioned by the literature for business' broader networks are

shown in table 3.5.

These consequences imply that climate change effects on regional or national services, such as utilities and transport networks can affect businesses, although to what extent they can undertake climate change adaptation to prevent these consequences appears limited. For the consequences that affect supply chain, it could be that businesses with experience in supply chain management will have an advantage in responding to the potential climate change effects on their businesses with adaptive measures.

Table 3.5: Potential climate change consequences to businesses' broader network

Potential consequences for broader network
Damage or disruption to utilities (e.g. water and electricity) as a result of extreme weather, flooding, subsidence or sea level rise [58, 88]
Damage or disruption to infrastructure (e.g. transport corridors and hubs) as a result of extreme weather, flooding, subsidence or sea level rise [58, 88]
Disruption of supply chains [58, 88]

3.3. WHAT ARE THE POTENTIAL CONSEQUENCES FOR BUSINESSES AS A RESULT OF A CHANGING CLIMATE?

The multitude of ways that climate change can manifest (table 3.2) can result in serious potential consequences for businesses, potentially affecting their core operations (table 3.3), their value chain (table 3.4), or their larger network (table 3.5). The potential consequences can generally be categorized by either damage to property, disruption to processes, or limited access to necessary resources. Businesses might face potential disruption, either on their own property, as a result of the declining health of their workers, or their local transport infrastructure as a result of extreme weather events. They might face potential damages and associated costs as a result of extreme weather events, such as heat waves, heavy rainfall that results in flooding, or subsidence as a result of drought. Further, there are more insidious consequences, such as decreased demand for their product or service or an inhibiting cost of resources or raw materials due to shortages.

3.4. EXPLORING THE BUSINESS CASE ARGUMENTS FOR CLIMATE ADAPTATION

The main components of a business case are an enumeration of the benefits, costs, threats, and opportunities of a certain activity, while acknowledging the trade-off between the former two, and considering the latter two.

The following sections will review what the literature and other publications, such as reports and brochures, mention as the relevant issues that contribute to a business case for climate adaptation, including less-quantifiable values that could still fall into these categories and influence a business' decision-making process.

3.4.1. BENEFITS OF CLIMATE ADAPTATION

The potential benefits of climate change adaptation for businesses cover a variety of topics. These potential benefits include maintenance of the status-quo business operations (e.g. avoiding shortages of inputs, decreasing vulnerability to future regulation) as well as the minimization of direct costs (e.g. cost as a result of flooding damage, cost as a result of increased heat stress). The potential benefits of climate change adaptation also include competitive benefits, such as increasing marketing or real-estate value, attracting more talented employees. Health and ecological benefits, such as cooler areas and more green areas, are also mentioned as potential benefits of climate change adaptation. A representative but not exhaustive list of the potential benefits of climate change adaptation for businesses mentioned by the literature are shown in table 3.6.

These potential benefits tend to focus on maintaining the status quo or on increasing business possibilities. The former focuses on preserving current levels of business operations in the face of negative effects as a result of a changing climate, while the latter benefits would result for businesses who use their adaptation for competitive advantages. These benefits imply that businesses who take on climate adaptation can increase their competitive advantage, and to what extent businesses are aware of and interested in this benefit is an open question.

Table 3.6: Potential benefits of climate change adaptation for businesses

Benefit
Increasing competitive advantage [8, 79]
Maintaining business operations at current levels [20]
Improving capacity to do business [20, 67]
Avoiding or mitigate damage [9, 20, 25, 67, 85]
Avoiding flooding [25, 85]
Avoiding water shortage [25, 85]
Avoiding heat stress, cooler areas [25, 85]
Keeping costs down [15, 20, 85]
Maintaining value or increasing profitability [20]
Increasing marketing value [21, 31]
Increasing the attraction of talented employees [31]
Increasing long-term real estate value [31]
Improving image [67, 85]
Healthier work environment [31, 85]
More attractive outdoor space [85]
Improving ecology and biodiversity [25, 85]
Decreasing pollution [25]
Decreasing vulnerability to increasingly stringent future laws and regulations [31]

3.4.2. COSTS OF CLIMATE ADAPTATION

The potential costs of climate change adaptation include both the capital and opportunity costs of investment. The financial cost of climate adaptation is an upfront investment, which requires sufficient cash, and may only make a return on the time scale of years. This can lead to the opportunity cost of technological lock-in, which occurs when a decision to invest in a technology in the past constrains future options for new or updated projects. Finally, climate adaptation projects introduce the cost of over-investment, which can be a real financial cost of a project that is over-designed to an extent that its expense does not align with its expected value. A representative but not exhaustive list of the potential costs of climate change adaptation for businesses mentioned by the literature are shown in table 3.7.

These potential costs highlight an inherent financial question for businesses considering climate change adaptation. The existence of possible high, upfront capital costs of such an investment could mean that smaller businesses with less cash flows are less likely to be interested in climate change adaptation, while larger businesses are able to act more strategically in this regard. The opportunity cost of lock-in and over-investment remain, and could actually be hindering businesses to invest in climate change adaptation.

Table 3.7: Potential costs of climate change adaptation for businesses

Cost
High upfront capital costs of investing in both short- and long-term adaptation measures [20]
Technological lock-in [57]
Over-investment [7]

3.4.3. THREATS OF CLIMATE CHANGE

The potential consequences that businesses face with respect to climate change effects were discussed in section 3.2.3. These consequences can also be conceptualized as threats for businesses as a result of climate change, thus they fulfill the need to explore climate threats to businesses. Generally speaking, the threats that businesses can face as a result of climate change effects are direct damage, limited access to material and human resources, and disruption to markets and transport networks. These findings were previously presented in table 3.3, table 3.4, and table 3.5 and they are be reproduced for convenience here as table 3.8, showing a representative, but not exhaustive, list of potential climate change threats to businesses.

These potential threats tend to manifest in physical damage as a result of climate change effects or activity disruption as a result of changing conditions or access to resources. The extent to which climate change adaptation might help a business prevent losses are not only a product of the threat, but the business' ability to respond to the threat at well. For threats that affect national infrastructure or utilities, for example, it is not directly apparent what a business could do in anticipation of these threats. Despite the fact that they can affect businesses, arguably they are the responsibility of the

utility owner (which in some cases might be the government). For more direct, or closer threats, the argument for the responsibility of an individual business is stronger.

Table 3.8: Potential climate change consequences for businesses

Threat
Damage to property as a result of extreme weather, flooding, subsidence or sea level rise [58, 88]
Damage to physical assets as a result of extreme weather or sea level rise [58]
Damage to products as a result of extreme weather [88]
Disruption to operations as a result of extreme weather [58, 88]
Disruption or decreased productivity of physical assets as a result of water scarcity [58]
Disruption or decreased productivity of physical assets as a result of higher temperatures [58]
Increased insurance costs and liability risks [58, 88]
Increased reputational risks [88]
Limited access to raw materials as a result of higher temperatures or sea level rise [88]
Limited production due to temperature and water quality and availability [88]
Limited access to workforce due to health effects in the local community (e.g. outside of work) [58, 88]
Disruption to operations as a result of unsafe conditions for the workforce to operate [58]
Disruption to markets or decreased demand for product or service [58, 88]
Increased cost of resources as a result of competition due to scarcity [58]
Decreased quality of product or service [88]
Damage or disruption to utilities (e.g. water and electricity) as a result of extreme weather, flooding, subsidence or sea level rise [58, 88]
Damage or disruption to infrastructure (e.g. transport corridors and hubs) as a result of extreme weather, flooding, subsidence or sea level rise [58, 88]
Disruption of supply chains [58, 88]

3.4.4. OPPORTUNITIES OF CLIMATE CHANGE

Climate change and adaptation can also present some opportunities for businesses, which can include both distant and local opportunities. Distant opportunities include the demand for new products and services, the chance to enter new markets, and the chance of better access to raw materials. More local opportunities include the chance to upgrade the business, adopt new technology, and diversity an existing set of product or service offerings. A representative, but not exhaustive, list of potential climate change (adaptation) opportunities for businesses are shown in table 3.9.

These opportunities tend to be opportunities related to new business or business growth. While these types of opportunities might be available to some businesses in certain sectors or regions, the extent to which they are broadly available is not clear. This raises a concerning aspect about individualized climate adaptation, that is that un-

equally distributed opportunities for business growth could have destabilizing effects. What's more, there is also a potential risk opportunities created by climate change might have the effect of demotivating businesses to take mitigation activities to help slow the onset of this global crisis.

Table 3.9: Potential climate change opportunities for businesses

Opportunity
Prevention of losses due to damage or disruption
New demand [20]
New products and services [20, 88]
New markets [20, 88]
Better access to raw materials [88]
More favorable regulatory framework [88]
Chance to diversify [20]
Chance to upgrade business [20]
Chance to adopt new technologies [20]

3.5. WHAT FACTORS MIGHT INFLUENCE THE EVALUATION OF THE BUSINESS CASE FOR CLIMATE ADAPTATION?

There are various forces that affect a business' engagement in climate change adaptation. Some of those forces are intrinsic, such as the evaluation of a business case, which weighs the potential costs, benefits, threats, and opportunities that climate change (adaptation) pose to businesses against each other. These motivations can also be induced by a desire to decrease own risk, or in response to a past extreme weather event. Despite entering into the frame of a business case and risk management activities, the costs and benefits of climate change adaptation are not only financial, there are real non-financial aspects that can be explored and potentially exploited in order to increase climate adaptation by businesses.

3.6. IMPLICATION FOR THE INTERVIEWS

The findings from the literature search suggest categories of factors that may or may not be important to an individual business. These "rational" factors will be used as the basis for interviews with businesses, in order to test to what extent certain businesses value certain factors.

The potential financial benefits (or costs) of climate change adaptation can play an important role for businesses. There are also potential human, environmental, and competitive benefits to be gained from climate adaptation. At the same time, the real cost of adaptation, as well as a potential fear of over-investment or lock-in could be preventing business action. Climate change can have potential consequences on core business operations by affecting physical property in the form of damage or operations in the form of disruption. There are consequences for a business' value chain as well, suggesting that

the long-term effects on human health and availability of water could also trigger businesses. While there are consequences for a businesses' broader network, they influence of other actors in managing these consequences is complex, and could have the effect of reducing a business' perception of these potential consequences.

These ideas will be used to design an interview that will test to what extent individual businesses value these business case or risk management factors in their own decision-making about climate change adaptation. They represent a set of potential positions that may or may not be important to businesses in practice, and thus are appropriate materials to bring into the interviewing stage of this research.

4

THEORY: THE NETWORK ACTOR

This chapter will enter the frame of “networked" decision-making and explore what factors might affect investment decisions from a business’ point of view.

This chapter will enter the frame of conceptualizing a “network" actor and explore what factors might affect investment decisions from a “networked" business' point of view. In order to do so, we will enter the frame of networked societies. This chapter will explore the network of actors and interactions that can influence a business' understanding of and potential interest in climate change adaptation.

4.1. ENTERING THE “NETWORKED" FRAME

In contrast to the “rational" actor that was discussed in section 3.1, there is also the existence of an “engagement rationale," which is that businesses are compelled to take action based on a sense of engagement with their community, or with a problem and a solution, and not only for factors that would traditionally fit into a “rational" decision-making scheme, such as a business case evaluation or a risk assessment [40]. The following sections will enter into the “networked" frame to explore the factors that might influence an actor in this setting.

The literature suggest that businesses conceptualized as networked actors value various engagement factors. They might find corporate responsibility or business volunteerism important. Businesses might also be interested in local community or economic development and high environmental quality. Finally, they can value inclusion in social networks and collaborative governance. A summary of these factors are shown in table 4.1.

Table 4.1: The potential motivations in a network frame

Factors that influence networked actors
Engagement rationale [40]
Corporate responsibility [21, 32, 45, 56, 64]
Business volunteerism [64]
Maintain local economic development[71]
Inclusion in social networks[71]
Support community development[71]
Maintain environmental sustainability[71]
Collaborative governance [64]

What determines a “networked" actor's decisions depends, thus, in large part on their local context: who do they interact with, what are their sources of information, what do they expect from themselves and others. This means that the position of businesses with respect to other businesses in their network as well as governmental actors is important to understand what aspects of an engagement rationale could be useful for increasing climate adaptation. Given the land ownership interplay on business parks (section 4.2.1), and the open question from municipalities with regards to the DPRA goals, the focus here will be on the relationship between businesses and governments. While business to business relationships are important, they are deemed out of scope for this search.

4.2. WHAT CHARACTERIZES BUSINESS PARKS?

According to the Centraal Bureau voor de Statistiek, a business park is defined as "land used for industry, trade and business services" [17]. These include: factory site, port area, auction site, exhibition area, livestock market (covered or not), wholesale complex, site with banks and insurance companies, etc ., associated storage area and parking, garage (incl. parking garage), garage of bus company, office building, and associated parking areas [17].

Business parks, therefore, can be categorized by their type, which includes: heavy industry, seaport sites, mixed areas, high quality production, distribution, and thematic parks, such as "science parks" [44].

4.2.1. MIXED LAND OWNERSHIP

Within a business park, the land ownership is not completely private. Areas such as the roads are the responsibility of the municipality, see fig. 4.1 for an example of the distribution of public and private land within a business park. Often, the municipality is also responsible for drainage as well.

This mix of land ownership creates the dilemma previously referred to in section 1.3.2 at an even more granular scale. That is, within a business park, which at a higher level can be viewed as “private" land, there are actually further divisions within the area, making it a mix of private and public land. This mixed land ownership has real consequences for the ability of actors to take climate adaptation action, as well as their own conceptualization of what they might or might not be responsible for.

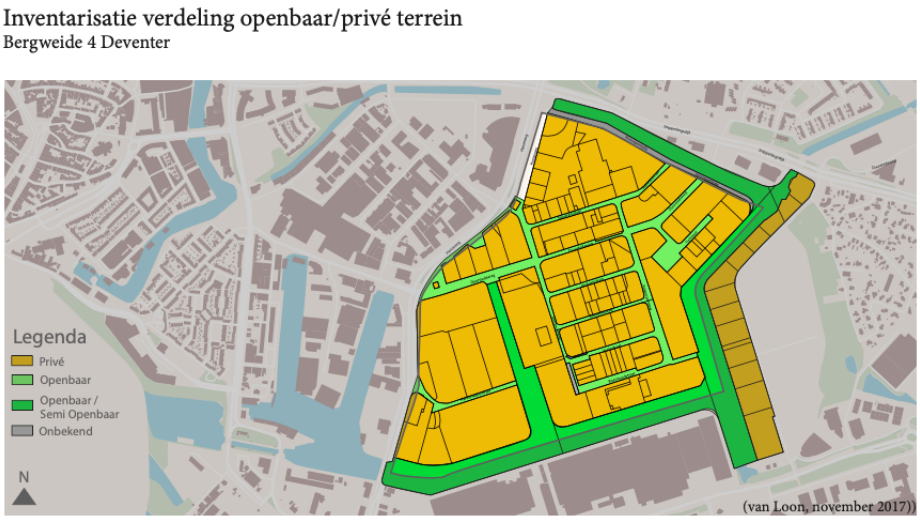

Figure 4.1: An example of the division of public and private land on a business park from van Loon and Jansma (2018)

4.2.2. MULTIPLE, INTERDEPENDENT ACTORS

The main, local actors involved in the management of existing business parks are the businesses themselves, which may or may not be organized into an association, a park management organization, which is not present on all business parks, and the municipal government.

Business parks in the Netherlands can generally be organized in one of three ways: as independent businesses without an overarching organization, as businesses bound by an association, or as businesses with park management.

Businesses, in addition to existing in location-, that is business park-, specific networks, also can exist in thematic networks. These include networks for small-medium enterprises or networks for businesses that exist in a given sector. The following actor analysis, however, will focus on actors that exist in a business' location-specific network.

INTERESTS, DEPENDENCIES, AND RESPONSIBILITIES

The national government's interest is that citizens, businesses, and local governments take action to become more climate adaptive. While they have taken charge of setting this national agenda via the DPRA, they are not directly engaging with businesses. They are responsible for developing policies at a high level and the development of the national planning task.

The municipalities are interested in complying with the requirements and timeline set out by the national government in the DPRA. They have legal, regulatory, financial, and communication tools for engaging with businesses. They are dependent on businesses to become more enthusiastic and proactive about climate adaptation. Further, municipalities are in competition with other municipalities to attract businesses to their area, therefore they are also dependent on businesses to select them. Municipalities are responsible for the creation of regional business park vision documents, managing zoning plans, and taking part in agreements about the business park management plans.

Park management is interested in attracting businesses to their business parks, and keeping the park safe and attractive make up a large part of this. They are dependent on businesses to cooperate with climate adaptation on the parks, and dependent on municipalities who determine the conditions that parks must satisfy to operate. They are responsible for facilities management, as well as the promotion of their own offerings, that is, the procurement of clients in the form of businesses who are interested in being located at their park.

Businesses may or may not be interested in climate adaptation. Generally they are interested in profits, business continuity, and financially secure transactions. To what extent they are exclusively interested in these issues will be explored during this research. They are dependent on municipalities who ultimately determine the conditions that businesses must satisfy to rent or buy in the municipality. They are responsible for compliance with ordinances set by the municipality.

POTENTIAL ROLES

Based on a search of climate-related literature (e.g. mentions "climate vulnerability" or "climate change adaptation"), a specific characterization of private sector actors emerges, see table 4.2. The prevailing idea is that private actors can mainly act as a source of financial investment, and that said investment is most likely to be directed to specific, and

well-scoped projects [21, 43]. In some cases, the stereotype of private sector actors is perpetuated: that they require government regulation or economic incentives to participate in activities that do not directly demonstrate any added value.

Table 4.2: Mentions of the role of private actors for climate-related projects

Private sector role
Investment or direct funding [21, 36, 43, 48, 63]
Involvement in local-scale projects [21, 43, 48]

With regards for roles of public actors, formal arrangements such as laws and organizational definitions define the role of public actors and their responsibilities. While business parks are most directly influenced by municipal policy, there are larger forces at work from the provincial and national policy levels. However, despite the existence of national business park policy, both the national and the provincial government have a limited role in the planning and development of business parks [62]. Municipalities therefore are able to develop their own business park policy, although they do tend to base their policies off of the vision documents organized at the higher levels of governments [55], see table 4.3.

The key role that municipalities play in business park policy is that they are often the provider of business parks, determining which businesses and under what conditions they issue parcels to companies [62]. As mentioned in the dependency section, there is also an attempt to create conditions that are attractive to businesses in order to increase their own income and job offerings, which suggests that the relationship between municipalities and businesses might be less hierarchical than it first appears when considering formal roles.

Table 4.3: The role of national, regional, and municipal policy for business park policy making, from Olden (2010)

Level of government	Roles
National government	Develop the policy aimed at careful and efficient use of space
	Create the national planning task based on the policy objectives to use space carefully and efficiently
Provincial government	Translate the national planning task into a structural vision, in which they align the strategic reservation for newly developed business parks with the restructuring task
	Encourage the creation of regional cooperation in the planning and implementation of the business park program
	Ensure that municipal zoning plans provide insight into the current demand for industrial sites
Municipal government	Create a regional business park vision, in which the planning task for new business parks is geared to the restructuring task
	Develop their zoning plans for business parks on insight into the current demand for space
	Base the restructuring task on an analysis of bottlenecks and associated measures
	Enter a binding agreements about the implementation of the business park program at a regional level

4.3. WHAT POTENTIAL ACTIONS ARE AVAILABLE TO PUBLIC ACTORS?

This section will consider from the point of view of governmental actors, what potential actions are available to them to either make climate change adaptation more attractive or to reduce barriers that might be preventing adaptation.

4.3.1. POTENTIAL POLICY INSTRUMENTS AND INCENTIVES

There are three broad categories of policy instruments discussed in the literature, they are regulatory instruments, economic and financial instruments, and soft instruments [10]. While regulatory instruments imply a hierarchical relationship between municipalities and businesses, the other instruments suggest more equal relationships. The financial and economic instruments imply an assumption about businesses as rational actors as discussed in chapter 3, and a more transaction-based relationship. The soft instruments, such as campaigns, guidance, and participatory processes, imply that governments and businesses have a more network-based relationship. The definitions of these three categories and some examples are shown in table 4.4.

Table 4.4: Types of policy instruments, columns 1-2 from Borrás and Edquist (2013)

Category	Definition	Example
Regulatory	The use of legal tools for the regulation of social and market interactions	Laws, rules, directives; in the case of non-compliance fines, other economic sanctions, or temporary withdrawal of rights [10]; Formal enforcements, incident-based regulations, management thresholds [33, 69]
Economic and financial	The use of monetary incentives (or disincentives) to support specific social and economic activities	In cash (grants, subsidies, reduced-interest loans, loan guarantees; taxes, charges, fees) or in kind (government provision of goods and services, private provision of goods and services under government contracts) [10]; Government subsidies, economic incentives [40, 43]
Soft	The use of voluntary and non-coercive means of achieving a policy goal	Campaigns, codes of conduct, recommendations, voluntary agreements, or public-private partnerships [10]; Guidance from government, voluntary measures [33, 45, 48]; Public-private business partnerships [40]; Institutional eco-innovation, collaborative governance [33, 64]; Participatory processes, engagement with programs from international NGOs [40, 45]

4.3.2. POTENTIAL BARRIERS TO ADOPTION

In addition to the aforementioned policy instruments, there is also the possibility that the existence of barriers exacerbates low levels of interest in climate change adaptation. These barriers can be categorized into various types such as organizational and informational barriers, among others.

The informational barriers have to do with a business' recognition of the problem, and ability to define it in concrete terms. Meanwhile, organizational barriers are related to a business' decision-making norms, which either due to lack of (perceived) capacity or authority or lack of long-term planning capacity, hinder the uptake of climate adaptation. Finally, the extra efforts related to potential climate adaptation projects, from solution exploration and selection to the project implementation, can create a psychological hassle barrier that has the effect of making adaptation less attractive. The barriers that might be preventing businesses from becoming more climate adaptive are shown in table 4.5.

These are of importance to the study because an understanding of private sector barriers can further explain the climate change adaptation market failure, and offer public actors, such as local governments interested in increasing climate adaptation, an insight into potential actions.

Table 4.5: The potential barriers for businesses to become more climate adaptive

Category	Examples from literature
Informational	Low levels of awareness, particularly of indirect risks [58]; Challenges in the interpretation of available information [20, 58]; Uncertainty complicating decision-making [58]
Organizational	A tendency to focus on short-term costs and cash flows, need for quick returns and short-term growth, limited appetite to engage [20, 58]; Lack of capacity to engage, lack of authority to take action [20, 58]; Difference in time horizon between climate change impacts and business investment planning [20]
Hassle	Difficulty selecting contractor, disruption to activities [22]

4.4. WHO ARE THE STAKEHOLDERS THAT CAN AFFECT BUSINESS' ENGAGEMENT WITH CLIMATE ADAPTATION, AND HOW DO THEY INFLUENCE BUSINESSES?

The main actors in the management of business parks are the local municipalities, who in addition to influencing business parks through policy instruments are also are interested in making their municipality an attractive place to work. This can result in an lack of a willingness to take prescriptive action to promote climate change adaptation, thus putting the onus on the individual businesses to become active in climate adaptation. These businesses are often organized into associations, which although not explored in detail in this research, might serve a key coordinating role. Local governments who want to increase climate adaptation, might consider leveraging these existing networks, and should consider reviewing the current institutional environment and process a business must go through to become climate adaptive. This could help municipalities identify how policy instruments might encourage or how potential neglect to reduce barriers might discourage businesses to invest in climate adaptation on their own.

4.5. IMPLICATION FOR THE INTERVIEWS

The findings from the literature search suggest categories of factors that may or may not be important to an individual business' decision to become climate adaptive. These "network" factors will be used as the basis for interviews with businesses, in order to test to what extend certain businesses value certain factors.

The relationships that businesses have with municipalities can play an important role in their awareness and interest in climate change adaptation. The formal roles that these actors have, especially the municipalities, can possibly lead to expectations from businesses that they will fulfill these roles. The relationship between businesses and governments is unique. While governments have policy instruments available to them, they are also interested in attracting businesses to their area, potentially disincentivizing them from using hierarchical instruments such as regulation. Given that there are potential barriers that in the current situation might be preventing businesses from becom-

ing climate adaptive, it is interesting to consider to what extent municipal governments might be inherently creating these conditions, or how they might take action to create an environment more conducive to climate change adaptation by businesses. These expectations, roles, and responsibilities that businesses and municipalities have of each other could be affecting or have an effect on businesses' climate change adaptation.

These ideas will be used to design an interview that will test to what extent extent are businesses perceive barriers or are receptive policy instruments focused on climate change adaptation. They represent a set of potential positions that may or may not be important to businesses in practice, and thus are appropriate materials to bring into the interviewing stage of this research.

5

METHOD: THE Q-METHODOLOGY

This chapter describes the theory behind the Q-methodology, the development of this Q-study, and the evaluation framework for the policy analysis.

The Q-methodology allows for an analysis of subjective perspectives: in this case, the perspectives that businesses have on the issue of climate change adaptation. The set up of the interviews for data collecting using the Q-methodology is described.

5.1. GENERAL OVERVIEW OF Q METHODOLOGY

The Q methodology was developed in the 1930s by William Stephenson as part of his study of subjectivity. In the context of climate change adaptation, the Q methodology has been used for a values exploration of local stakeholders in the Ebro delta in Spain [3], and for departments of municipalities in the Netherlands [81]. This research is an exploration of the perspectives and values that *businesses* have about climate change adaptation.

One of the goals of this research is to challenge a prescriptive view of business motivations: that is, the idea that businesses only act for financial gain. It is with hope that by challenging this stereotype, businesses themselves will feel better recognized and validated while governments will be freed from potentially constrictive viewpoints of their own efficacy and agency. It has been established that when focusing on climate change adaptation, there are (or, there should be) open questions about how businesses internalize the value proposition of adaptation. It is yet to be empirically established how businesses value the “rational" (i.e. financial aspects, environmental benefits) and “bounded-rational" (i.e. information internalization, engagement effects) factors in order to come to a decision about whether and when to become climate adaptive. In addition, businesses do not make decisions about climate change adaptation in a vacuum, they themselves are part of a network of actors that directly and indirectly influence their behavior. In order to answer the main research question by identifying how businesses can be encouraged to be more engaged with climate change adaptation,“empirical research must focus instead on exploration, discovery, and attempts to properly *understand* its subject matter" [87, p. 176]. Given this exploratory nature of this research's main question, the Q methodology is an appropriate research method.

5.1.1. HOW THE Q METHODOLOGY ALIGNS WITH THE STUDY GOAL

The goal of the Q methodology is to “systematically and holistically identify different types of people, or different types of mood, types of viewpoint, and so on" [87, p. 14]. The use of the Q methodology in this study allows for a deeper examination of the perspectives of respondents (businesses) about climate change adaptation. The use of the Q methodology is directly linked to the study goals of broadening an understanding of businesses, and challenging sweeping generalizations of a non-homogeneous group. By using the Q methodology, this study will explore a multiplicity of types of businesses who have varied views on climate change adaptation, for a variety of reasons. Further, by using the Q methodology for this study we will be able to classify “persons who resemble one another with respect to whole aspects of their personality" (Stephenson, 1936, as cited in Watts and Stenner, 2012, p. 14).

Notably, the data collection method of the Q methodology involves unique procedure, called the Q sort, and produces holistic data [87, p. 176]. This is achieved by having a sample of statements (the Q-set, see section 5.2.2) scaled relatively (that is, with respect

to the other statements in the set) by a group of individuals (the P-set, see section 5.3). The participants in the study are able to rank the statements with a score sheet (see section 5.4.1) to guide them. An overview of these components and their location in the Q methodology procedure are shown in fig. 5.1.

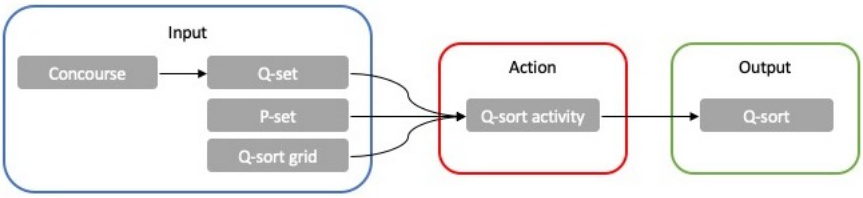

Figure 5.1: The components needed for a Q-study and the data collection process

For now it is important to know two things about the Q methodology. First, that the data is collected via Q sorts, and second, that the analysis of this data involves a by-participant inter-correlation factor analysis, which will be described more in section 5.5 [87]. Ultimately, this meets the study goal of exploring climate adaptation from various business perspectives and uncovering "the relationships between themes [in order] to be seen and appreciated" [87, p. 177].

In this study, the added value of the Q methodology is the ability to create a profiles describing the potential dominant perspectives that businesses have towards climate change adaptation. This result will provide the needed insight to develop more successful engagement strategies with these stakeholders as a more granular understanding of the different types of businesses within the private sector will be gained.

5.1.2. CONSIDERATIONS FOR SUCCESSFUL USE OF THE Q METHODOLOGY

THE Q METHODOLOGY ITSELF

An important consideration for the Q methodology is its relatively high dependence on both the selection of the Q- and P-set.

The Q-set should have good coverage of the topic, and be well-balanced [87, p. 57]. In order to have good coverage, the Q-set should consist of a selection of statements that are "representative of some relevant population of opinion" [87, p. 58]. In order to be well-balanced, the Q-set should "not appear to be value-laden or biased towards some particular viewpoint" [87, p. 58]. For this study, this translates to two activities. On a higher level, the categorization of potential statements by topic, and the selection of representative statements per topic. On a lower level, an iterative re-formulation of each statement itself, in order to ensure they are unbiased and formulated such that different respondents could potentially have different views on the statement.

Meanwhile the P-set should "avoid an unduly homogeneous participant group" [87, p. 70] as the intended outcome of the Q methodology is "to establish the existence of particular viewpoints and thereafter to understand, explicate, and compare them" [87,

p. 72]. For this study this translates to approaching potential study participants across various regions in the Netherlands, and in different sectors, and at both large and small organizations. In the same vein, various methods for soliciting study participants were used, in an attempt to create a diverse P-set.

Thus, for the successful use of the Q methodology, it is imperative that both the Q- and P-set are rigorously designed and considered. The potential impact on the study results are significant. During the factor analysis and interpretation that follows the data collection phase, factors will emerge based on an inter-correlation of the collected data. This means that if a majority of respondents share similar viewpoints, those Q-sorts will inter-correlate strongly, creating a coherent factor, but potentially obscuring relevant factors that are relevant for the research question.

A disadvantage of the Q methodology is that the data collection procedure can be time-consuming, which can be discouraging for participants. Due to its voluntary nature, the chance that participant self-selecting occurs along the lines of high or low awareness of climate change effects is also high. Further, the timing of the study might also have an effect on the participant group as the research topic itself, climate change adaptation, can seem low-priority for the target audience of businesses during the economic crisis as a result of the current global pandemic. These factors certainly had an effect on the final P-set, the limitations of which are further discussed in chapter 8.

CONDUCTING A REMOTE Q STUDY

Reber et al. (2000) performed two validation studies comparing computer- and interview-based Q sorts, and they found no apparent difference in reliability or validity [60]. An important finding from this research was the role of clear and consistent instructions across participants, which is valid for any Q methodology research. Therefore, in preparation for the online (and thus, remote) Q study, significant effort was put into finding a medium for an online Q study, setting up and designing the online Q study, and testing and debugging the online Q study. The instructions and supporting infrastructure that made a remote, online Q-study possible is described in appendix E.

One of the main challenges of a remote Q study is the high rates of attrition, alas [87]. However, given the extenuating circumstances at the time of this study (February to July 2020), the option to complete Q sorts in person is ill-advised and presents and undue health risk for both the researcher and study participants. Thus, a remote Q study was completed instead of an in-person study.

5.2. Q-SET DESIGN AND CONTENTS

5.2.1. CONCOURSE DEFINITION

This first step to making the Q-set, the set of statements to be rank-ordered during the Q sort, is to gain a clear picture of the concourse. This is " 'a universe of statements for [and about] any situation or context' " (Stephenson, 1986, as cited in Watts and Stenner, 2012, p.33). The concourse can be understood as the space of potential statements, sentiments, or opinions that can be had by potential participants about the topic of interest. This can be a broad and varied collection of statements.

The concourse was selected using a theory-based approach. While answering the first three sub-research questions, documents and relevant literature were scanned for

statements about the following themes: impacts of climate change on businesses (chapter 3), the potential costs and benefits of climate adaptation (chapter 3), or the incentives and barriers created by other actors (chapter 4). They were collected in a database, where the document source was also recorded. Each item was also categorized inductively based on the theme that was most applicable, as shown in fig. 5.2. The categories that were used during the concourse selection were “Consequences [of climate change],” “External incentive," “Internal motivation," “Problem definition," “Roles," and “Miscellaneous." A reproduction of the concourse database (341 statements) is shown in appendix B.

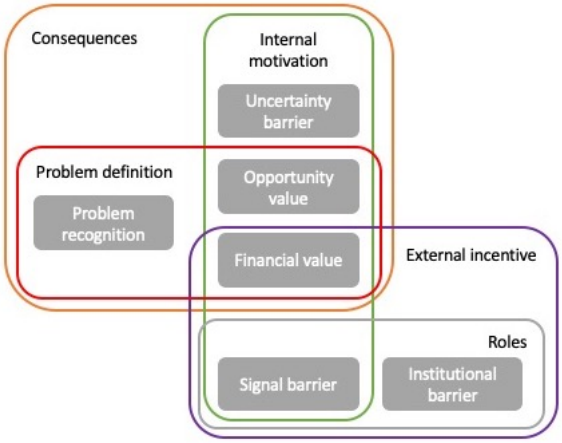

Figure 5.2: The concourse categorizations and Q-set themes

5.2.2. Q-SET SELECTION

While the concourse was a widening process (attempting to discover all possible statements related to the topic), the selection of the Q-set is a narrowing process. This narrowing is necessary to distill the 341 concourse statements to a length that is suitable for a Q sort and palatable for respondents. The resulting subset of the concourse, the Q-set, will be used as the input statements for the Q sorts. The Q-set should be an abridged version of the concourse, that is both comprehensive and balanced [87, p. 60], while remaining specific to the Q interview question.

The guiding question for the Q interview, which is also to be used in validating the Q set is: How do you see the role of business in climate change adaptation

Based on the categorization of the concourse items, the items were reviewed per category. Redundant items were removed or consolidated, and concourse items at different levels of abstraction, for example a specific statement about water storage capacity at a certain location, were reformulated to the level of abstraction of the Q-set, for example, a statement about increased rain water storage capacity. The categories originally used during the concourse creation were refined based upon the concourse findings them-

selves, resulting in the Q-set categories of: problem definition, uncertainty, financial value, opportunity value, institutional barriers, and signal barriers. These are shown in fig. 5.2.

During the selection of the Q-set statements, every effort was made to maintain the topical coverage of the concourse, while giving a specific topic the number of statements needed to address it fully. This means that not every topic has the number of statements that correspond to the topic. This resulted in a Q-set with 22 statements, from an original concourse that had 341 statements. In appendix B is a table with statements, categorized by their relation to the Q-set themes.

In order to ensure that the Q-set statements had both good overage of the topic, and were not biased, they were piloted with three practitioners in the water and urban development field. A short interview was held with each industry expert, and they were asked to comment on each statement, in particular about the statement's relevance, redundancy, and phrasing (especially word choice). They were also asked if they thought any relevant statement or topic was missing from the set. Based on this feedback, another round of statement edits took place. No statements were added, and the final set of statements is shown in table 5.1.

Table 5.1: The complete set of statements for the Q-sort, the Q-set

English	**Dutch**
The risks as a result of climate change are small for my business	De risico's van klimaatverandering zijn klein voor mijn bedrijf
I take enough climate adaptation measures to keep my business' risks acceptable	Ik neem voldoende klimaatadaptieve maatregelen om de risico's voor mijn bedrijf acceptabel te houden
I will take climate adaptation measures only if I experience negative effects of climate change	Pas wanneer ik negatieve gevolgen van klimaatverandering ervaar, zal ik klimaatadaptieve maatregelen nemen
There is enough information about climate change to estimate its effects	Er is genoeg beschikbare informatie over klimaatverandering om de gevolgen in te schatten
It is necessary to take climate adaptation measures as soon as possible	Het is noodzakelijk om zo snel mogelijk klimaatadaptieve maatregelen te nemen
I am ultimately not responsible for taking climate adaptive measures	Ik ben uiteindelijk niet verantwoordelijk om klimaatadaptieve maatregelen te nemen
It is the role of my insurer to cover the cost of possible damage as a result of climate change	Het is de rol van mijn verzekeraar om eventuele schade als gevolg van klimaatverandering te betalen
It is clear to me what the government expects from businesses with respect to climate adaptation	Het is voor mij duidelijk wat de overheid verwacht van bedrijven rondom klimaatadaptieve maatregelen
Regulation prevents taking climate adaptation measures	De huidige regelgeving belemmert het nemen van klimaatadaptieve maatregelen

Decision-making within my organization prevents taking climate adaptation measures	De huidige besluitvorming binnen mijn organisatie belemmert het nemen van klimaatadaptieve maatregelen
It is the role of the government to communicate the risks of climate change	Het is de rol van de overheid om de risico's van een veranderend klimaat te communiceren
I am only prepared to take climate adaptation measures if someone requires it of me	Ik ben alleen bereid klimaatadaptieve maatregelen te nemen als iemand dat van me eist
I will be prepared to take climate adaptation measures only if there is favorable subsidy available	Pas als er een gunstige subsidie is, ben ik bereid om klimaatadaptieve maatregelen te nemen
Building codes need to change before I can take climate adaptation measures	Bouwvoorschriften moeten veranderen voordat ik klimaatadaptieve maatregelen kan nemen
By taking climate adaptation measures I can distinguish myself from competitors	Ik zie het nemen van klimaatadaptieve maatregelen als een middel om mij te onderscheiden van concurrenten
By taking climate adaptation measures I can distinguish myself from labor competition	Door het nemen van klimaatadaptieve maatregelen kan ik mij onderscheiden op de arbeidsmarkt
By taking climate adaptation measures I can increase the value of my real estate	Door het nemen van klimaatadaptieve maatregelen kan ik de waarde van mijn bedrijfspand verhogen
By taking climate adaptation measures I can save money	Door klimaatadaptieve maatregelen te nemen kan ik geld besparen
By taking climate adaptation measures I can ensure my business continuity	Door klimaatadaptieve maatregelen te nemen kan ik mijn bedrijfscontinuiteit verzekeren
By taking climate adaptation measures I can protect my assets	Door klimaatadaptieve maatregelen te nemen kan ik mijn bedrijfsmiddelen verzekeren
I see planned work as an opportunity to take climate adaptation measures	Ik zie geplande werkzaamheden als een kans om klimaatadaptieve maatregelen te nemen
I think that sustainability is a bigger priority than climate adaptation	Ik vind dat verduurzamen een grotere prioriteit heeft dan klimaatadaptatie

5.3. PARTICIPANTS

5.3.1. P-SET SELECTION

The P-set is the participant group that completes the Q-sorting activity as part of the data collection for the Q methodology. In order to satisfy the purpose of the Q sorting procedure, which was to collect data representing diverse views on the rationale for and

against climate change adaptation, a P-set that represents these potential viewpoints was needed.

Two main groups were targeted as participants: businesses and business park managers. Businesses were targets because they are the stakeholder group that is of direct interest for this study, while the park managers were contacted in order to increase the potential viewpoints that would result from the analysis, as they are also “private actors" that local governments could potentially be interested in activating to become more climate adaptive. Both of these stakeholder groups were included for the reason that the local governments interested in increasing climate adaptation are “resource-dependent" on either or both of these groups to become active with regards to climate change adaptation. Thus, the perspectives of both of these profiles were deemed to add value to this study.

Participants were approached in a variety of ways: direct calls, direct emails, via business parks, via branch organizations, via business associations, and via social media communications (e.g., LinkedIn, CityDeal newsletter), or the snowballing method. A portion of respondents were identified by tapping into the researcher's colleagues' network (N = 10), where snowball sampling was used to identify further respondents (N = 2), and the remaining respondents were approached directly using contact information that was available online or in response to the social media posting (N = 2).

5.3.2. P-SET DEMOGRAPHICS

The P-set for this research consisted of 14 individuals. The majority of the respondents were individuals who worked at a company (N = 10 respondents), while the remaining participants had a role as a park manager of a business park (N = 2), representing the business sector at a branch organization (N = 1), and consultancy for business parks (N = 1). The latter two participants performed the Q sort using the alternate ranking method described in section 5.4.3.

The participants who worked at companies had various roles, such as owner, facilities, utilities and maintenance, or building services specialist, energy specialist, and green facilities, innovation programs, or technical manager. The participants represented a variety of sectors including agriculture, forestry and fishing (N = 1), industry (N = 4), construction (N = 2), rental and trade in real estate (N = 2), advice and consulting (N = 1), health services (N = 1), culture, sports, and recreation (N = 1), and a mixed infrastructure and services (N = 2). Various sizes of organizations (as estimated by the number of employees) were also represented by the P-set, with the following number of employees: 1-10 (N = 3), 11-50 (N = 3), 51-100 (N = 2), 101-500 (N = 1), 501-1000 (none), 1001-5000 (N = 4), and 5000+ (N = 1) employees. Finally, the work locations of the respondents represented various provinces of the Netherlands: Noord-Brabant (N = 6), Overijssel (N = 2), Limburg (N = 2), Flevoland (N = 1), Gelderland (N = 1), Zuid-Holland (N = 1), and Multiple provinces (N = 1).

5.3.3. IMPLICATIONS OF THE P-SET

Although it is not possible to know a participant's viewpoint in advance of the interview, every effort was made to recruit participants with potentially different viewpoints. The diversity of the P-set, therefore, was based on work location, sector, and size of company.

While demonstrated awareness of climate change adaptation, or lack thereof, would also bring an important component of diversity to the P-set, this is difficult to determine in advance of the interviews, based in information that is publicly available. Unfortunately, without a pre-interview screening, it is impossible to determine which respondents tend to be open, or not, to climate change adaptation. Because participation in the study was voluntary, there is a strong self-selecting effect on the P-set; namely, that potential respondents who have previously experienced problems as a result of a changing climate, or who are open to the idea of climate change adaptation are more likely to participate in the study. In order to combat this effect, interview respondents were asked to nominate another respondent who would have a view that differed from their own, which occurred in two cases.

The potential impact of the skewness of the P-set on the results is significant. A P-set that is fairly homogeneous will result in strong Q-set inter-correlations and factors that could potentially obscure the existence of other factors. This will have an effect on the factors that are ultimately deemed statistically significant during the factor analysis. It will be important to remember that the resulting profiles, which are describing dominant perspectives, are representative of the P-set, not the population as a whole.

5.4. ADMINISTERING THE Q SORT

During the Q sorting procedure, all the items in the Q-set are ranked relative to one another in the defined distribution. The Q sort data collection process took place via online interviews (N = 11) and standalone (unguided) Q sorts online (N = 3) between April and June 2020. The interviews lasted between 30 and 75 minutes.

5.4.1. Q-SORT DESIGN

The following selections were made for the design of the Q-sort distribution. A forced and standardized distribution was selected, for more pragmatic ranking and for ease of comparison across Q-sorts. A normal and symmetrical distribution was selected, under the assumption that given a set of statements, most people will only feel *very* strongly about a small subset of those statements. A wide range (9 cells wide) with a flat slope was selected, to allow for “fine-grained discrimination at the extremes of the distributions" [87, p. 80]. The poles against which the respondents sort the statements are “Agree" and “Disagree", with extreme values of +4 and -4. For a complete overview of the design choices of the Q-sort distribution, see appendix C.

5.4.2. PROCEDURE

A five step procedure was used during the data collection process, where the first four steps constituted the Q sort portion, and the final step focused on collecting descriptive demographic information.

In the case of an interview, before the data collection began, the conversation started with an introduction to the research project and some questions about the respondents function and work experience. The Q sort activity was introduced, and the respondents were asked to complete the following steps, keeping in mind the Q interview question, *How do you see the role of business in climate change adaptation*

In the case of a standalone Q sort, the respondents were asked to watch an introduction video that introduced the topic and explained the Q sorting process.

STEP 1

The participants are asked to sort the 22 statements of the Q set into disagree, agree, and neutral piles. And, in the case of an interview, they are asked to explain their reasoning.

STEP 2

The participants are asked to place the statements onto the forced distribution grid. And, in the case of an interview, they are asked to explain their reasoning.

STEP 3

The participants are given a chance to review their Q sort, and make and changes if necessary. In the case of an interview, the respondents are asked if there are any statements they would like to highlight or elaborate on.

STEP 4

The participants are asked to describe in their own words why they ranked their "most agree" and "most disagree" statements as they did.

STEP 5

The participants answer some follow-up survey questions, for survey demographic purposes. This is also where questions about data storage, anonymous citations, and other important participation questions answers are recorded.

The Q sorts and follow up survey questions were saved via the real-time database set up in preparation for the online interviews. The qualitative interview data was recorded and saved.

5.4.3. ALTERNATE (PRIMED) Q-RANKING

While Q-sorts often are completed by a respondent ranking the statements from their own point of view, there are alternate types of Q-sorts that allow for a respondent to rank the statements “from the perspective of someone else" [87, p.51], which can be “imposed or *primed* by the researcher" [87, p. 51].

In this study, this alternate type of ranking was employed by two respondents at the researcher’s discretion. In both cases this was because the interviewee, by nature of their position, had specific insights into the perspectives of businesses that had not yet been represented in the P-set. This assessment was based upon the initial conversation with the respondents, who expressed that in their work they interacted frequently with individuals who were not interested in climate change adaptation, while they themselves

were already aware of the issue. As the P-set sampling limitations of this study (see section 5.3.3) tended to individuals who self-selected based on interest in climate change adaptation, it was deemed justifiable to ask the two respondents with experience with individuals who are not aware of climate adaptation to act as ghost sorters. This would serve to help balance the P-set, and overcome the challenge of creating a heterogeneous P-set.

5.4.4. IMPLICATIONS OF THE ALTERNATE RANKING

This type of sorting could lead to some validity issues in the results, especially because the ghost sorters performed the Q sort activity based on an second hand understanding of the businesses they are supposed to represent. Further, they ran they risk of sorting based on an aggregate understanding of their experience, and not from the point of view of a particular individual. These limitations are further discussed in chapter 8.

The data from these sorts were not given any special weighting compared to the other Q sorts, and were included with and analyzed just as the other Q sorts were analyzed.

The remaining respondents ranked the statements from their own point of view, and no mention was made of this alternate ranking method.

5.5. STATISTICAL ANALYSIS

In this section a conceptual overview of the steps of the statistical analysis will be reviewed. In addition, the analysis decisions that were made during the analysis will be highlighted. The complete list of steps and outputs of the full analysis can be found in appendix F.

5.5.1. CONCEPTUAL OVERVIEW

FROM SORTS TO FACTORS CONCEPTUALLY

In the data collection phase of the research, Q sorts are completed by the study participants. During the analysis, these Q sorts are compared to each other and all the other sorts to see which sorts are similar to each other. This is achieved via an inter-correlation matrix. In this case, “correlation provides a measure of the nature and extent of the relationship between any two Q sorts" [87, p. 97].

This measure of similarity is needed to achieve the Q factor analysis goal, which is to “to explain as much as we can about the relationships between the many Q sorts in the group - through the identification of, and by reference to, any sizeable portions of common or *shared* meaning that are present in the data" [87, p. 97]. Thus, by identifying Q sorts that are similar to each other, it is possible to identify the common variance in a given subset of the Q sorts that are similar to each other. In this case, common variance is “the proportion of the meaning and variability in a Q sort or study that is *held in common* with the group" [87, p. 97]. Once these common variances are identified in the inter-correlation matrix, they can be removed, or extracted, to to create common factors.

FROM FACTORS TO ARRAYS CONCEPTUALLY

Given the identification of factors, it is possible to aggregate the subset of Q sorts that shared a common factor. This is achieved via a weighted averaging procedure, where

the original Q sorts that load most significantly on the given factor are given a greater weight for the averaging procedure.

The result is a list of the Q-set statements with their Z-scores, where the Z-score of a given item is the difference of total weighted score for that item and the mean of the total weighted scores for all items divided by the standard deviation of the total weighted scores for all items.

The Z-scores can be used to reconstruct a representative Q sort, called a factor array, which creates a (discrete) scoring of the Q-set statements according to the study score sheet. Another description of the factor array is "a single Q sort configured to represent the viewpoint of a particular factor" [87, p. 139, emphasis removed].

FROM ARRAYS TO INTERPRETATION CONCEPTUALLY

Once the factor arrays are created, the final step of the analysis is to interpret them. This is in order to "lead us back to the viewpoint - and to a full explanation of the whole viewpoint" [87, p. 148].

There is no set methodological procedure on how to complete a factor analysis, in fact "there is very little that tells anyone *how* to do the job effectively" [87, p. 147]. The goal is to interpret and internalize "the interrelationship of the many items *within* the factor. . . array that should ultimately drive our interpretation of this factor" [87, p. 148].

During interpretation, the attempt was made to consider the whole set of Q-set statements in a given factor array to back-reason the ranking decisions for a factor. This back-reasoning was filled in by the statements made by respondents during the interviews, in order to further flush out the ranking interpretation.

5.5.2. ANALYSIS DECISIONS

There are a few statistical packages that perform this factor analysis of Q sort data. For this research, the Ken-Q analysis software developed by Banasick was used. See appendix E for more information about these tools.

THE RATIONALE BEHIND FACTOR EXTRACTION IN THIS STUDY

A round of analysis was performed after seven, nine, twelve, and fourteen sorts in order to check how the results changed with the addition of respondents. Centroid factor analysis was selected instead of Principal Component Analysis (PCA) because "PCA will resolve itself into a single, mathematically *best* solution. . . . which deprives us of the opportunity to properly explore the data or to engage with the process of factor rotation in any sort of abductive, theoretically informed or investigatory fashion" [87, p. 99].

For each analysis, seven centroid factors were initially extracted. This is in accordance with the rule of thumb that " ' "the magic number 7" is generally suitable' " (Brown, 1980, as cited in Watts and Stenner, 2012, p.106). Thereafter, two other sets of criteria were used to evaluate the number of factors to keep for further steps in the analysis. These were the "Eigenvalue criterion" and the "Humphrey's rule." The rules are briefly described here, and more information about these criteria are described in appendix F.

The **Eigenvalue (Kaiser-Guttman) criterion** uses a factor's eigenvalue as a proxy for its significance, where factors with an eigenvalue greater than 1.00 are significant enough to be kept for further analysis. While this criterion is widely accepted [87, p. 105], there

is also the possibility that this cutoff can lead to the exclusion of " 'significant factors' " (Brown, 1980, as cited in Watts and Stenner, 2012, p.105).

Humphrey's rule uses a calculation of the cross-product of a factor's two highest loadings as a proxy for its significance. In order to be deemed significant, the absolute value of the cross-product of a factor's two highest loadings should be greater than twice the standard error [11].

According to these criteria, the first two factors in the study are significant, and acceptable to select for further analysis. However, at the risk of extracting " 'spurious factors"' " (Brown, 1980, as cited in Watts and Stenner, 2012, p.105), the decision was made to extract two additional factors with eigenvalues that were close to 1.00 in the unrotated factor matrix (0.9316 and 0.9727, respectively). These additional factors (number three and four) had 2 and 3 sorts, respectively, significantly loading on the factors at a $p < 0.05$ value.

Keeping in mind that factor rotation can affect the eigenvalue of factors, it is acceptable during factor extraction to select " 'more factors than it is expected ahead of time will be significant' " (Brown, 1980, as cited in Watts and Stenner, 2012, p.110). So, at the researcher's discretion, four factors were selected for rotation. In the interpretation and strategy development phase, the profiles of perspectives that emerge as a result of the latter two factors will be given less attention in order to maintain focus on the two statistically significant factors in the study.

The decision to keep two additional factors was made after multiple iterations of the factor analysis and interpretation. After completing the full factor analysis and initial interpretation for a two factor and a four factor solution, it was deemed that while two factor solution was acceptable, the four factor solution would be accepted in order to capture some of the theoretically-informed richness that would otherwise have been lost in the two factor solution.

In this researcher's eyes, one of the risks of a four factor solution is the effect that Q sorts that load on one of the two factors in the two factor solution will be "pulled away" from those first factors in the four factor solution. This possibility was examined by comparing the factor loadings of the two and four factor solutions for factors 1 and 2 against each other. As shown in table 5.2, the number of sorts and percentage of explained variance for the two factors do not significantly change as a result of including two additional factors in the solution.

There is a change in the loading of sorts on factor 1. While in the two factor solution, sort number 5 loaded significantly on factor 1, it does not in the four factor solution. Similarly, in the two factor solution sort number 9 does not load significantly on factor 1, but it does, however, in the four factor solution. The Q-sorts that load significantly on factor 2 remain unchanged between the two and four factor solution. Thus, the risk of including extra factors in the analysis is deemed small enough in comparison to the benefit of the broader variety of viewpoint achieved by including the additional factors.

THE RATIONALE BEHIND FACTOR ROTATION IN THIS STUDY

There are two options for the rotation of factors. First, there is the by-hand (or, judgemental) rotation, and second, there is the varimax rotation. The varimax rotation positions factors "according to statistical criteria and so that, taken together, the factors ac-

Table 5.2: A comparison of factors one and two between the four and two factor solution

		Two factor solution	**Four factor solution**
Factor 1	# of sorts loading significantly	4	4
	Q-sorts loading significantly	5*, 6, 7, 13	6, 7, 9*, 13
	% explained variance	18	17
Factor 2	# of sorts loading significantly	5	5
	Q-sorts loading significantly	1, 2, 4, 10, 14	1, 2, 4, 10, 14
	% explained variance	22	20

count for the maximum amount of study variance" [87, p. 122], which is, "the *common* variance" [87, p. 123].

The use of varimax rotation has consequences for the emergence and significance of factors, especially in light of the limitations of this study's P-set. Varimax rotation "will, therefore, tend to focus on the majority or predominant viewpoints that are extant in the group as a whole, i.e. those that are adopted with greater frequency or regularity, not on those one or two viewpoints that may *in reality* carry the most substantive weight" [87, p. 123].

Given the inclusion of the two additional factors without "by the book" statistical significance, the varimax rotation could have had the effect of further obfuscating relevant perspectives on adaptation. The use of judgemental rotation could have proved useful to combat this effect, as it rotates the factors " '*deliberately* so as to bring unexpected but not unsuspected results to light' " (Stephenson, 1961, as cited in Watts and Stenner, 2012, p. 40).

Despite the potential benefit of judgemental rotation, which is that it "reserves a key place for the substantive reality - the real world and real people - that have led, in the first place, to the generation and configuration of a set of Q sorts" [87, p. 123], the varimax solution was applied. Attempts were made to use the judgemental rotation method in order to combat the varimax focus on the majority viewpoints, but a more satisfactory solution was not generated. Thus, the varimax solution was accepted with the understanding that despite being mathematically optimal, that it has its own limitations (i.e. an over reliance on statistical reasoning instead of abductive reasoning [87, p. 40]).

THE RATIONALE BEHIND FACTOR LOADING IN THIS STUDY

Auto-flagging was used to determine which Q-sorts loaded significantly on the factors, at $p < 0.05$.

During a visual examination of the factor loadings it appeared that factor 4 was a bipolar factor. Thus, the decision was made to split this factor into 4a and 4b. Two sorts loaded significantly on factor 4a while only one sort loaded significantly on 4b. That is to say, that factor 4b is simply a Q sort from an individual participant, and should be considered as limited in its ability to say anything conclusive.

However, it is interesting to interpret as the existence of a bipolar factors indicates something meaningful about how the topic is perceived by the participants. A bipolar factor represents "two distinct but connected viewpoints, two equally positive and acceptable responses to a single situation. . ." [87, p. 166]. Thus, by the existence of a

bipolar factor, a fifth profile is brought into view, which is interpreted alongside the other profiles.

THE RATIONAL BEHIND ARRAY INTERPRETATION IN THIS STUDY

When it comes to factor array interpretation, there is "very little that tells anyone *how* to do the job" [87, p. 148].

Watts and Stenner (2012) suggest the use of a crib sheet in order to systematically examine the items in the factor arrays for interpretation. This involves categorizing statements per factor array into different groups. These groups are: items given the highest ranking, items given the lowest ranking, items ranked higher by the factor than by any other study factor, and items ranked lower by the factor than by any other study factor.

The benefit of this approach is that it highlights potentially significant items in the middle of a factor array distribution by comparing the rankings of items between factors arrays. This assures that items, due to their proximity to the distensive zero, are not assumed to be neutral. The items ranked lower or higher by a given factor than by any other factor allows for an exploration of items in the middle of a factor array distribution. This is important, because instead of indicating neutrality, a statement placed in the middle of a distribution could for example be "indicative of cautious agreement" [87, p. 154], or a feeling of both agreement and disagreement about the statement.

The crib sheet usage was the guiding method for the factor array interpretation. And this method was supplemented by notes and quotes from the respondents themselves, as Watts and Stenner suggest the use of the "participant's words and any relevant demographic information to clarify and interpret the signs and clues contained in each [factor] array" [87, p. 166].

CATEGORIZATION OF PROFILES

In addition, based on an inductive review of the themes included in the Q-set and their ranking by the various profiles, a short list of salient categories were developed in order to give a quick overview of a given profile's features. The categories are: Need (is climate change adaptation perceived as needed?), Urgency (is climate change adaptation perceived as urgent?), Responsibility (who should bear the responsibility for climate change adaptation?), Motivation (is the motivation for climate change adaptation intrinsic or extrinsic?), and Approach (is the issue to be addressed proactively or re actively?). A summary of the potential categorization values are shown in table 5.3.

Table 5.3: The scales for profile categorization and potential values

Category	**Potential categorization**
Need	Needed, Not needed
Urgency	Urgent, Not urgent
Responsibility	Own responsibility, Shared responsibility
Motivation	Intrinsic, Extrinsic
Approach	Proactive, Reactive

The Q-set statements that, when ranked, offer insight into these categories for the purposes of assigning each profile a category are shown in table 5.4.

Table 5.4: The Q-set statements and which category they might be indicative of when ranked

Number	Statement	Category
1	The risks as a result of climate change are small for my business	Need
2	I take enough climate adaptation measures to keep my business' risks acceptable	Need
5	It is necessary to take climate adaptation measures as soon as possible	Urgency
22	I think that sustainability is a bigger priority than climate adaptation	Urgency
6	I am ultimately not responsible for taking climate adaptive measures	Responsibility
7	It is the role of my insurer to cover the cost of possible damage as a result of climate change	Responsibility
11	It is the role of the government to communicate the risks of climate change	Motivation
12	I am only prepared to take climate adaptation measures if someone requires it of me	Motivation
13	I will be prepared to take climate adaptation measures only if there is favorable subsidy available	Motivation
14	Building codes need to change before I can take climate adaptation measures	Motivation
15	By taking climate adaptation measures I can distinguish myself from competitors	Motivation
16	By taking climate adaptation measures I can distinguish myself from labor competition	Motivation
17	By taking climate adaptation measures I can increase the value of my real estate	Motivation
18	By taking climate adaptation measures I can save money	Motivation
19	By taking climate adaptation measures I can ensure my business continuity	Motivation
20	By taking climate adaptation measures I can protect my assets	Motivation
3	I will take climate adaptation measures only if I experience negative effects of climate change	Approach

5.5.3. VALIDATION

While it is important to validate research results, this exercise proves difficult, and potentially moot for the Q methodology. The literature argues that " 'the concept of validity has very little status [relative to Q methodology] since there is no outside criterion for a person's own point of view' " (Brown, 1980, as cited in Watts and Stenner, 2012, p. 51). That is to say, the results of a Q methodology study, given a sound experimental set up, analysis, and interpretation, cannot be externally validated. The nature of method itself is exploratory, and it is conceivable that about any given topic, a given perspective could be had about the issue, so to impose judgements of validity would be nonsensical.

Despite the lack of theoretical need for validation, this research did make use of the evaluation of industry experts and practitioners to "gut check" the research results. After the analysis and interpretation was completed, the research results were presented to three different practitioners in the field of climate change adaptation. While the experts did not expect some of the findings, they found them plausible, and in addition, much of their own experience was confirmed.

5.6. PER-PROFILE DEVELOPMENT OF RECOMMENDATIONS

Given the creation of different business profiles as an output of the factor analysis and interpretation, a review of policy instruments will be evaluated against the ranking of statements by each profile. This will result in profile-specific development of strategies to encourage climate change adaptation.

In the following sections, the relevant types of policy instruments are reviewed. Then, these concepts are correlated with the Q-set statements that, when ranked, express some sentiment about these types of instruments or strategies. This is used to create the "score sheet" shown in section 5.6.1. In appendix G, the scoring per profile is completed, and the recommendations per profile are summarized in the following chapter.

5.6.1. EVALUATING STRATEGIES PER PROFILE

The effectiveness of the above-mentioned categories of instruments and strategies can be inferred by the ranking of certain statements in the Q-set per profile. A summary of the recommendation-indicative statements are summarized in table 5.5.

For example, when statement 12 is ranked highly, it expresses the expectation of the profile that regulation is needed, thus indicating that regulation would be an effective policy instrument for such a profile. Similarly, when statement 13 is ranked highly, it expresses that a profile expects monetary policy instruments, indicating that monetary policy instruments would be effective for said profile. Finally, when statement 11 is ranked highly, it expresses that there is the expectation that the government would be providing signals in the form of communication, indicating that soft policy instruments would be appropriate for this profile.

Table 5.5: The Q-set statements that are potentially indicative for recommendations

Number	Statement	Instrument
9	Regulation prevents taking climate adaptation measures	Regulatory
12	I am only prepared to take climate adaptation measures if it is required	Regulatory
14	Buildling codes need to change before I can take climate adaptation measures	Regulatory
7	It is the role of my insurer to cover the cost of possible damage as a result of climate change	Economic and financial
13	I will be prepared to take climate adaptation measures only if there is favorable subsidy available	Economic and financial
4	There is enough information about climate change to estimate its effects	Soft
8	It is clear to me what the government expects from businesses with respect to climate adaptation	Soft
11	It is the role of the government to communicate the risks of climate change	Soft

6

RESULTS: PERSPECTIVE ANALYSIS

This chapter presents the results of interviewing businesses about their perspectives on climate change adaptation.

The data collection using the Q-methodology and subsequent analysis leads to the creation of five profiles that can be interpreted. The interpretation of these results is the basis of the typology of businesses, divided into profiles based on their perspective on climate change adaptation.

6.1. CONSENSUS-DISAGREEMENT STATEMENTS

After completing a factor analysis of Q-sort data it is possible to create a ranking of statements with respect to their level of consensus or disagreement. This is indicated by the Z-score variance, a high Z-score variance indicates that the profiles scored the statement dis-similarly from each other, while a low Z-score variance indicates that the profiles scored the statement similarly to each other.

This offers a first look into the data, and demonstrates that respondents are generally in agreement about current regulation, business decision-making, and building codes not currently hindering their ability to become climate adaptive (statements 9, 10, and 14), see table 6.1. Further, they give an early indication that the statements that will distinguish any given profile from another will be about the prioritization of climate adaptation (statement 22), the availability of information (4), the role of the government and insurer (7 and 12), and the benefits of decreased risk of damage and increased marketing value (20 and 15), see table 6.2. The complete ranking of all statements from the Q-set with respect to their level of consensus-disagreement are shown in appendix F, where table F.4 shows the factor array for each of the profiles, in order of the consensus-disagreement ranking.

Table 6.1: Top six statements with the most agreement

#	**Statement**	**Z-score variance**	**Rankings by the profiles**	**Average ranking**	**Consensus sentiment**
9	Regulation prevents taking climate adaptation measures	0.087	-2, -1, 0, -2, 0	-1	Neutral, disagreement
10	Decision-making within my organization prevents taking climate adaptation measures	0.121	-1, -2, -4, -2, -1	-2	Disagreement
2	I take enough climate adaptation measures to keep my business' risks acceptable	0.143	1, 1, 0, 0, 0	+0.4	Neutral, slight agreement
14	Building codes need to change before I can take climate adaptation measures	0.28	-1, 0, -2, 1, -2	-0.8	Neutral, slight disagreement
8	It is clear to me what the government expects from businesses with respect to climate adaptation	0.291	0, 0, 0, -1, -3	-0.8	Neutral, slight disagreement
5	It is necessary to take climate adaptation measures as soon as possible	0.315	0 2 0 1 -1	+0.4	Neutral, slight agreement

Table 6.2: Top six disagreement statements

Statement Number	**Statement**	**Z-Score variance**
15	By taking climate adaptation measures I can distinguish myself from competitors	0.909
12	I am only prepared to take climate adaptation measures if someone requires it of me	0.976
20	By taking climate adaptation measures I can protect my assets	0.991
7	It is the role of my insurer to cover the cost of possible damage as a result of climate change	1.552
4	There is enough information about climate change to estimate its effects	1.614
22	I think that sustainability is a bigger priority than climate adaptation	1.759

6.2. BUSINESS PROFILES BASED ON PERSPECTIVES

The result of the factor analysis and interpretation of the quantitative outputs thereof in combination with the qualitative interview (or written comment data, in the case of unguided Q sort data) are profiles that describe the trending viewpoints that are present in the group of respondents.

A NOTE ABOUT STATISTICAL SIGNIFICANCE:

It is important to know before reading these profiles that profiles 3, 4a, and 4b are constructed from factors that do not satisfy some of the common factor interpretation requirements (such as Humphrey's rule and the Eigenvalue criterion), described in chapter 5. Thus, they cannot be considered statistically significant. However, they do include some interesting insights which would have been missed with their exclusion, which is why they are included in the analysis. The potential causes and implications of including these non-statistically significant findings are discussed further in chapter 8.

6.2.1. PROFILE 1: STRIKE THE IRON WHILE IT'S HOT

Four participants loaded significantly on this factor. They represent a mix of companies in terms of size (companies with size between 1-10 through 1000-5000 employees were represented). The sectors that loaded on this profile were from industry and infrastructure/services. One participant participated in the study using the alternate ranking described in section 5.4.3.

The crib sheet used for the interpretation of factor 1 is shown in table 6.3.

Table 6.3: The crib sheet for factor 1

#	Highest Ranked Statements	Q-sort value	Consensus or Distinguishing
21	I see planned work as an opportunity to take climate adaptation measures	4	
	Positive Statements Ranked Higher in factor 1 Array than in Other Factor Arrays		
17	By taking climate adaptation measures I can increase the value of my real estate	3	
20	By taking climate adaptation measures I can protect my assets	2	
2	I take enough climate adaptation measures to keep my business' risks acceptable	1	
8	It is clear to me what the government expects from businesses with respect to climate adaptation	0	
	Negative Statements Ranked Lower in factor 1 Array than in Other Factor Arrays		
9	Regulation prevents taking climate adaptation measures	-2	C*
4	There is enough information about climate change to estimate its effects	-3	
	Lowest Ranked Statements		
6	I am ultimately not responsible for taking climate adaptive measures	-4	

PROBLEM DEFINITION

This profile is characterized by their view that they take enough action to keep their risks acceptable (statement 2), but the group is split on whether they have a proactive or reactive stance on the issue (statement 3). This acceptability can be a result of a proactive stance (sort 13), or the opposite, a result of a reactive stance (sort 6). This profile is also split with regards to their perception of the urgency of climate adaptation (statement 5).

INTERPRETATION OF SIGNALS

This profile disagrees that there is enough available information about the consequences of a changing climate to determine their local-level impacts (statement 4). Thus, despite their awareness of the need for climate change adaptation, they are still unsure of what the impacts on their businesses will be.

SENSE OF RESPONSIBILITY

This profile is defined by a strong sense of responsibility to take climate adaptive action (statement 6, defining statement). They view that as a business they are responsible (sort 13) and that they should always be planning for the future (sort 6). Similarly, they do not view it as the role of their insurer to cover the cost of damages as a result of the effects of climate change (statement 7). This was due to the view that the insurer either

is not contractually responsible for these damages, requiring businesses to make their own best effort to reduce their risk as part of their insurance agreement (sort 7, 13) or that there was a preference to save the money for payment of damages instead of paying for an insurance premium (sort 6).

VIEW ON BARRIERS

They strongly believe that their own internal decision-making does not prevent taking climate adaptation action (statement 10), which the justification that their decisions are "safety-focused" (sort 7) and in line with risk-management activities (sort 13). This profile is also characterized by the view that the government's expectations of businesses are not clear (statement 8). The regulations need to be more concrete and specific (sort 6, 13).

RESPONSE TO IMPULSES

This profile is characterized by an insensitivity to external impulses such as subsidy (statement 13). The responses showed that business decisions are made independently of subsidies (sort 13) and for non-financial benefits such as increased safety or better business continuity (sort 7).

ASSESSMENT OF BENEFITS OR COSTS

They do not view climate adaptation action as something that can directly lead to saving money (statement 18, sort 13). They vary on other potential benefits, but in general this profile is characterized by the view that climate adaptation can increase their real-estate value (statement 17) and protect their assets (statement 20) and that competitive benefits of climate adaptation, such as product market competitiveness (statement 15) and labor market competitiveness (statement 16) are likely.

ASSESSMENT OF OPPORTUNITIES OR THREATS

This profile is defined by the view that planned work is the moment to include climate adaptation action (s21, defining statement). The phrase "als je toch bezig bent" (in English, if you're already busy) came up, illustrating the view that planned work is an important window of opportunity (sort 6, 7) and that it also an important moment is to combine climate adaptation with other goals (sort 6) and ongoing management plans (sort 13). This profile also views climate adaptation as important to their business continuity, which was ranked as the highest threat that the effects of climate change can have on their business (statement 19) and for respondents a main driver for potentially taking action (sort 7, 13).

6.2.2. PROFILE 2: SEEING THE PROBLEM, BUT NOT SOLUTIONS

Five participants loaded significantly on this factor. They represent a mix of companies in terms of size (companies with size between 1-10 through 5000+ employees were represented). The sectors that loaded on this profile were from industry, infrastructure/services, healthcare, agriculture, and rental of real-estate.

The crib sheet used for the interpretation of factor 2 is shown in table 6.4.

Table 6.4: The crib sheet for factor 2

#	Highest Ranked Statements	Q-sort value	Consensus or Distinguishing
4	There is enough information about climate change to estimate its effects	4	
	Positive Statements Ranked Higher in factor 2 Array than in Other Factor Arrays		
15	By taking climate adaptation measures I can distinguish myself from competitors	3	
17	By taking climate adaptation measures I can increase the value of my real estate	3	
5	It is necessary to take climate adaptation measures as soon as possible	2	
16	By taking climate adaptation measures I can distinguish myself from labor competition	2	
11	It is the role of the government to communicate the risks of climate change	2	
2	I take enough climate adaptation measures to keep my business' risks acceptable	1	
8	It is clear to me what the government expects from businesses with respect to climate adaptation	0	
	Negative Statements Ranked Lower in factor 2 Array than in Other Factor Arrays		
19	By taking climate adaptation measures I can ensure my business continuity	-1	D*
3	I will take climate adaptation measures only if I experience negative effects of climate change	-3	D*
13	I will be prepared to take climate adaptation measures only if there is favorable subsidy available	-3	
	Lowest Ranked Statements		
7	It is the role of my insurer to cover the cost of possible damage as a result of climate change	-4	

PROBLEM DEFINITION

This profile's own assessment of the problem is that there is urgency for climate adaptation (statement 5). However, they are at a loss for what actions they should prioritize (sort 1) and what to do about the more "unseen" problems, such as heat stress (sort 10). This represents a kind of fatalistic tendency in this profile. One respondent noted that despite the existence of risks, they themselves do not have an opportunity to really influence them, referencing heat waves (sort 14).

This profile believes that the effects of climate change affect everyone, and that all entrepreneurs should take action (sort 14), with a more proactive stance (sort 10). And does not believe that sustainability has a higher priority than climate adaptation (statement 22).

INTERPRETATION OF SIGNALS

The high levels of awareness of this profile is further characterized by their lack of need for a personal event to trigger their action (s3, distinguishing statement). This profile is characterized by their belief that enough information about the effects of climate change is available (statement 4) from various sources including the news, university studies, research institutes, and the government (sort 1, 2), whom they expect to disseminate information (statement 11).

SENSE OF RESPONSIBILITY

This profile feels responsible for the effects of climate change on their business (statement 6). Further, they are characterized by a belief that their insurer is not responsible for the payment in response to damage (statement 7). The uninsurability of damages is the explanation for this perception, and this ranges from company assets that are too expensive to insure (sort 1) to negative health effects experienced by personnel and clients that are uninsurable (sort 2).

VIEW ON BARRIERS

This profile perceives that current regulation is a barrier to action (statement 9). The offered explanations center around timing and clarity: respondents feel like regulation is often delayed (sort 14) and not clear (sort 10). This profile does not believe that decision-making internal to their company prevents from taking climate adaptation action (statement 10). They believe that management does need to be convinced to take action, but that it is possible (sort 1) because "where there is a will, there is a way" (sort 4).

RESPONSE TO IMPULSES

This profile is characterized by their lack of interest in subsidies (statement 13). This profile believes a subsidy is not the reason that they would make an investment (sort 1) nor do they believe that dependence on the "subsidy spout" is a sustainable solution (sort 14).

This profile believes that regulation is similarly irrelevant (statement 12), and that their own responsibility is cited as the main reason for the lack of need for regulation (sort 10).

ASSESSMENT OF BENEFITS OR COSTS

This profile sees becoming climate adaptive as potentially having a positive effect on their ability to distinguish themselves from competitors (statement 15) and on the value of their real-estate (statement 17). This profile is split on whether they view climate change adaptation as producing a return on investment in the traditional sense. One respondent described how they see climate change adaptation as an investment that might only cost money (sort 1) and another said they see the possibility that in the long term it could save money (sort 14).

ASSESSMENT OF OPPORTUNITIES OR THREATS

This profile sees business continuity as a threat that climate change adaptation does not necessarily influence (statement 19). Similarly, they see the threat of damage to assets as not influenced by climate change adaptation (statement 20).

6.2.3. COMPARISON OF PROFILE 1 AND 2

Profile 1 and 2 differ on their characterization of whether a response is needed urgently or not. Profile 2 ranks the statement “it is necessary to take climate adaptation measures as soon as possible" higher than any other profile, including profile 1. Meanwhile profile 1 ranks the statement “I see planned work as a chance to take climate adaptation measures" as highly as possible, placing it in the +4 slot. Thus, despite the high awareness that both profiles have of the risks created by a changing climate as well as their awareness of the issue, their evaluation of the optimal tie to act varies. From this analysis it appears that businesses that fall under profile 1 value strategic and synergistic timing of climate change adaptation action. Meanwhile, businesses that fall under profile 2 value a response sooner rather than later.

This can be in part explained by the type of climate change effect that the businesses from these two profiles are sensitive to. While businesses in both profiles have, to some extent, indicated their vulnerability to heat stress, drought, and heavy rainfall, the businesses that fall under profile two tend to express greater vulnerability to and more experience with the negative effects of heat stress and drought. These climate climate effects are distinct from the climate change effect of pluvial flooding because they are chronic and pervasive, which might be influencing the sense of urgency profile 2 feels to take climate change adaptation action.

6.3. ADDITIONAL PROFILES

Although the following profiles are not statistically significant according to the Eigenvalue criterion and Humphrey’s rule (see appendix F), they are included because they were deemed to be of qualitative interest to the study.

An explanation of the rationale behind keeping these profiles for analysis is in chapter 5 and a discussion of the implications of this choice is in chapter 8.

6.3.1. PROFILE 3: WAITING FOR RETURN ON INVESTMENT

This is one of the factors that by the Eigenvalue criterion and Humphrey’s rule is not statistically significant.

Two participants loaded significantly on this factor. They both represent construction companies with 11-50 employees, where one participant participated in the study using the alternate ranking described in section 5.4.3.

The crib sheet used for the interpretation of factor 3 is shown in table 6.5.

Table 6.5: The crib sheet for factor 3

#	Highest Ranked Statements	Q-sort value	Consensus or Distinguishing
21	I see planned work as an opportunity to take climate adaptation measures	4	
	Positive Statements Ranked Higher in factor 3 Array than in Other Factor Arrays		
22	I think that sustainability is a bigger priority than climate adaptation	3	
7	It is the role of my insurer to cover the cost of possible damage as a result of climate change	3	
11	It is the role of the government to communicate the risks of climate change	2	
3	I will take climate adaptation measures only if I experience negative effects of climate change	2	
1	The risks as a result of climate change are small for my business	1	
8	It is clear to me what the government expects from businesses with respect to climate adaptation	0	
9	Regulation prevents taking climate adaptation measures	0	C*
	Negative Statements Ranked Lower in factor 3 Array than in Other Factor Arrays		
2	I take enough climate adaptation measures to keep my business' risks acceptable	0	
16	By taking climate adaptation measures I can distinguish myself from labor competition	-1	
15	By taking climate adaptation measures I can distinguish myself from competitors	-2	
14	Building codes need to change before I can take climate adaptation measures	-2	
12	I am only prepared to take climate adaptation measures if someone requires it of me	-3	
20	By taking climate adaptation measures I can protect my assets	-3	
	Lowest Ranked Statements		
10	Decision-making within my organization prevents taking climate adaptation measures	-4	C

CHARACTERISTICS

Problem definition This profile views climate adaptation as a lesser priority than sustainability (statement 22). In current practice they see that the energy transition has more priority (sort 8). And in fact, climate adaptation is not necessarily a business threat because it can lead to new work opportunities (sort 12). They do not believe it is nec-

essary to take climate adaptation action as soon as possible (statement 5), underscoring their lack of perceived urgency for climate adaptation.

Interpretation of signals This profile believes it is the role of the government to communicate the risks of a changing climate (statement 11), as that has been their experience to date (sort 8), however they do not view is as exclusively the role of government (sort 12). To date, they have not had many negative experiences with extreme weather as a result of climate change, and interruptions that they have experience they have accepted (sort 12). This correlates to their perception that they will be moved to take adaptation action after they have experienced a negative event, in a reactive manner (statement 3).

Sense of responsibility This profile is characterized by their belief that it is the role of their insurer to pay for damages as a result of extreme weather (statement 7). This was, in this profile's view definitely the role of the insurer, and that this clearly is covered by insurance (sort 12). And while they believe that they are responsible for climate adaptation (statement 6), they believe that the municipality is equally responsible, for issues such as sewage and public space (sort 8) and they expect the municipality to commit to similar levels of adaptation (sort 12).

View on barriers This profile is clear that their internal decision making is not a barrier to taking climate adaptation action (s10, defining statement). Bureaucracy is not an issue (sort 8) in part because the respondents who fall under this profile are both small or medium sized businesses. They do not perceive the current regulation as hindering them (statement 9), however they acknowledge that extra effort is sometimes needed to filter an influx of information, especially when they work in different municipalities (sort 8).

Response to impulses This profile does not believe that regulation is required to motivate them to become climate adaptive (statement 12). Instead, they perceive that they will be moved to become more climate adaptive either when they face damages (sort 8) or when the investment will pay off (sort 12).

Assessment of benefits or costs This profile believes that climate change adaptation could increase the value of their real estate (statement 17), but it is not a real driver for business because they are renting their facility and do not own it (sort 12). They do not believe they can save money (statement 18), because they view climate adaptation as an investment (sort 8). They do not see a direct link to distinguish themselves on the product market with climate adaptation (statement 15), however they do bid on work from the municipalities, so if climate adaptation was included as part of the tender that would incentivize them to take some action (sort 12).

Assessment of opportunities or threats This profile believes that planned work is the opportunity to take climate adaptation action (s21, defining statement). In fact, when they make any investment they always consider the long term (sort 8). However, they view the link between planned work and climate adaptation as conditional upon receiving the right information on time, that is before any project planning begins so that it can be included in planned work (sort 8).

6.3.2. BIPOLAR FACTORS: CONTINUITY & COMPLIANCE

These factors are created from the bipolar factor (factor number 4) that is one of the factors that by the Eigenvalue criterion and Humphrey's rule is not statistically significant.

The remaining profile, profile 4, had a sort that loaded negatively on the factor, which was then used to split this bipolar factor into two profiles: profile 4a and 4b. These profiles share the motivation that business continuity is important. They express that the potential benefit of protecting processes and services against interruption as a result of extreme weather as a result of climate change is of interest. Further, both profiles are sensitive to regulation, and the importance of compliance with rules and regulations was expressed. These profiles perceive that the government expectations for businesses with regards to climate change adaptation are unclear.

However, these profiles differ on their perception of the availability of information about the risks of a changing climate for businesses as well as the urgency of climate change adaptation. They also differ on their perception of their own responsibility to become climate adaptive.

6.3.3. PROFILE 4A: RISK NOT YET INTERNALIZED

This is one of the factors that by the Eigenvalue criterion and Humphrey's rule is not statistically significant.

Two participants loaded significantly on this factor. They are from the sectors culture & sport and industry, with sizes ranging from 51-100 to 1001-5000 employees.

The crib sheet used for the interpretation of factor 4a is shown in table 6.6.

Table 6.6: The crib sheet for factor 4a

#	Highest Ranked Statements	Q-sort value	Consensus or Distinguishing
4	There is enough information about climate change to estimate its effects	4	
	Positive Statements Ranked Higher in factor 4a Array than in Other Factor Arrays		
22	I think that sustainability is a bigger priority than climate adaptation	3	
18	By taking climate adaptation measures I can save money	3	
20	By taking climate adaptation measures I can protect my assets	2	
6	I am ultimately not responsible for taking climate adaptive measures	2	D*
14	Building codes need to change before I can take climate adaptation measures	1	
	Negative Statements Ranked Lower in factor 4a Array than in Other Factor Arrays		
21	I see planned work as an opportunity to take climate adaptation measures	0	
2	I take enough climate adaptation measures to keep my business' risks acceptable	0	
9	Regulation prevents taking climate adaptation measures	-2	C*
17	By taking climate adaptation measures I can increase the value of my real estate	-2	D
11	It is the role of the government to communicate the risks of climate change	-3	D*
	Lowest Ranked Statements		
1	The risks as a result of climate change are small for my business	-4	

CHARACTERISTICS

Problem definition This profile believes that there significant need for climate adaptation (statement 1, defining statement), and as a result perceived an urgency to take action (statement 5). They view climate change as affecting intensity and the health of workers (sort 11). Underlying their urgency is the perception that if they reach the point of their business processes being interrupted, it is already too late (sort 3).

Interpretation of signals This profile believes there is enough information about climate change effects (s4, defining statement), although they doubt that all businesses are doing enough to interpret the real risks for themselves (sort 11). This profile does not perceive that is is solely the role of the government to communicate climate risks (statement 11). Instead, they view environmental organizations as important contributors (sort 11) and

that businesses themselves need to take on this education responsibility (sort 3).

Sense of responsibility This profile does not perceive that it is the role of their insurer to pay for their damage costs (statement 7). They believe that while some damage could be covered by their insurance (sort 3), less tangible costs, such as those as a result of heat stress, are not covered by any insurance (sort 3, 11). They view that they are responsible (statement 6), and even asked, if I am not responsible, then who is? (sort 11)

View on barriers This profile views the government's expectations as being unclear (statement 8). They perceive that the government themselves is not sure what to do, which results in unclear and inconsistent policy (sort 11).

Response to impulses This profile does believe that building codes need to change (statement 14) as it is a piece of the law that affects climate adaptation (sort 11). However, they do not perceive that subsidy is a driver to become climate adaptive (statement 13). They say that in practice they consider subsidies and try to take advantage of them when possible, but that it is not a driver for them. They view compliance with regulation as a driver instead (sort 11).

Assessment of benefits or costs This profile believes that climate adaptation might save them money (statement 18) indirectly as they are sensitive to business interruptions (sort 3). They also perceive a weak link between climate adaptation and better standing in the labor markets (statement 16), because they are interested in attracting new and young employees, although they perceive a stronger link between climate mitigation and increased labor market competitiveness (sort 11).

Assessment of opportunities or threats This profile believes that climate adaptation can secure their business assets (statement 20), and prefers to invest money in doing so instead of hoping that their insurer will repay any damages later (sort 11). They also perceive a link between climate adaptation their business continuity (statement 19), where temperature issues can result in significant business interruption (sort 3, 11).

6.3.4. PROFILE 4B: RISK NOT YET RECOGNIZED

This is one of the factors that by the Eigenvalue criterion and Humphrey's rule is not statistically significant.

One participant loaded significantly on this factor. They are from an advice/consulting company with 1-10 employees.

The crib sheet used for the interpretation of factor 4b is shown in table 6.7.

Table 6.7: The crib sheet for factor 4b

#	Highest Ranked Statements	Q-sort value	Consensus or Distinguishing
19	By taking climate adaptation measures I can ensure my business continuity	4	
	Positive Statements Ranked Higher in factor 4b Array than in Other Factor Arrays		
12	I am only prepared to take climate adaptation measures if someone requires it of me	3	D
17	By taking climate adaptation measures I can increase the value of my real estate	3	
16	By taking climate adaptation measures I can distinguish myself from labor competition	2	
13	I will be prepared to take climate adaptation measures only if there is favorable subsidy available	1	
9	Regulation prevents taking climate adaptation measures	0	C*
	Negative Statements Ranked Lower in factor 4b Array than in Other Factor Arrays		
2	I take enough climate adaptation measures to keep my business' risks acceptable	0	
21	I see planned work as an opportunity to take climate adaptation measures	0	
5	It is necessary to take climate adaptation measures as soon as possible	-1	
14	Building codes need to change before I can take climate adaptation measures	-2	
8	It is clear to me what the government expects from businesses with respect to climate adaptation	-3	
18	By taking climate adaptation measures I can save money	-3	
	Lowest Ranked Statements		
22	I think that sustainability is a bigger priority than climate adaptation	-4	D*

CHARACTERISTICS

Problem definition This profile views climate adaptation as more important than sustainability in general (statement 22, distinguishing statement). They perceive that climate adaptation should be prioritized because it has a greater influence on business operations than sustainability (sort 5). Independent of their perception of the need for climate adaptation, they do not believe it needs to be completed as soon as possible (statement 5).

Interpretation of signals This profile perceives that there is not enough information about the risks of climate change (statement 4) and that it is the government's role to

provide this information (statement 11). In addition to expecting signals from the government, they also believe in taking climate adaptation action after they have had a negative experience themselves (statement 3).

Sense of responsibility While they recognize their own responsibility for climate adaptation (statement 6), they view it as the role of their insurer to pay for damages as a result of extreme weather events (statement 7).

View on barriers Their own internal decision making does not prevent them from taking climate adaptation measures (statement 10), however, they view that the government's expectations around the issue are unclear (statement 8).

Response to impulses This profile perceives that regulation is a main driver for them to become active in climate adaptation (statement 12, distinguishing statement). While subsidy also has an influence, it is not as big of a driver (statement 13).

Assessment of benefits (or costs) This profile views becoming more climate adaptive as having a positive influence on the value of their real estate (statement 17), as well as their competitiveness on the labor and product market (statement 15, 16). They do not view climate adaptation as a means to save money (statement 18), which correlates with their view that regulation is required for them to become active in this area.

Assessment of opportunities (or threats) This profile views the threat to their business continuity as the most important (statement 19, defining statement). They add that without the security of business continuity their risk of bankruptcy is very high (sort 5).

6.4. WHAT PERSPECTIVES DO BUSINESSES HAVE ON THEIR ROLE IN CLIMATE ADAPTATION?

The resulting profiles from the Q-study and factor analysis show that there are key differences between the businesses profiles with respect to their perspective on their role in climate change adaptation. The results show that there is dissent with regards to both the sense of urgency and need for climate change adaptation. While some exhibit intrinsic motivation driven by financial gain or out of self-interest in risk reduction, there are others who exhibit an externalization of the effects of climate change and the expectation that other stakeholders are responsible for managing or leading a response to the effects of climate change. As such, the expectations that businesses have of the government and their insurer vary widely. With this more granular understanding of the problem and role definition that businesses have, targeted policy instruments to increase climate adaptation activities can be evaluated.

7

RESULTS: STRATEGY DEVELOPMENT

Based on the profiles of business perspectives defined in the interview analysis, an examination of potential policy instruments per profile is presented.

The typology of business profiles that was created is used as a basis to compare policy instruments with the goal of matching specific types of instruments to specific business profiles. The aim is to illustrate what kinds of policy instruments will be most effective for the different business profiles in encouraging climate change adaptation.

7.1. COMPARISON OF THE PROFILES

The framework defined in section 5.5.2 was used to categorize the profiles that emerged in chapter 6 based on five different features. These were perceived need, urgency, responsibility, motivation, and approach. Based on the ranking of statements and respondent explanations, the following questions for each feature were attempted to answer from the point of view of the profile under consideration.

1. Need: is climate change adaptation needed?
2. Urgency: is climate change adaptation urgent?
3. Responsibility: is responsibility for climate adaptation shared?
4. Motivation: is my organization's motivation for climate change adaptation intrinsic or extrinsic?
5. Approach: is my organization's response proactive or reactive?

The result is a side-by-side comparison of the profiles based on these categories, shown in fig. 7.1.

	Profile 1	Profile 2	Profile 3	Profile 4a	Profile 4b
Is climate adaptation needed	Needed	Needed	Not needed	Needed	Neutral
Is climate adaptation urgent?	Not urgent	Urgent	Neutral	Urgent	Not urgent
Is responsibility shared or not?	Own	Neutral	Shared	Own	Shared
Is motivation intrinsic or extrinsic?	Intrinsic	Intrinsic	Intrinsic	Extrinsic	Extrinsic
Is the response reactive or proactive?	Neutral	Proactive	Reactive	Neutral	Reactive

Figure 7.1: Categorization of the five profiles

Based on the various profiles of businesses highlighted in chapter 6 it is possible to target the businesses that belong to each type of profile based on their own ranking of responsiveness to various incentives and motivations. In this section we will consider economic and financial, regulatory, and soft policy interventions and consider how each profile might respond to these [10]. In table 7.1 is an overview of the profiles and types of stimulation to which they are potentially responsive.

This is based off of the rankings of the Q-set statements in the factor arrays in combination with the statements of study respondents whose individual Q-sort arrays loaded significantly on a given factor.

The table 7.1 shows how different profiles might be more receptive to different types of instruments and engagement. The idea behind this table is that it presents a suite of

policy instrument options to local governments that they could use to target businesses that identify with different profiles.

Table 7.1: Of the three categories of policy interventions, which are most likely to be successful per profile.

	Profile 1	**Profile 2**	**Profile 3**	**Profile 4a**	**Profile 4b**
Economic and financial	no	no	yes	no	no
Regulatory	no	no	no	yes	yes
Soft	yes	yes	yes	yes	yes
Leveraging planned work	yes	-	yes	-	-
Communicating about damage and disruption	yes	-	-	yes	yes
Presenting solutions	-	yes	-	-	-
Coupling adaptation with other environmental activities	-	-	yes	yes	-
Reducing barriers	-	yes	-	-	-

7.2. ECONOMIC AND FINANCIAL INSTRUMENTS

Profile 3 is sensitive to financial stimulation, as shown during the analysis (appendix G.2.1). This profile indicated that they would be interested in climate adaptation if it proved to be a financially lucrative investment. Thus, financial schemes that would make an investment in climate adaptation not only financially feasible but also profitable will attract this profile to becoming more climate adaptive. Important considerations should be taken when deciding what type of financial scheme is selected (for example, subsidy versus low interest loans), which are further elaborated on in section 8.5.1.

Further, profile 3 sees it as the role of their insurer to pay for damages as a result of extreme weather events. Thus, if a financial stimulation scheme is created that is more attractive than the sense of financial security that this profile has from their perception of insurability, they could be pushed from their reactive stance to taking a more proactive stance.

7.3. REGULATORY INSTRUMENTS

Profiles 4a and 4b are sensitive to regulatory stimulation, as shown during the analysis (appendix G.2.2 and appendix G.2.3). These profiles see regulation as playing an important role in motivating their businesses to become more climate adaptive. Despite the recognition of the need for proactive climate change adaptation that some individuals from this profile personally expressed, they see regulation as filling the gap between the need for climate adaptation that they see and the investments that their upper management is willing to make. The word “compliance" was suggested by respondents as a key driver, suggesting that these profiles that are expecting their local governments to enact mandatory regulations are seeking the definition of standards with which they can comply.

The (temporal) gap between identifying a need, creating policy, and following up with compliance and control emerged as another consideration for this type of stimulation, and is further elaborated on in section 8.5.2.

7.4. "SOFT" POLICY INSTRUMENTS

Soft policy instruments are defined by [10] as being "voluntary and non-coercive" [p. 12]. In this analysis, we will focus on two strains of soft instruments: communication and reduction of barriers. All the profiles (1, 2, 3, 4a, 4b) are potentially sensitive to "soft" policy interventions, including communication and other outreach efforts. The different profiles have different information needs and expectations, so various sub themes related to the category of "soft" policy instruments are presented here.

7.4.1. COMMUNICATION CONSIDERATIONS

Based on the qualitative data collected during the interviews, the following concepts for good communication are presented and discussed.

ENGAGEMENT TIMING

Profile 1 and 3 share the perception that during planned work is the time to take climate adaptation action (appendix G.1.1 and appendix G.2.1). In order to take advantage of their willingness to include climate adaptive actions in planned work, the *timing* of messaging about the need for climate adaptation as well as potential options for climate adaptation are needed consistently and in advance of the work or renovation planning process.

SENSITIVITY TO CONTINUITY AND DAMAGE

Profiles 1, 4a, and 4b show that the threat of climate events affecting business continuity are a central concern for businesses (appendix G.1.1, appendix G.2.2, and appendix G.2.3). This sensitivity means that the possibility of interruptions at various levels of centrality to the business (such as in fig. 3.1) are real risks. Tools that communicate business-specific sources of business interruption (whether on-site or in the value or supply chain) could leverage this sensitivity for climate change adaptation.

In addition, profiles 3 and 4b show that there is a prevalent belief that insurers will pay to cover the costs of damage as a result of climate events (appendix G.2.1 and appendix G.2.3). While this may be true for some damages under some circumstances, communication that explains the cases when insurance payment is either not possible (e.g. heat stress) or not desirable (waiting for a refund leads to delays, and significant damage to interruptions) could reduce the (false) sense of security that some businesses feel as a result of insurance.

EXPECTATION OF SOLUTIONS

Profile 2 shows that awareness of the need for climate adaptation is not enough to ensure that it is actively adopted by businesses (appendix G.1.2). They show that there is an implementation gap between being aware of many sources of information about climate change and its effects, and being able to act on becoming more climate adaptive. It could be that this profile is plugged in to the available information about climate change

and adaptation to the extent that they have saturated their own ability to discern what climate adaptation initiatives are possible and worthwhile for their business. In order to take advantage of this profile's willingness to engage with the issue of climate adaptation, the *practicality* of communication should be emphasized: communicating clearly and succinctly what the specific effects of a changing climate can have on their business and what specific actions they can take to combat these effects.

COUPLING WITH ENVIRONMENTAL ACTIVITIES

Profiles 3 and 4a show that it is possible to be aware of the energy transition and sustainability without prioritizing climate adaptation (statement 22, ranked by both at +3), see (appendix G.2.1 and appendix G.2.2). They show that the defining characteristics of climate mitigation (including sustainability and energy transition) and adaptation are different enough that they can be considered conceptually separate issues. In order to take advantage of this profile's awareness and prioritization of the need for climate mitigation, communication should emphasize the *unity* of climate mitigation and adaptation. This includes a practical argument: that if you are considering climate mitigation activities, then it is a logical next step to recognize the effects of a changing climate and the need for climate adaptation activities. Additionally, there is a terminology or conceptualization re-definition argument to be made: that climate mitigation and adaptation activities are not mutually exclusive; in fact, many adaptation options have mitigation benefits, and vice versa.

7.4.2. REDUCING BARRIERS

There is also something important to be said about the barriers that businesses (perceive they) face when it comes to becoming more climate adaptive. Some barriers were tested during the Q sorting activity (e.g. current policy, internal decision-making) and based on how these barriers were ranked and the explanation offered by respondents, a quick analysis of these perceived barriers was made.

This analysis is based on an analysis presented in De Vries et al. (2019) which was constructed to summarize which hassles affects an individual's decision to invest in a "green home" and what activities can reduce this hassle. In this case, hassle is referring to the psychological hassle defined as "a micro-stressor... [that] can lead to considerable stress and inaction" [22]. In their paper, De Vries et al. identify three stages of investment decisions and identify barriers that are present in each stage. The stages are awareness, consideration, and decision.

Since barriers were tested during this research, we will use the term barriers instead of hassles, despite its different connotation. For each of these stages, the barriers identified by respondents during the Q-sorting activity were collected and categorized into one of the three stages, either awareness, consideration, or decision. These are shown in table 7.2. Based on the respondent's identification of a barrier, a solution is presented in the last column of table 7.2 in response to the perceived barrier.

These hassles are particularly relevant for businesses who fall under profile 2, but that is not to say that the removal of these barriers would not help businesses from the other profiles to becoming more climate adaptive as well.

Table 7.2: The identification of hassles and potential solutions per stage of a decision-making process

Stage	Identified barrier	Potential response
Awareness	Overload of information	Targeted and concise information, per sector or location for example
	Too little information	Reorganization of online media, with one central landing point for all businesses
	Low urgency	Emphasize the “win-win" possibility of preventive response and combination with planned work
Consideration	Uncertainty	Focus on translating potential effects to real consequences and probability of events
	Hesitancy	Suggest “no-regret" and “soft" adaptation measures that will prevent over-investment or lock-in
	Negative framing of DPRA outreach	Focus communication on real benefits and opportunities for businesses
Decision	Selection of adaptation measure	Consultation provided at a discount or free of cost
	Comparison with mitigation measure	Suggest adaptation measures that are also carbon-reducing

7.5. WHAT STRATEGIES TO ENCOURAGE CLIMATE ADAPTATION CAN BE USED TO TARGET THE DIFFERENT TYPES OF BUSINESSES, BASED ON THEIR PERSPECTIVES?

Across the board, consistent and clear communication about the need for climate adaptation is needed, and principles such as timing, sensitivity, practicality, and unity of the messaging can address the key communication challenges identified during the research. While the results showed that direct interventions such as regulation can motivate some business profiles, the option of subsidy was largely deemed ineffective by this respondent group. Meanwhile, the influence of indirect interventions, such as reducing barriers and increasing the effectiveness of communication were identified. Recommendations for the removal of barriers and increasing communication effectiveness were presented.

8

DISCUSSION

This chapter will discuss the contributions of the study, as well as its limitations, and recommendations for future research.

A reflection on this research's contribution, limitations, and opportunities for future research are presented.

8.1. COMPARISON BETWEEN PROFILES AND THEORY

The resulting profiles based on business perspectives on climate adaptation represent a broadening of the definition of how businesses can perceive and evaluate the issue of climate change adaptation.

The literature that describes the factors that influence a rational actor's decisions, financial and quantifiable factors dominate. While non-financial benefits are also considered, the extent of their influence is not known. In this regard, the first, second, and third profiles that result from this research are a marked deviation from this characterization of businesses. They show that businesses can be sensitive to potential non-financial benefits of climate change adaptation.

With regards to risks for businesses and businesses' risk perceptions, the profiles that recognize risks related to climate change adaptation do follow what the literature suggests. That is, that a recognition of the potential risks due to climate change can support the problem definition by businesses that climate change adaptation is needed. This is demonstrated by the first, second, and fourth profiles. They show that sensitivity to the risks of climate change is related to the problem definition that adaptation is necessary.

The literature that describes the factors that influence the decisions of networked actor are to some extent supported by the profiles. The first and third profile demonstrate to some degree an internalization of the responsibility for climate change adaptation, which may indicate a less hierarchical relationship to municipalities. Meanwhile, the fourth (4a) and fifth (4b) profiles reflect an expectation that municipalities will regulate businesses to take climate change adaptation action, demonstrating a hierarchical understanding of their relationship to municipalities as subordinate.

8.2. THE TARGET AUDIENCE

During the development of strategies it was assumed that a (somewhat nebulous) governmental actor had vested interest in activating private sector actors to become more climate adaptive. While this is true for municipalities in the Netherlands as part of the DPRA, it is not necessarily true for the separate departments that make up a municipality. That is to say, municipalities themselves are not homogeneous organizations: they are made up of various departments with sometimes conflicting interests.

In the case of climate change adaptation, the relationship between economic-focused and the environment-focused departments can potentially have differing interests. Broadly speaking, the mandate of the economic department is to build and maintain relationships with businesses in order to attract economic activity, jobs, and taxable income to the municipality, while the mandate of the environmental department is to increase resilience, quality of life, and comply with national programs such as the DPRA.

Due to the environmental and economic implications of climate change adaptation, it is not valid to assume that a governmental actor only has interest in furthering an environmental agenda without accounting for potential economic effects. Thus, there is potential need for mainstreaming climate change adaptation *within* a municipal or-

ganization (see Uittenbroek et al. 2013) in addition to mainstreaming climate change adaptation in its relationships with external actors, such as businesses.

8.3. SCIENTIFIC CONTRIBUTION

8.3.1. THEORETICAL CONTRIBUTION

This research takes an economic understanding of business decision-making and interrogates it, expanding upon it, producing a novel understanding of the various factors that affect business decision making with respect to climate adaptation. These findings have the potential to be applicable to other issues, such as the energy transition.

This research operationalizes decision-making, market and network, and vulnerability and risk management theories for the evaluation of business perspectives on climate change adaptation. The result is a novel framework for categorizing businesses based on their conceptualization of the need for and expectations for who should be responsible for climate change adaptation.

Further, the effectiveness of various types of policy instruments are evaluated per business profile. Mainstreaming theories are synthesized with the typology of businesses in order to make recommendations for municipalities interested in increasing climate adaptation by businesses. This is relevant in the Netherlands at the time of writing, as the DPRA activites are ongoing.

8.3.2. METHODOLOGICAL VALIDATION AND INNOVATION

This research makes a methodological contribution by validating the use of an online Q-methodology study, while combining both guided and unguided data collection techniques. In an attempt to create an accessible and attractive online Q-study, multiple, existing resources were combined to create a novel, remote Q-data collection method.

This method combined Qualtrics survey software, which is often used in research projects, with the web-hosted Q interview, in order to simplify the experience for potential respondents. This created the effect that any potential respondent who had received the invitation, or clicked on the study link, would be directed to a web page where they could select their preferred participation option: an unguided Q sort (referred to as “survey") or a guided Q sort (referred to as “interview"). Based on their selection, they were either immediately linked to the online Q-sort website, or continued to a web-form where they could submit their contact information in order to be contacted for an interview.

The interviews themselves used Microsoft Teams, and the screen sharing feature of the video calling, in order to allow the respondent to enter the Q-sort website while sharing their screen. This mimicked the effect of traditional Q-sort interviews, which involve a respondent sorting while a researcher looks on and asks clarifying questions. The choice to use Microsoft Teams was due to its availability to the researcher and because anyone had the option to join a call via their web-browser. This is also true for other video calling services, such as Zoom, which would have been a good option if Teams had not been available. The Q sorting activity was hosted on a website on a url that was publicly available, so this could also be accessed by any respondent.

The infrastructure that makes up these innovations is described in appendix E.

VALIDATION OF ONLINE Q SORTING

This research relied on remote data collection via an online Q sorting tool. While this introduced some (technical) complications, especially in the design phase of the study, it also created many benefits.

For the study design, extra time was needed to change course from an in-person interview to an online interview. These preparations included the research and selection of an online Q sorting tool, the customization of the selected tool (including a quick introduction web-development, for this researcher), and the adjustment to working with the data outputs of said tool (as opposed to the manually collected data from an in-person interview). In addition, a complete interview preparation process was set up to support the use of this online tool. This included the development of supporting materials, such as the introductory video, as well a standardized interview invitation and pre-interview instructions.

There were numerous benefits of this effort. First, the study was able to be completed on time, while obeying local health recommendations to work from home and limit unnecessary travel. Second, this reduced the (anticipated) travel burden on the researcher, opening up the opportunity to speak with any respondent, independent of location. Third, it ensured that there were no errors in transcribing by-hand sorts to a digital format and delivered the interview data in a standardized form for analysis. Finally, it also introduced the option to have respondents complete the Q sorting activity independently.

The online sorting did introduce some challenges. In one case, the combination of a video call at the same time as online Q sorting activity was not possible due to the limitations of a respondent's computer. The solution for this was for the respondent to open the video call on their phone, and film their computer screen as they sorted and we talked. In another case, the security measures of a respondent's company prevented them from opening the researcher's personal website where the Q sorting activity was to take place. In response, during this interview the Q sorting was opened on the researcher's computer, and via the video calling the respondent was able to complete the Q sort.

From this researcher's perspective, the virtual interviews in combination with a video call were able to mimic an in-person interview without too much extra effort for the respondents, although it is possible that potential respondents without comfort in or the resources to video call self-selected not to participate in the study.

VALIDATION OF UNGUIDED Q SORTING

The decision to collect online Q sort data opened up the possibility to offer respondents a chance to complete the Q sorting independently, instead of with the video-calling interview.

This option was offered in order to increase the attractiveness of study participation for potential respondents. This was under the assumption that the idea of an interview would be off-putting for some respondents, and that the option to complete the Q sorting activity independently, and hopefully more quickly, would increase responsiveness to the study invitation.

Assuming that timing is a proxy for ease of study participation, the measurement of how long it took a participant to complete the online Q sort shows that respondents who

completed an unguided Q sort had an easier time than those who completed a guided sort with an interview.The study respondents who completed an unguided Q sort took between approximately 15 and 30 minutes to complete the entire process, including the follow up questions. The study respondents who completed a guided Q sort (that is, with the video interview) took between approximately 30 and 75 minutes to complete the entire process.

The option to complete the Q-sort independently introduced the problem that there would be no direct contact between the researcher and the respondent, creating the chance that the Q-sort could be overwhelming, completed “incorrectly," or that the topic and statements could be misinterpreted. To minimize these risks, an introduction video was made and placed on YouTube, where survey respondents could view it before starting the Q-sort process. Interview respondents were also asked to view this video in preparation for the interview in order to offer all respondents the same introductory information, regardless of whether they completed the Q sorting activity independently or not. In the video, the topic itself was (re)introduced, with some examples, and a quick overview of what was going to take place during the Q-sort survey or interview was shown.

Despite the option to explain their responses via a follow up phone call, the respondents who completed the unguided Q sorting activity all declined that option. Ultimately this had an effect on the ability to interpret those Q sort data due to the lack of insight that is normally provided by the conversation that takes place during an interview. Nonetheless, there were three individuals who opted to complete the Q sort independently instead of in combination with an interview, so this option to independently complete a source was useful in increasing the number of respondents.

This type of data collection could have benefited from additional, open-ended questions about the respondent’s type of work and their role. Further, the Q sort section of the data collection could have been expanded to not only ask for an explanation of the most extreme statements (in this study, ±4, in total two statements), but also the #2 and #3 highest and lowest ranked statements (in this study, ±3, in total four statements). This would have increased the work load for the respondents, but would have had the benefit of increased insight into the ranking of the top six most extremely ranked statements, instead of only the top two.

VALIDATION OF ALTERNATE (PRIMED) Q SORTING

This study employed an alternate ranking method for two respondents. These respondents were given a condition of instruction where they were asked to complete the Q sort activity from the point of a view of a Small-medium enterprise (MKB, in Dutch). This took place at the researcher’s discretion, due to fact that the participants individuals were not part of the target audience, but did have in-depth experience with the target group.

Certainly, this method has limitations as it is asked for a second-hand interpretation of a complex issue. Thus, it should only be used in the cases where the respondent has sufficient experience to complete the Q sorting activity from the primed point of view. There is not a definitive way to judge to what extent a respondent can understand and express the point of view of another individual, so this sorting method does introduce some risk.

However, the factor analysis showed that these two respondents did not create a “new" factor and in fact, their rankings loaded significantly on factor 1 and 3. This shows that the respondents who were primed to complete the Q sorting activity from a different point of view expressed potential viewpoints that did not deviate significantly from what was already being said by the rest of the respondent group, who had completed the Q sorting activity from their own point of view.

In future use of method, I would adjust the condition of instruction. In this study it was a represent the viewpoint of the “average" Small-medium enterprise business, for one respondent, from their sector, and for the other respondent, from the business park where they had experience. I would recommend adjusting the condition of instruction to sort it from the viewpoint of one particular small-medium enterprise in particular, as that might reveal a more distinct business profile. And of course, when it is possible to interview the small-medium enterprise themselves, that would be the preferred method of data collection.

8.4. STUDY LIMITATIONS AND IMPLICATIONS THEREOF

8.4.1. TERMINOLOGY CHOICE

Due to the subjective nature of respondents ranking statements, the terminology used during invitations to participate, instructions before participation, and during the interview themselves have significant influence on the study outcomes. This influence would be due to the effect of (semantic) priming, which occurs when “the processing of a stimulus is more efficient after the earlier processing of a meaningfully related stimulus," [5]. By nature of the need to give context for the study topic and goal, the respondents have to be primed to some extent, but hopefully not to the point that participants are unable to “ ‘inject statements with their own understanding’ " [13, p.11] in [87, p.64].

Ultimately, language such as “climate change (adaptation)" and “extreme weather events" were used in the explanation of the study. There was a risk that using “climate change" could alienate respondents who do not believe in climate change. In addition, there was a risk that by using “extreme weather events" to illustrate the effects of a changing climate that might require adaptation, respondents were primed to consider local-scale effects, stealing emphasis from the broader effects. This could have affected how participants interpreted the Q-set statement about business continuity (statement 19), for example.

The concepts of adaptation and mitigation were sometimes conflated. This became obvious when some respondents used climate mitigation activities to describe their adaptation ambitions. In other cases, however, the difference was recognized, and respondents used some of the programs for climate mitigation, such as a CO2 ranking ladder, as a parallel to describe the possibility of a similar tool for climate adaptation. This became clear when the statement about the prioritization of “sustainability" versus adaptation (statement 22) was discussed.

There is also something to say about my translation from English to Dutch. While my word choice was not always optimal, I do not believe that the language barrier caused significant disruption to the interpretation and sorting of the statements.

8.4.2. COMPOSITION OF THE Q-SET

In order to keep the study attractive enough for respondents, and the mental load small enough that it could be completed within the goal interview time of approximately 1 hour, the number of topics that could be represented in the Q-set were intentionally limited. This scoping is, of course, the nature of any research, especially a Q-study. However, it should still be acknowledge that a select list of themes related to climate change adaptation by businesses were included in the final Q-set used in this study. There were, other themes that also could have been interesting to include, and which may have been included if an “ecological" instead of theoretical approach was used to explore the concourse and select the Q-set.

Some potentially interesting themes that could be included in a future study include: various definitions and conceptualizations of adaptation, sustainability, resiliency, and other related terms; various statements about different financial incentives; and statements about the opportunities that climate change presents (as opposed to statements about mitigating risks). These are translated to recommendations for future research in section 8.6.

8.4.3. COMPOSITION OF THE P-SET

Upon reflection of the P-set sampling used in this study it seems that despite best efforts, the P-set sampling method still fell into the trap of opportunistic sampling, which the literature does not recommend. Although the final P-set of this study did include businesses from different locations, sectors, and with different sizes, the P-set tended to be less diverse with regards to experience and awareness to the effects of a changing climate. This would have been improved by a more structured sampling method that would have specifically included a businesses' level of awareness as a criteria for inclusion in the study, although the way in which one would define and measure awareness without a pre-interview or pre-survey remains a difficult task.

The interviewing method as a data collection method relied on the voluntary participation of respondents which created an inherent bias in the respondent pool. The respondents are individuals who, to some degree, self-selected to participate in the study based on personal knowledge, interest, or experience with climate change effects on their business. Conversely, potential respondents who do not feel the effects of climate change, perceive its risks, or even acknowledge its existence are unlikely to volunteer their time to participate in this study, creating an under representation of this sub-group. It is also possible that individuals without the ability to or interest in participating in a virtual interview also excluded themselves from the study, although the option to complete an unguided Q sort was available to them.

This effect is compounded by the fact that some portion of the interview respondents were initially contacted via the Arcadis network, meaning that they already had contact, and often, direct, personal experience with climate change effects on their businesses. Despite these limitations, the added value of this study still remains; it expands an understanding of the values that underlie business decision-making, and how they can relate to values of environmental resilience. That being said, it would be valuable to perform this same Q-study with a P-set that has more diverse experience with climate change effects, and test whether the same or similar profiles emerge from the analysis.

Despite the fact that a Q-study does not need to be tied to specific cases or locations, were I to do this again, for my own organization I would use a more structured sampling methodology. I would imagine that the use of case studies to build the P-set group on the basis of pre-selected case locations could be useful. These cases would be, for example, three business parks located in different municipalities, with different types and sizes of businesses, and different experiences with climate change effects. I think this could have ensured a more diverse P-set with regards to awareness of a changing climate, without the need for a pre-survey or pre-interview.

8.4.4. OBSERVER-EXPECTANCY EFFECT & RESPONSE BIAS

The use of interviewing as a research method offers benefits such as increased interaction, and the opportunity to explore topics that emerge naturally during conversation. However, interviews can also introduce biases that affect the validity of research results. Here I will mention two relevant phenomena that could affect the validity of this research. First, the observer-expectancy effect occurs when a researcher's unconscious bias causes them to subconsciously influence the participants in an experiment. Second, the response bias (which is influenced by acquiescence bias and social desirability bias, among others) can skew survey and interview results. I cannot comment to what degree either of the phenomena occurred during the study, but acknowledge that their existence should be considered during interpretation and generalization of results.

8.4.5. INCLUSION OF ADDITIONAL PROFILES

The Q-sort interpretation presented some significant challenges, despite the factor-analysis method itself seeming straightforward. First, I performed intermediate factor analyses after seven, nine, twelve, and the final fourteen Q-sort data were collected. I also iterated on the final fourteen factor analysis five times in order to adjust parameters such as the number of factors to keep, the thresholds for factor loading, and the splitting of a bipolar factor.

An odd thing happened, which was some of my earlier iterations of the factor analysis (namely, the analysis after nine sorts) made more sense on the first attempt than the final factor analysis (with fourteen sorts) made after the first attempt. In response, I completed multiple iterations of the fourteen sort factor analysis. It appears that with the addition of additional sorts, the complexity of the Q-sort data increases to a degree that the factor analysis with standard parameterization is insufficient to uncover the stories that the data is trying to tell. This manifested in sometimes seemingly contradictory ranking of statements. Making sense of these contradictions, of course, is representative of the complexity and contradictions that exist in the real world. While it produces useful results (e.g. profiles that can create a conversation about the different perspectives actors within one actor "group" have about the same issue), it is somewhat unsatisfying in that the individual researcher can "tip" results to appear a certain way.

Ultimately, the cause of this issue appears to be a lack of respondents the P-set group. According to Watts and Stenner, approximately 6 respondents can support the extraction of one factor, meaning that the P-set group in this study could, according to this rule of thumb, support a two-factor solution. For the reasons mentioned previously in chapter 5 which I will not repeat here, there was sufficient motivation to explore a three or

four factor solution. That decision was made, and while it had the benefit of revealing some more variance in the respondents' Q sorts, it did introduce the possibility that more respondents were needed to support this parametrization of the analysis.

8.4.6. ABILITY TO GENERALIZE RESULTS

A Q methodology study has an exploratory nature and its study goals are to explore and expand an understanding of a target group. That means that a Q study does not claim to represent all the opinions of a larger population, either in content or representation. The results of this study, both the profile definitions and the policy evaluations should be considered from their exploratory standpoint; not as a definitive or strict set of rules.

It is possible that were a larger P-set to be sampled for the study again, the profiles would shift, with new profiles emerging as dominant compared to the dominant profiles in this study. It is also possible that new factors would emerge, and that the existing profiles would change or new profiles would emerge. This is to say that the results of this study are not immediately generalizable to all businesses in all sectors in all provinces of the Netherlands, but that businesses who conceptualize climate adaptation this way or similarly and with these underlying values do exist. This expanded understanding of businesses can be used during the development of climate change adaptation policies and programs as is, although a more refined set of results would be possible with broader study participation and a more diverse P-set.

8.5. INTERESTING DISCUSSIONS

8.5.1. THE LIMITATIONS OF SUBSIDY

I was surprised by some of the reaction that respondents had when presented with the option of subsidy. In some cases, the idea of subsidy was rejected because it was not seen as a long-term funding structure, and therefore an undesirable business investment. In other cases, it was acknowledged, but mentioned that its positive effect was relatively small, that is, that the existence of a subsidy alone was not enough to motivate businesses to act. Other benefits had to also be present in order for a business to invest in climate adaptation.

There was a moral argument against subsidies. One respondent explained that they are against subsidies because of the co-financing structure they often entail. From their point of view, this means that only large companies (or, ones with large cash reserves) can reap the benefits of subsidies, while smaller (less cash reserves) are excluded from the benefits. From their point of view, this ensures that large companies stay ahead of the game while smaller ones fall further behind, entrenching environmental inequality in economic inequality. Their preference, by the way, was for no- or low-rent loans, which would be more accessible to all businesses. The acceptability of subsidies versus loans would be interesting to explore in follow up research.

During an intermediate presentation of the study results to practitioners an industry expert asked if the rejection of subsidy could also be due to their conditional nature (i.e., if you receive this subsidy you must abide by these rules). While this could be an interesting barrier for businesses to see subsidy as a positive incentive for climate change adaptation, this barrier was not present in this Q-set, and therefore not tested in this

study. This would be interesting to consider in follow up research.

8.5.2. THE LIMITATIONS OF REGULATION

I was also surprised by the split opinion on the role of regulation in encouraging climate change adaptation. To some extent, the “traditional" view of businesses as motivated by compliance was revealed; however, there was also a strong opinion from other respondents that regulation was not necessary to motivate their action. The main difference between these respondents was that the latter seem to have internalized their climate risks, and believe climate adaptation action is necessary to ensure their own self-interest (e.g. business continuity, one of the most prevalent cited benefits of climate adaptation during the interviews).

There was another group of respondents that did not see the role of regulation as being important. These respondents viewed regulation as lagging behind the problems (i.e. market failures) they seek to resolve. While this is understandable, it has the negative effect of feeding into the stereotype that government is slow and not agile, which could decrease their authority or credibility. It would be interested in future research to consider how the credibility of local government also plays a role in encouraging systemic change, such as the energy transition or climate adaptation, in other actors, such as businesses.

8.5.3. THE COVID-19 EFFECT

It is impossible to separate a study from its context. This research is unique because it (unexpectedly) occurred during the early stages of a global pandemic. In the Netherlands, the societal response was an “intelligent lockdown" beginning in March 2020. Unfortunately for me, my research schedule included approaching respondent from late March onwards. I often received a decline to participate with the explanation that businesses were thoroughly occupied with the shutdown, which I interpreted as a sign that either time or mental energy (or both) were fully occupied by the economic consequences of the COVID-19 induced lock down in the Netherlands.

On the other hand, some of the respondents who chose to participate suggested that the current economic shock shares some common traits with an anticipated climate-induced shock. The sheer unpredictability of both a global pandemic event and a climate-crisis event highlight the benefit of risk management activities, and how even for “unlikely" events, risk mitigation and management is important. These respondents, by drawing a parallel between the current crisis and a potential future climate crisis offer the opportunity to use the current shock as a warning, and a reminder that investment in climate adaptation now could mean the difference between business survival and failure in the (not too far) future.

There is considerable research that shows a direct link between an emergency event and increased risk awareness. In the Netherlands, the most salient example is the storm flood of 1953 and the creation of the Delta Commission and the subsequent development of the Delta Works (both of which, not coincidentally, are linked to the inspiration for this study, the Delta Plan Ruimtelijke Adaptatie). On the other hand, research has also shown that Dutch levels of risk awareness are misaligned with their actual (coastal and fluvial) flood risks, at levels much lower than they “should" be. This occurs in part

because of the mollifying effect of the government initiative to implement flood protections nation wide.

With that being said, it would be interesting in future research to explore how the emergency event of the current pandemic-induced economic crisis can be used to increase risk awareness of future climate-induced economic crises, without undermining increased risk awareness with adaptation-induced complacency.

8.6. RECOMMENDATIONS FOR FUTURE RESEARCH

8.6.1. RECOMMENDATIONS FOR ITERATIONS ON THIS Q-STUDY

During the study development and creation of the Q-set, all possible actions were taken to lessen the study burden on the participants. An important aspect of reducing the study burden included limiting the amount of statements in the Q-set, in order to reduce both the mental burden of sorting and, in theory, the time required to complete the sort. In addition to reducing the burden on participants, the total of 22 statements and projected interview duration of 30-45 minutes was necessary to make the study attractive to potential respondents, business owners, who were expected to want to spend less than an hour on an interview.

This meant that the Q-set had to be limited to a short-list of topics for this study. In additional research, other topics that had to be excluded during this research can be explored.

A Q-STUDY WITH A FOCUS ON TERMINOLOGY

This study could include statements that explore the various definitions of climate change manifestations highlighted in Marshall et al. 2010 and their relationship to awareness and action. These findings could offer insight into what climate effects are most salient for various sub-groups, potentially based on location, or sector of work.

Another terminology issue uncovered by the Marshall et al. 2010 study is the conflation between climate mitigation and adaptation. While this study included a statement about sustainability and its relationship to adaptation, it would be useful to explore the links that respondents perceive (or don't perceive) between the concepts, and in what context the links exist. These findings could offer insights that could be used to strengthen the argument for the coupling of climate mitigation and adaptation responses.

A Q-STUDY WITH A FOCUS ON POSITIVE FRAMING

In part due to my own research bias, I was interested in the barriers that could be preventing adoption of climate adaptation by the private sector, as well as the role in risk awareness in determining a willingness to take action to prevent negative effects as a result of climate change. Unintentionally, this resulted in a "negative" framing of my study and the Q-set, framing climate change as creating risk and threats for businesses.

While I did include statements about the benefits of *becoming* climate adaptive in the Q-set, I did not explicitly include statements about the opportunities that a changing climate *itself* could present, such as changing access to resources or changing market opportunities. The exclusion of these statements could have been due to my own bias, that these potential opportunities presented by climate change, if they do exist, are vague

and just as likely to trend towards less resource access and less market chances as they are to trend towards more resource access and more market chances. Yet, at the moment of writing about this dual nature of opportunity, it appears these statements would have been interesting to measure during this study; thus, fodder for future work.

A Q-STUDY WITH A FOCUS ON INTERVENTIONS

What became readily apparent during this study was that one type of financial intervention is not a proxy for all financial interventions (specifically, that a statement about subsidies was not a good proxy for statements about financial incentives in general). With that in mind, I recommend a future Q-study take up a Q-set that compares various kinds of financial interventions (e.g. subsidy, loan, tax) provoke different responses. This kind of future research could provide very practical insights for local government actors who would like to intervene for the purpose of encouraging climate adaptation, both by private citizens and businesses.

USING THE (ONLINE) Q METHODOLOGY FOR DIALOGUES

During demonstrations of the online Q sorting tool and in consultations about the research findings, practitioners expressed interest in the online Q sorting tool as a means of preparing or conducting a dialogue. Future studies could explore the use of a Q sorting activity in generating discussion groups with similar and different perspectives, for example.

USING THE (ONLINE) Q METHODOLOGY FOR SURVEYING

An online Q sorting tool also offers the chance to return results in real-time. For example, if a Q methodology study is completed with a sample group of respondents, and profiles are generated, the study could then be spread further, and collect additional responses. These additional responses could then be categorized based on their similarity to the profiles identified in the analysis of the sample group. This would be a means of measuring what percent of a population corresponds to a particular profile.

8.6.2. RECOMMENDATIONS FOR OTHER RESEARCH

This study also generates more questions that could be answered by non-Q methodology studies. Here I will list some recommendations.

A study that uses the profiles defined in this research, or other profiles, to define a climate change adaptation maturity model for businesses. The stages can be defined by the business' perspectives or in combination with their activities. Such a maturity model could help sketch a road map for businesses and could help define the elusive answer to the inevitable question, when is a business climate adaptive?

A study about the interaction between risk aversion and complacency. Does the act of adaptation introduce negative side effects? For example, to what extent does taking climate adaptation action as a response to risk aversion increase a sense of risk complacency, ultimately re-introducing risk? See Tessler et al. (2015) for an explanation of this phenomenon.

A study about the ongoing tools for lower-level understanding of climate change effects. To what extent does increased granularity of impacts increase risk awareness and

result in action? Is it enough to communicate the potential impacts of climate chance at a local level? How can the probability of climate chance impacts also be communicated in order to offer not just an impact analysis, but a risk analysis?

A study about scenario development. How can the concept of scenario thinking be brought into the mainstream? That is, as an alternate to and in addition to site-specific risk analysis, how can the development and conceptualization of scenarios (with probabilities attached or not) increase an internalization of the need for climate change adaptation?

A study about adaptive policy pathways. Given that predictions and measurements of risk change with the improvement of tools for effect prediction as well as the changing circumstances of the effects of climate change itself, how can the concepts of adaptive policy pathways be used in the climate change adaptation policy field?

A study about the influence of insurance and lending institutions on climate change adaptation. To what extent can and do these institutions influence the uptake of climate change adaptation? What tools do they use, and to what extend are they effective? This could look at, for example, the dependency of insurance premiums on climate change adaptation activity and the effect of risk-management schemes such as the Equator Principles (https://equator-principles.com/) or the effect of local level initiatives such as the Leiden Sustainability Funds (https://www.duurzaambouwloket.nl/duurzaamheidsfonds-leiden).

A study about the DPRA (Deltaplan Ruimtelijke Adaptatie) and National Climate Adaptation Strategy (NAS, Nationale klimaatadaptatiestrategie in Dutch). To what extent are the programs successful? What can be used to measure the success of these programs, and what can be learned from their experiences over the last few years?

9

CONCLUSION

This chapter revisits the answers to the sub-research questions, answers the main research question, and describes the main research outputs and their implications.

The answers to the research questions are reviewed in order to answer the main research question, and the main research outputs are highlighted.

9.1. ANSWERS TO THE RESEARCH QUESTIONS

WHAT ARE THE POTENTIAL CONSEQUENCES FOR BUSINESSES AS A RESULT OF A CHANGING CLIMATE?

The multitude of ways that climate change can manifest can result in serious potential consequences for businesses, potentially affecting their core operations, their value chain, or their larger network. The potential consequences can generally be categorized by either damage to property, disruption to processes, or limited access to necessary resources. Businesses might face potential disruption, either on their own property, as a result of the declining health of their workers, or their local transport infrastructure as a result of extreme weather events. They might face potential damages and associated costs as a result of extreme weather events, such as heat waves, heavy rainfall that results in flooding, or subsidence as a result of drought. Further, there are more insidious consequences, such as decreased demand for their product or service or an inhibiting cost of resources or raw materials due to shortages.

WHAT FACTORS MIGHT INFLUENCE THE EVALUATION OF THE BUSINESS CASE FOR CLIMATE ADAPTATION?

There are various forces that affect a business' engagement in climate change adaptation. Some of those forces are intrinsic, such as the evaluation of a business case, which weighs the potential costs, benefits, threats, and opportunities that climate change (adaptation) pose to businesses against each other. These motivations can also be induced by a desire to decrease own risk, or in response to a past extreme weather event. Despite entering into the frame of a business case and risk management activities, the costs and benefits of climate change adaptation are not only financial, there are real non-financial aspects that can be explored and potentially exploited in order to increase climate adaptation by businesses.

WHO ARE THE STAKEHOLDERS THAT CAN AFFECT BUSINESS' ENGAGEMENT WITH CLIMATE ADAPTATION, AND HOW DO THEY INFLUENCE BUSINESSES?

The main actors in the management of business parks are the local municipalities, who in addition to influencing business parks through policy instruments are also are interested in making their municipality an attractive place to work. This can result in an lack of a willingness to take prescriptive action to promote climate change adaptation, thus putting the onus on the individual businesses to become active in climate adaptation. These businesses are often organized into associations, which although not explored in detail in this research, might serve a key coordinating role. Local governments who want to increase climate adaptation, might consider leveraging these existing networks, and should consider reviewing the current institutional environment and process a business must go through to become climate adaptive. This could help municipalities identify how policy instruments might encourage or how potential neglect to reduce barriers might discourage businesses to invest in climate adaptation on their own.

WHAT PERSPECTIVES DO BUSINESSES HAVE ON THEIR ROLE IN CLIMATE ADAPTATION?

The resulting profiles from the Q-study and factor analysis show that there are key differences between the businesses profiles with respect to their perspective on their role in climate change adaptation. The results show that there is dissent with regards to both the sense of urgency and need for climate change adaptation. While some exhibit intrinsic motivation driven by financial gain or out of self-interest in risk reduction, there are others who exhibit an externalization of the effects of climate change and the expectation that other stakeholders are responsible for managing or leading a response to the effects of climate change. As such, the expectations that businesses have of the government and their insurer vary widely. With this more granular understanding of the problem and role definition that businesses have, targeted policy instruments to increase climate adaptation activities can be evaluated.

WHAT STRATEGIES TO ENCOURAGE CLIMATE ADAPTATION CAN BE USED TO TARGET THE DIFFERENT TYPES OF BUSINESSES, BASED ON THEIR PERSPECTIVES?

Across the board, consistent and clear communication about the need for climate adaptation is needed, and principles such as timing, sensitivity, practicality, and unity of the messaging can address the key communication challenges identified during the research. While the results showed that direct interventions such as regulation can motivate some business profiles, the option of subsidy was largely deemed ineffective by this respondent group. Meanwhile, the influence of indirect interventions, such as reducing barriers and increasing the effectiveness of communication were identified. Recommendations for the removal of barriers and increasing communication effectiveness were presented.

HOW CAN ENGAGEMENT BY BUSINESSES TO ADAPT TO A CHANGING CLIMATE BE INCREASED?

This research presents some options for initiatives by municipalities to increase climate adaptation activities. They can lean into their widely accepted role as communicator, and transfer knowledge about the effects of climate change and their practical implications for businesses to increase awareness. When doing so there are some key factors to keep in mind, such as the communication timing, the discussion of continuity and damage, acquiescing to the expectation of solution-oriented engagement, and coupling climate change adaptation with environmental activities in general.

Municipalities can recognize and try to remove barriers that might be hindering the uptake of climate adaptation by businesses. In consultation with more businesses about the issue they can identify more barriers than those identified by this study and work to remove those as well.

Municipalities can leverage their regulatory and financial policy instrument toolkit to increase adaptation; they would do well to consider the limitations of both from the perspectives of businesses and work to anticipate their reactions to their usage. For example, this study uncovered that businesses perceive regulation as being reactive and delayed and that they perceive subsidy as temporary and unsustainable.

Municipalities can enter in dialogue with businesses, as prescribed by the DPRA, while using tools such as an online Q-sort in preparation for or during a workshop to begin a content-rich and value-based discussion. In their dialogues, they can not only focus on the individual business risks identified by the stress-test results, but also the

potential benefits and opportunities that businesses would be interested in, as well as the potential barriers that businesses need municipal help with circumventing.

9.2. RESEARCH OUTPUTS

9.2.1. SYNTHESIS OF INFORMATION

This research identified the consequences of extreme weather events in the Netherlands for businesses, the relevant stakeholders and their potential roles as they relates to spatial adaptation, and potential advantages and disadvantages of climate change adaptation. Interviews and surveys using the Q-methodology, was used to bring the perspectives of businesses with respect to their role in climate change adaptation to light by creating business profiles. Strategies to increase the engagement of businesses in climate adaptation, based on their profile, were developed.

9.2.2. CREATION OF A BUSINESS TYPOLOGY

The results of this research support the hypothesis that businesses have diverse viewpoints about the need for climate change adaptation and the role and responsibility division across stakeholders. The main profiles revealed by the research agree that climate adaptation is necessary, and their motivation to take action can be characterized as intrinsic, although with different reasons. These two profiles differ on their categorization of climate adaptation as urgent versus not urgent. These main profiles emerged in part as a result of the P-set make up of this research. There are three additional profiles uncovered during the factor analysis, that while not statistically significant, contribute to a more complete typology of businesses based on their perspective on climate change adaptation. While efforts were made to include less dominant perspectives during the analysis, the resulting five profiles are surely not a characterization of all the possible perspectives that businesses might have with respect to climate change adaptation. The profiles that were uncovered in this research do demonstrate a significant deviation from the traditional characterization of businesses as solely caring about financial values, such as return on investments.

9.2.3. RECOMMENDATIONS FOR MUNICIPALITIES

Based on these results, this research recommends a reëvaluation of the role of financial incentives, especially by exploring options other than subsidies, which were rejected by 2 of the 4 profiles. It is also recommended that governments do not wholly abandon the use of (compulsory) regulation, as an incentive, as some profiles indicate this is a major motivation to take action on environmental issues. The use of clear, concise, and consistent information from the government about both the individual business risks of a changing climate and the options for solutions that can be implemented by businesses is also recommended. Finally, the removal of barriers is an important intervention for one profile, and it is recommended that the active removal of barriers to becoming climate adaptation are pursued, which would likely increase engagement by not only the profile sensitive to hassles, but all profiles.

9.3. IMPLICATIONS OF THE RESEARCH FINDINGS

9.3.1. BUSINESSES ARE NOT HOMOGENEOUS

It is possible to develop a more nuanced understanding of the relevant drivers for business to become more climate adaptive. This research shows that businesses vary in their conceptualization of the need and urgency of climate adaptation. Further, when it comes to perceptions on solutions, they differ on their understanding of who is responsible, and what kind of approach is needed.

9.3.2. BUSINESSES ARE MADE UP OF PEOPLE

There are chances where the interests of businesses and local governments overlap, and these can be leveraged for mutual gain. While a business needs to maintain financial profitability, they are also receptive to non-financial costs and benefits. In many cases respondents expressed personal interest in environmental issues, which further suggests their receptivity to issues such as climate change adaptation, and an opportunity for government to engage with them on this issue.

9.3.3. BUSINESSES' INDIVIDUAL RISK ISN'T EVERYTHING

There is an important process-based question for local governments in the Netherlands who are trying to encourage climate change adaptation and the risk-dialogues of the DPRA. While the steps and timeline of the DPRA focus on the stress tests results, and imply that those results are the beginning of a risk-dialogue, this is not the only way to approach the issue of climate change adaptation. This research offers another point of entry for the dialogues, by beginning with a recognition of the businesses in their complexity and the various values they have to consider when making decisions. There are varied and equally valid perspectives on climate adaptation, and an approach that begins with acknowledging business' values and concerns before diving directly into risk-evangelization could prove successful.

That is, there is a risk (no pun intended) to focusing a campaign and intensive dialogue process on the frame of risk assessment and management if businesses are not receptive to the idea that climate change creates (immediate or impending) risks for them. It is possible that businesses might agree that climate change can result in a serious consequence for their business, but disagree that that consequence has a high likelihood of occurring (soon). If that is the case, then such a business would not be receptive to the line of argumentation currently implied by the organization of risk-dialogues.

This research demonstrates that many other factors besides risk alone affect businesses' decision-making about climate change adaptation. Thus, the risk-based framing of climate change adaptation potentially closes off other interesting points of entry into a conversation with businesses about climate change adaptation. It would be interesting, per-dialogue, to begin with a more open exploration of businesses' visions for the future, and find a way to integrate climate adaptation in to the topics that businesses are already considering.

Further, this research demonstrates that businesses are at various stages in the process of defining climate change as a problem and working towards adaptation as a solution. This means that for some, guidance with taking climate adaptation action is needed

because they already recognize the risks, while for others, the risks are not yet recognized, and thus other values of climate change adaptation (such as competitive benefits, for example) can be explored in addition to the risk reduction benefits.

9.3.4. TECHNOLOGY CAN STRUCTURE DISCUSSION

Interactive tools (such as a modified version of the online Q-sort used during this research) can be a useful way to begin a content-rich dialogue with various stakeholders. Respondents expressed enthusiasm about the interviewing method, and in a presentation of the research findings with practitioners, they also expressed curiosity about using the concept of a Q-sort to facilitate a dialogue.

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A

Appendix: Approval for Human Research

This research was approved by the Human Research Ethics Committee at TU Delft, see https://www.tudelft.nl/en/about-tu-delft/strategy/integrity-policy/human-research-ethics/ for more information about the requirements.

B

APPENDIX: CONCOURSE AND Q-SET SELECTION

B.1. CONCOURSE SELECTION

B.1.1. SEARCH TERMS AND ENGINES

In order to explore the sentiments and statement that could constitute the concourse, two main type of desk research were used. First, academic literature about the roles of actors in climate change adaptation, and the motivations for climate change adaptation were searched for in the Web of Science database. In addition, searches about the costs and benefits (or, the “business case") of climate adaptation were used in the Google search engine, in order to search for relevant reports from consultancy or government organizations, for example, about the topic. Finally, also in the Google search engine, searches in Dutch for climate adaptive business parks or business parks and climate adaptation, were used in order to find municipality- or park-specific brochures and strategies about making business parks in the Netherlands more climate adaptive.

B.1.2. CATEGORIES OF STATEMENTS

The categories that were used during the concourse selection were “Consequences [of climate change]," “External incentive," “Internal motivation," “Problem definition," “Roles," and “Miscellaneous."

B.1.3. CONCOURSE

The resulting concourse included 341 statements or concepts, which are shown in table B.1.

Table B.1: The concourse statements used as input for the Q-set selection

#	Quote or paraphrasing of statement	Source	Category
1	an analysis of risks, including social, and intermediate objectives... throughout their value chain	[76]	Consequences
2	map the physical effects of climate change (for example through structural changes in weather patterns), and take measures where necessary	[76]	Consequences
3	SMEs see water damage due to heavy rainfall as a problem.	[52]	Consequences
4	SMEs who have already experienced water damage from heavy rainfall are more willing to take preventive measures.	[52]	Consequences
5	SMEs recognize that damage caused by heavy rainfall endangers business continuity and has (major) financial consequences.	[52]	Consequences
6	Disturbance to my business due to heavy rainfall is a problem for me	[52]	Consequences
7	Damage to my business due to heavy rainfall is a large risk	[52]	Consequences
8	Disturbance to my business due to drought is a large risk	[52]	Consequences
9	Damage to my business due to drought is a large risk	[52]	Consequences
10	Disturbance to my business due to heat waves is a large risk	[52]	Consequences
11	Damage to my business due to heat waves is a large risk	[52]	Consequences
12	I am knowledgeable about the weather-related risks my business faces	[52]	Consequences
13	Flood management needs attention	[54]	Consequences
14	Higher incidence of heat waves need attention	[54]	Consequences
15	Increased heavy precipitation needs attention	[54]	Consequences
16	Groundwater salinization needs attention	[54]	Consequences
17	Changing options for transport by water needs attention	[54]	Consequences
18	Increased volatility of groundwater needs attention	[54]	Consequences
19	Improve stormwater management and reduce flood risk is important	[53]	Consequences
20	The private sector should engage in adapting to climate risks because financial effects related to floods, droughts, hurricanes, high temperatures, and other weather-related disasters have risen steadily due to climate change.	[8]	Consequences

21	Private sector awareness of climate risks is increasing, but the number of businesses who have completed risk assessments and evaluated adaptation options are low	[8]	Consequences
22	Legal requirements and investor expectations are beginning to promote, and in some cases, mandate disclosure of climate risks based on their potential financial effect.	[8]	Consequences
23	Reputational risks, in order to address concerns by socially conscious investors	[8]	Consequences
24	The risk is in some seemingly remote future several decades hence and beyond time frames relevant for investment purposes.	[8]	Consequences
25	Significance, potential risks, and necessary response measures.	[8]	Consequences
26	Most companies surveyed recognized current and future risks that climate change may post to their operations, fewer engaged in supplementary activities related to awareness.	[8]	Consequences
27	Potential to mitigate the damages and consequences of climate change by compensating victims.	[8]	Consequences
28	Public perception of risk is low.	[9]	Consequences
29	The localized nature of coastal adaptation public goods gives rise to conflicts of interests between public actors in federal systems.	[9]	Consequences
30	Influential actors may enable their jurisdictions to attract more central government funds, leading to suboptimal levels adaptation investment overall	[9]	Consequences
31	Country risk generally refers to risks that arise from uncertainty in a country's institutional environment, including regulatory and legislative risks as well as currency risks.	[9]	Consequences
32	Liability risks to private investors associated with large-scale coastal adaptation investments can pose significant barriers in light of the uncertainties associated with climate change and sea-level rise.	[9]	Consequences

33	Limiting the liability of private investors, either through such formal policies or informally by acting in practice as the insurer-of-last- resort, can create a moral hazard, disincentivizing private investors from making sufficient coastal protection investments, for example, in land creation or redevelopment projects.	[9]	Consequences
34	Equipment failure, unseasonal temperatures during key building periods leading to property damage and delays, building supply chain risks...	[9]	Consequences
35	Revenue can be generated directly through the sale or lease of land or other assets that have increased in price due to the value created by infrastructure investments.	[9]	Consequences
36	Revenue can be thus generated indirectly through taxes or levies on land or other activities, whose value has increased due to infrastructure investments. (land value capture)	[9]	Consequences
37	Tax increment finance, used largely in the United States and the Netherlands; land value tax; and special levies, such as special assessment districts and impact fees.	[9]	Consequences
38	However businesses will also be exposed to different risks, ranging from economy-wide risks to specific sectoral, industry or company-level risks. The impacts can be both direct, including damage to infrastructure and disruption to production processes, and indirect through disruption to supply chains, and changes in regulation, product demand and business reputation.	[20]	Consequences
39	Reactive coping strategies at times of climate stress, such as distress sale of assets and making staff redundancies.	[20]	Consequences
40	Climate change impacts pose a risk to their products or services.	[56]	Consequences
41	Business parks, in particular, are sensitive because business parks are generally almost fully paved and have little green or water	[86]	Consequences
42	Energy costs for air conditioners, for example, or the loss of labor productivity due to heat	[86]	Consequences
43	Health and money loss due to heat	[14]	Consequences
44	Simply put, companies can insure themselves against minor accidents and absenteeism	[14]	Consequences

45	When the municipality starts laying that type of paving on its own buildings, other entrepreneurs will automatically come by to see if they can apply it themselves.	[14]	Consequences
46	Workers have to take it more easy	[14]	Consequences
47	Use of airconditioning increase	[14]	Consequences
48	The companies that experience flooding say that the drainage around the company are not working optimally.	[83]	Consequences
49	There was also a strong sense that unless business knows about the impact of climate change to their business, they are very reluctant to prepare for, and adapt to, climate change	[49]	Consequences
50	Most of our respondents believed that their business was not at risk and they thought that the connection between their business and climate change impacts was a distant one	[49]	Consequences
51	Irregular patterns of seasons had wreaked havoc on their pricing and the availability of goods	[49]	Consequences
52	Respondents do not know enough about impacts, and the few that did know something about impacts had already been affected as opposed to having a forward-thinking strategy.	[49]	Consequences
53	Physical risks, supply chain risks, raw material risks, product demand risks, financial risks, regulatory risks, reputational risks, litigation risks	[2]	Consequences
54	Extreme events versus gradual changes	[2]	Consequences
55	Assessments of adaptation options are difficult as they need to be based on detailed identifications of impacts at local levels	[2]	Consequences
56	I don't need to invest because my business is flexible enough	[2]	Consequences
57	Offering incentives for resilience enhancing measures	[8]	External incentive
58	Regulation to avoid shifting risk to the public	[8]	External incentive
59	Provide services to understand climate risks	[8]	External incentive
60	Create technologies and business models to make future investments climate resilient	[8]	External incentive

61	Increase greater awareness about the significance of climate change	[8]	External incentive
62	Include the private sector in national and international adaptation efforts	[8]	External incentive
63	Uncertainty in many forms, including actions by competitors, changing customer preferences, and shifts in government policies exist.	[8]	External incentive
64	Unwelcome regulation	[8]	External incentive
65	Regulatory mandates such as building codes and zoning restrictions which directly address the need for cost-effective improvements in building design and location.	[8]	External incentive
66	Lenders and insurers can reinforce or sometimes substitute for regulation through their requirements, viz, refusing to lend or insure buildings that fail to incorporate climate resilience.	[8]	External incentive
67	Investor awareness	[8]	External incentive
68	This concept begins with an assessment of financial vulnerabilities and then evaluates the costs and benefits of options to mitigate the risk, based on estimates of the probability that an event may occur within a given timeframe.	[8]	External incentive
69	Awareness raising, including potential risks and response measures	[8]	External incentive
70	Capacity building to train private entities how to manage climate change risks	[8]	External incentive
71	Activities that change regulation, policies, and institutional infrastructure	[8]	External incentive
72	Public–private partnerships and efforts that promote private sector responses to climate change	[8]	External incentive
73	Entrepreneurship development/encouragement that opens new private sector opportunities for reducing climate vulnerability	[8]	External incentive
74	Engage the private sector in developing products and services to reduce costs and effects of climate change	[8]	External incentive
75	National and international level appeared to depend on the level of engagement of the public sector, and the public attention given to adaptation to climate change	[8]	External incentive
76	Communicating risk, either as a condition for coverage (e.g. by dictating storm-resistant construction) or by differential premiums reflecting the higher probability of damages in some locations or activities.	[8]	External incentive

77	The essential requirement for issuing insurance is confidence in the ability to estimate and hedge against risk	[8]	External incentive
78	The role of trust or inclusiveness	[9]	External incentive
79	The discursive setting on project's ability to address long-term adaptation	[9]	External incentive
80	"De-risk" coastal adaptation project	[9]	External incentive
81	"Mission-oriented" state investment banks	[9]	External incentive
82	Better targeting institutional investors, who have an interest in the long time horizons of coastal adaptation investment.	[9]	External incentive
83	The development of standards and labels for financial instruments that address coastal adaptation	[9]	External incentive
84	Provision of climate information, adoption of sensible regulations and creation of appropriate economic incentives	[20]	External incentive
85	Legal and regulatory drivers, policies and incentive structures, economic and financial incentives, market drivers	[20]	External incentive
86	Climate change adaptation policies at national and regional levels, building standards and/or codes incorporating climate change considerations, local zoning rules incorporating climate change considerations	[20]	External incentive
87	Information and communication technologies, websites/online portals on climate change adaptation and market information	[20]	External incentive
88	Government incentives, finance instruments, climate and adaptation funds, insurance schemes	[20]	External incentive
89	Climate change adaptation training courses or programmes targeted at the private sector, research institutions or centres engaged in climate change research/work, forums/conferences on climate change, agricultural extension and training services, training and technology development centres	[20]	External incentive

90	Climate and hydrological observations, and early warning systems, seasonal weather forecasts, climate change projections, data and information on direct and indirect impacts of climate change, information on, or case studies of, adaptation measures, costs and benefits, information on, or case studies of, community vulnerability, risk and adaptation, adaptation decision support tools and toolkits, standardised risk assessment tools for private sector	[20]	External incentive
91	Identifying no-regret strategies that bring benefits even in absence of future climate change (e.g. improved building codes and limiting development in high risk areas).	[32]	External incentive
92	Risk-based pricing is the practice of charging individual insurance policyholders premiums that directly reflect the risk of losses to which they are exposed (i.e. the technical risk price).	[32]	External incentive
93	Directly finance customer-side adaptation measures that improve the resilience of properties to damage by weather hazards and thus reduce the risk of losses	[32]	External incentive
94	Identification of priorities for risk mitigation, advice on risk transfer options and business continuity or disaster response planning	[32]	External incentive
95	Informing and educating customers about the risks of climate change that they face, and, importantly, about how best to reduce them.	[32]	External incentive
96	The joint project by Lloyd's of London and RMS quantified the impact of climate change on flood risk on individual properties at a number of coastal locations, and the benefits of a variety of adaptation measures, such as building flood defences, elevating property and changing the property's characteristics.	[32]	External incentive
97	Tax incentives, foreign exchange liquidity facilities, loan guarantees; subsidies; establishing roadmaps for developing and disseminating key technologies and services; enhanced communication systems between public and private actors, and public–private partnerships (PPPs) through tools such as risk mitigation instruments, insurance, and equitiese	[56]	External incentive
98	The focus of private-sector engagement in adaptation has been to deal with climate risks, rather than on exploring business opportunities	[56]	External incentive

99	Measures based on individuals' social responsibility, government regulations, and carbon pricing	[67]	External incentive
100	Amplifying climate signals will alter consumers' perceptions, and so will the income growth always embedded in the projections of future emissions growth.	[67]	External incentive
101	Governments will most likely take some concrete actions like including climate change concerns in a variety of development plans such as housing developments, public transportation systems, and enhanced energy production and transmission systems.	[67]	External incentive
102	Voter pressures and financial losses.	[67]	External incentive
103	Drought insurance may encourage current risk reduction because the lower the risk, the lower the premium (and thus there is a price signal incentive). However, it does not necessary align incentives for longer term risk reduction that takes into account the changing nature of the future risk profile	[84]	External incentive
104	Energy label standardization	[86]	External incentive
105	Mandatory building codes	[86]	External incentive
106	Stimulation via insurance	[86]	External incentive
107	Businesses working together	[86]	External incentive
108	Local examples	[14]	External incentive
109	Sustainable entrepreneurial funds	[14]	External incentive
110	Examples	[14]	External incentive
111	Subsidies	[14]	External incentive
112	The demand for green production from customers	[14]	External incentive
113	Smart use of (restructuring) funds that are available	[83]	External incentive
114	The companies interviewed all indicate that they are thinking or considering purchasing solar panels. They also indicate that they are considering a collective approach and are willing to cooperate to pay for the solar panels	[83]	External incentive
115	Green label, external standards	[83]	External incentive
116	Funding, subsidies, tax breaks	[49]	External incentive

117	Provide more information about the effects of climate change	[49]	External incentive
118	Show how climate change is relevant to my kind of organisation	[49]	External incentive
119	Reduce red tape, bureaucracy, regulation	[49]	External incentive
120	Promote new minimum standards	[49]	External incentive
121	Increase public attention	[2]	External incentive
122	Guidelines, regulation	[2]	External incentive
123	I am willing to invest in this with financial assistance from government	[2]	External incentive
124	I don't need to invest because there are no specific policies requiring such action	[2]	External incentive
125	It is very important that I adapt to these changes	[38]	Internal motivation
126	We expect companies to develop a clear business strategy around their role in the climate transition	[76]	Internal motivation
127	SMEs want to preventively limit the risk of water damage.	[52]	Internal motivation
128	SMEs prefer a preventive service to insurance to limit water damage.	[52]	Internal motivation
129	I am interested in preventive measures to reduce my weather-related risks	[52]	Internal motivation
130	Permanent protection and accessibility	[54]	Internal motivation
131	To create extra opportunities to make area more attractive place in which to live, work, relax, and invest	[54]	Internal motivation
132	Adaptation to climate chance is also an economic opportunity	[54]	Internal motivation
133	Being proactive is important	[54]	Internal motivation
134	Being able to adjust is important	[54]	Internal motivation
135	A strong economy for the residential and business communities is important	[54]	Internal motivation
136	Conversation about risk and opportunity	[18]	Internal motivation
137	Create new and enhanced civic spaces	[53]	Internal motivation
138	Attract economic development opportunities	[53]	Internal motivation
139	A high-quality business park is important to me	[26]	Internal motivation
140	A sustainable business park is important to me	[26]	Internal motivation
141	A modern business park is important to me	[26]	Internal motivation
142	Access to the highway is important to me	[26]	Internal motivation

143	Access to the railway is important to me	[26]	Internal motivation
144	My environmental rating is important to me	[26]	Internal motivation
145	Recreational quality, quality of life is important to me	[16]	Internal motivation
146	Traffic flow is important to me	[16]	Internal motivation
147	Parking is important to me	[16]	Internal motivation
148	Function is important to me	[16]	Internal motivation
149	Urban quality is important to me	[16]	Internal motivation
150	Beauty is important ot met	[16]	Internal motivation
151	Safety is important to me	[16]	Internal motivation
152	Comfort is important to me	[16]	Internal motivation
153	Air pollution removal is important to me	[16]	Internal motivation
154	Added real estate value is important to me	[16]	Internal motivation
155	Climate change adaptation focuses on the future by addressing uncertainty and new risks	[16]	Internal motivation
156	Communicating risks	[8]	Internal motivation
157	Mitigation in the form of energy efficiency improvements, which can immediately reduce costs and contribute to profitability	[8]	Internal motivation
158	Efforts to improve climate resilience take the form of risk avoidance and only generate a return if and when an extreme event occurs.	[8]	Internal motivation
159	Perceive consideration of climate risk in their investments and business plans to be unnecessary, technically difficult, and perhaps premature; acknowledging empirical evidence of climate effects and economic losses can be seen as politically sensitive	[8]	Internal motivation
160	When actions have been identified, they may involve trade-offs with short-term profitability (changes in seed varieties), require costly infrastructure (building coastal fortifications), or be difficult to finance	[8]	Internal motivation
161	Climate change is still unproven and a future rather than current risk, and that adaptation is largely dependent on uncertain model results.	[8]	Internal motivation

162	Climate resilience can be a source of competitive advantage	[8]	Internal motivation
163	Tend to focus more on extreme events rather than gradual changes.	[8]	Internal motivation
164	Not fully aware of potential reputational and litigation risks to their businesses.	[8]	Internal motivation
165	Integrating adaptation planning and measures will make their investments and returns less risky and ultimately more profitable	[8]	Internal motivation
166	Without adaptation measures, most development investments in vulnerable countries are not sustainable	[8]	Internal motivation
167	Ethical imperative	[8]	Internal motivation
168	Coastal protection investments are made to avoid damages, and decision-makers are rarely rewarded for avoiding crises.	[9]	Internal motivation
169	Installing flood protection measures, investing in infrastructure to protect assets and processes, investment within supply chains to secure supply availability, integrating climate risk management into business management practices, undertaking vulnerability risk assessments, moving locations and selecting suppliers based on their resilience profiles	[20]	Internal motivation
170	Businesses implementing adaptation strategies remain in the minority and tend to be large corporations in developed countries, mainly within the insurance, agriculture and water sectors.	[20]	Internal motivation
171	Sustainable adaptation strategies, that seek to maintain business operations at existing levels	[20]	Internal motivation
172	General motives for private sector adaptation to climate change include keeping costs down, minimising disruption to production and services, maintaining or increasing value and profitability and improving capacity to do business	[20]	Internal motivation
173	The underlying paradigm of such private sector adaptation “is of economic agents that maximise their profits or welfare in the light of climatic risk”	[20]	Internal motivation
174	Changing demand, diversify their activities, develop new products and services, upgrade their business, adopt new technologies, access new markets and seize new business opportunities arising from climate change	[20]	Internal motivation

175	High upfront capital costs of investing in both short- and long-term adaptation measures.	[20]	Internal motivation
176	The differences in time horizons between climate change impacts and business investment planning, alongside the need for quick returns and short term growth, also present key challenges.	[20]	Internal motivation
177	The business case for investing in adaptation measures to protect themselves against future climate risk may be less apparent	[20]	Internal motivation
178	Anticipatory adaptation planning also requires the ability to make long-term decisions under conditions of uncertainty, which many businesses find difficult even in their core operations.	[20]	Internal motivation
179	Adequate expertise for risk assessment and management is less likely to be found within micro, small and medium enterprises, compared to larger companies	[20]	Internal motivation
180	Presence of a climate change leader/champion within the business (not limited to the business owner); Internal capacity of business; Climate change relevant knowledge/expertise and skills amongst employees; Financial resources; Access to data, knowledge and information; Experience of climatic impacts or awareness of risks	[20]	Internal motivation
181	Adaptation (or risk mitigation) can have significant benefits in terms of helping existing private insurance markets to continue to function.	[32]	Internal motivation
182	The business case for corporate social responsibility.	[32]	Internal motivation
183	Risk-informed decision-making	[32]	Internal motivation
184	Reasonable, relatively quick and predictable returns at acceptable risk	[56]	Internal motivation
185	'Climate risk management' is understood as mainstreaming adaptation in business practice to protect revenues and to prevent future costs from changing climatic conditions.	[56]	Internal motivation
186	The academic or political concept of adaptation as a somewhat artificial concept, what counts is business continuity.	[56]	Internal motivation
187	Corporate social responsibility (CSR) activities.	[56]	Internal motivation

188	A country would view the option of adaptation to be especially important if it perceives global climate action to be too limited	[65]	Internal motivation
189	Smart adaptations based on an individual agent's incentive to respond to climate signals.	[66]	Internal motivation
190	A carbon reducing adaptation is a critical concept that the economic literature has generally overlooked.	[66]	Internal motivation
191	Individuals' voluntary actions arising from self-interest rather than social responsibility	[67]	Internal motivation
192	Global warming alters people's decisions even without a policy intervention through carbon price or government regulations.	[67]	Internal motivation
193	Adaptation strategies to climatic changes arise from climate signals.	[67]	Internal motivation
194	Climate signals are now evident locally and are not susceptible to academic disputes since they are directly tangible and measurable	[67]	Internal motivation
195	The importance of climate signals as an indicator that guides people's decisions lies in the fact that there is little such uncertainty associated with the current (therefore observed) climate signals.	[67]	Internal motivation
196	In response to the personal benefits and costs that are incurred from changing climates, that is, for efficiency reasons.	[67]	Internal motivation
197	Collective action at the community level in an effort to mitigate damage or make the best use of new conditions	[67]	Internal motivation
198	Adaptation to climate change can be 'climate smart', that is, carbon-removing/abating	[67]	Internal motivation
199	Cost considerations of the agents involved.	[67]	Internal motivation
200	Climate signals will amplify with severe damage occurring in some parts of the world, which may then make it necessary and efficient for the concerned parties to employ more costly adaptation strategies.	[67]	Internal motivation
201	Sell products	[67]	Internal motivation
202	Improve their image	[67]	Internal motivation

203	Businesses will employ abatement technologies and cleaner fuels to lower carbon emissions per dollar of output	[67]	Internal motivation
204	Sustainability	[86]	Internal motivation
205	We must better arm ourselves against the harmful effects that climate change will have on our daily lives	[86]	Internal motivation
206	Sustainable entrepreneurship	[86]	Internal motivation
207	Threats	[86]	Internal motivation
208	Opportunities	[86]	Internal motivation
209	Business economic benefits	[86]	Internal motivation
210	Lower energy bill and a higher energy label by building a green roof, but it can also improve the company's presentation	[86]	Internal motivation
211	Progressive modern companies that are involved in sustainability	[86]	Internal motivation
212	Renewable energy is no longer dependent on government subsidies, but can be financed profitably in itself	[86]	Internal motivation
213	to become more climate-robust	[86]	Internal motivation
214	cost savings and image	[86]	Internal motivation
215	To the eye (and towards customers) a much friendlier appearance	[86]	Internal motivation
216	Extinguishing water supplies available	[86]	Internal motivation
217	Creating more shade and thus improving the working climate and is good for bio-diversity	[86]	Internal motivation
218	Healthy working environment	[86]	Internal motivation
219	Attractive outdoor space	[86]	Internal motivation
220	Green workplace	[86]	Internal motivation
221	Renewable energy	[86]	Internal motivation
222	Fight flooding	[86]	Internal motivation
223	Avoid water shortage	[86]	Internal motivation
224	Avoid heat stress	[86]	Internal motivation
225	Reuse water	[86]	Internal motivation

226	Certification	[86]	Internal motivation
227	Ecology and Biodiversity	[86]	Internal motivation
228	Individual appearance	[86]	Internal motivation
229	Collective appearance	[86]	Internal motivation
230	Perceived effects	[14]	Internal motivation
231	Responsibility	[14]	Internal motivation
232	Immediate benefits	[14]	Internal motivation
233	Easy solutions	[14]	Internal motivation
234	Uncertainty	[14]	Internal motivation
235	Efficiency	[14]	Internal motivation
236	Feasibility	[14]	Internal motivation
237	Functionality	[14]	Internal motivation
238	The costs will not be recovered quickly enough	[14]	Internal motivation
239	It is expensive and the period of complaints is quite short, so I think companies would rather turn that money into profit or short-term investments than make long-term investments that are not certain to make it.	[14]	Internal motivation
240	Inspiring vision	[83]	Internal motivation
241	Cycling and walking are not always easy and safe in the area	[83]	Internal motivation
242	A parking problem is experienced in some places in the area	[83]	Internal motivation
243	Walking in the area is made difficult by incomplete walkways and excess foliage	[83]	Internal motivation
244	The employers interviewed think it is messy on the street and that there are many weeds	[83]	Internal motivation
245	There is a nuisance from freight traffic	[83]	Internal motivation
246	Walking routes along the water	[83]	Internal motivation
247	According to the employers, the appearance of the area offers opportunities. Companies are willing to consider modifications to the facades.	[83]	Internal motivation
248	Importance of sustainable entrepreneurship	[83]	Internal motivation

249	Green working environment where the company, employees, neighbors and society could enjoy the benefits	[83]	Internal motivation
250	Cheaper to maintain	[83]	Internal motivation
251	For the benefit of nature in the immediate vicinity.	[83]	Internal motivation
252	high-quality and climate-conscious design of the area.	[83]	Internal motivation
253	Healthier less particulate matter, more oxygen and cooler	[25]	Internal motivation
254	Experience nicer and more pleasant living	[25]	Internal motivation
255	More natural, more biodiversity, less desiccation	[25]	Internal motivation
256	More economical less energy consumption and damage	[25]	Internal motivation
257	More sustainable less use of raw materials	[25]	Internal motivation
258	Safety less flooding	[25]	Internal motivation
259	Lowers the vulnerability to increasingly strict future laws and regulations.	[31]	Internal motivation
260	Lowers operating costs	[31]	Internal motivation
261	Increases the experience and marketing value	[31]	Internal motivation
262	Increases health	[31]	Internal motivation
263	Creates marketing value	[31]	Internal motivation
264	Increases the margin of companies, increases the attraction of talented employees, increases the marketing value and experience	[31]	Internal motivation
265	Long-term real estate value created	[31]	Internal motivation
266	We expect companies to map out the physical effects of climate change (for example due to structural changes in weather patterns) on their company and to take measures where necessary.	[76]	Internal motivation
267	I'd think about planning for climate change if I saw it would save us money	[49]	Internal motivation
268	Climate change in the UK is more of a threat to wildlife & our natural environment than to people & cities	[49]	Internal motivation
269	Show how climate change offers opportunities	[49]	Internal motivation
270	The requirement on companies to spend money in something that will not be of benefit to them in the near future did not make sense to many respondents	[49]	Internal motivation

271	What matters most is for their revenue to be steady for the next few seasons so that their business is robust, and this is considered to be the main foundation of resilience	[49]	Internal motivation
272	Time and resourcing constraints were also important to respondents	[49]	Internal motivation
273	Previous losses	[2]	Internal motivation
274	Adaptation is an opportunity	[2]	Internal motivation
275	"No-regret" and soft adaptation measures. These are often synergistic measures, which are beneficial to companies' business operations while also increasing resilience to climate change impacts	[2]	Internal motivation
276	Hard adaptation measures – these companies principally belong to industry sectors that are already sensitised to climate change impacts	[2]	Internal motivation
277	Companies with less operational flexibility, such as mining businesses, have a particular need to consider future climate change and necessary adaptation measures	[2]	Internal motivation
278	I have previous experience with losses	[2]	Internal motivation
279	Investing now is always better than later	[2]	Internal motivation
280	Global scale, disparate impacts, a centuries-timescale planning horizon, behavioural adjustments, and climate signals	[67]	Miscellaneous
281	Adaptation behaviours by individuals arise from private incentives that shift as a result of alterations in evident climate signals. A portfolio of adaptation strategies that reduce carbon in the atmosphere will function through strategic partnerships between individuals and public sectors, motivated by self-interest and coordination rather than benevolence.	[67]	Miscellaneous
282	The economics of adaptations is rooted in the concept of micro efficiency. That is, private adaptation actions are efficient for the micro agents as they weigh benefits against costs	[67]	Miscellaneous
283	Lack of space	[14]	Miscellaneous
284	Plan per company	[25]	Miscellaneous
285	I have the internal capacity to asses risk	[2]	Miscellaneous

286	Confidence on conditions during the next decade may not hold for decades thereafter	[8]	Problem definition
287	Say what the effects of climate change will be, not what they might be	[49]	Problem definition
288	That the issue is not considered urgent due to the very gradual progression of climate change	[49]	Problem definition
289	I'm more concerned about reducing emissions than damage or disruption from extreme weather events	[49]	Problem definition
290	Climate change impacts are not thought to be imminent and there is a sense that there will be many more warning signs in the future.	[49]	Problem definition
291	Many focus on direct and immediate impacts that may already be evident, such as more frequent and violent natural hazards, rather than more distant and uncertain systemic risks	[2]	Problem definition
292	Future climate change risks–half of the companies interviewed assess longer-term impacts	[2]	Problem definition
293	They are already taking the necessary actions to address climate change risks, and may not implement specific adaptation measures.	[2]	Problem definition
294	Uncertainty is a good enough reason to wait and invest later	[2]	Problem definition
295	This is a future problem, I don't need to invest now	[2]	Problem definition
296	I have previous experiences with managing risks	[2]	Problem definition
297	Entrepreneurs initially take a wait-and-see attitude with regard to the restructuring task. They expect the municipality to take the lead	[15]	Roles
298	Entrepreneurs recognize that the connection between them and the municipality requires attention	[15]	Roles
299	The lease between SMEs and landlords does not adequately address damage liability.	[52]	Roles
300	I believe my insurance covers weather-related risks	[52]	Roles
301	Engage the private sector in developing products and services that can reduce the costs and effects of climate change.	[8]	Roles

302	Private initiatives are not a substitute for governmental adaptation efforts, and indeed, the former are very dependent on the latter for information, supportive policies and regulation, and other support.	[8]	Roles
303	Provision of basic weather and climate information, design, and implementation of risk management policies (e.g. building codes, land use restrictions, and insurance regulations), and disaster planning and preparedness	[8]	Roles
304	They need short- to medium- term projections of localized climate effects, commensurate with the scale of business activity, from sources they trust and understand	[8]	Roles
305	Provider of technology to working in partnership with governments to the assumption of primary responsibility for delivery of adaptation services	[8]	Roles
306	very few insurers are actively engaged in promoting awareness of climate risks, much less helping to promote risk-reducing behaviors	[8]	Roles
307	Coastal adaptation involves flood protection and land-use planning, often both explicit constitutional responsibilities of the government	[9]	Roles
308	Otherwise responsible for land-use planning, for example, setting zoning laws, building codes, and developing master plans	[9]	Roles
309	One example where such barriers have been overcome is the Netherlands, where regional water authorities ("water boards") successfully collect taxes on residents and property owners for coastal protection infrastructure. There, however, the very early historical development of these institutions has been partly driven by the exceptionally long history of exposure coastal flooding in the Netherlands.	[9]	Roles
310	Further, institutional investors with long-term liabilities, that is, pension funds and insurers, have investment horizons that match the long time horizons of coastal adaptation projects. Due to their need to match investments and liabilities, pension funds and insurers, who control a large share of global assets... could be a significant source of private finance	[9]	Roles

311	This public actor selects the coastal adaptation provisioning mode and adaptation provider. A provisioning mode consists of the legal relationship, that is, the distribution of rights and responsibilities, between the public actor and the adaptation provider.	[9]	Roles
312	Adaptation to current climate risks (sustainable or reactive) and anticipatory planning for future climate change	[20]	Roles
313	A key role for government in supporting SME adaptation through business capacity building and information services. Governments and development partners could, for example, support adaptation by domestic private businesses through providing credible and easily accessible scientific information, through weather and climate services, through guidelines, models and tools and through co-financing research and developing new products and services.	[20]	Roles
314	Policies and regulatory and legal frameworks represent further critical external drivers that can stimulate or constrain private sector engagement. Low institutional capacity, poor business environments and policies and incentive structures that distort price signals (e.g. subsidies on certain seeds, fertilisers or irrigation water) can constrain the private sector's ability to respond to climate change risks	[20]	Roles
315	Economic incentives may encourage SMEs to invest in climate resilience and subsidies and tax breaks can be employed by governments to encourage SMEs to adopt strategic adaptation responses	[20]	Roles
316	Market drivers also play a role, as businesses can respond to changing demand, develop new products and services, access new markets and seize new business opportunities from climate change	[20]	Roles
317	Multi-stakeholder or public-private partnerships (MSP/PPPs) to support climate change adaptation decision making, Private sector multipliers – private sector associations/entities (e.g. chambers, business associations), Networks or consortia on climate change adaptation	[20]	Roles

318	Insurers often argue that others, such as property-owners and governments, should bear the costs of risk mitigation measures. The willingness or capacity of insurers, property-owners and governments to pay for risk mitigation measures depends on the question of who accrues the benefit and over what period. It is well known that homeowners might be reluctant to invest significant sums in, say, strengthening their roofs against wind damage if the financial benefit is only realised over an extended period of lower premium payments, particularly if there is no long-term guarantee about the returns.	[32]	Roles
319	Publicly funded adaptation projects such as climate-resilient roads and flood protection barriers require implementation by the (domestic) private sector.	[56]	Roles
320	Government expects international private-sector financing for adaptation	[56]	Roles
321	Employers are expected to provide good working conditions for their employees	[86]	Roles
322	Example set by the municipality	[14]	Roles
323	The municipality could facilitate the underground water management. Sewerage is the legal task of the municipality, this could be a good start to get the companies and the municipality around a table	[14]	Roles
324	The role of the municipality is to take the lead in the layout of the public space	[14]	Roles
325	At more than 30 degrees, the employees of the production department are sent home	[14]	Roles
326	Try pilot	[14]	Roles
327	Covenant with the municipality	[25]	Roles
328	What and how handbook	[31]	Roles
329	Our organisation has insurance that would cover extreme weather, so we don't need to plan much more	[49]	Roles
330	I'd consider planning more carefully for climate change if I saw the Government was doing it	[49]	Roles
331	I'd consider planning more carefully for climate change if I saw other organizations that are like mine doing it	[49]	Roles

332	I'd consider planning more carefully for climate change if I saw my competitors doing it	[49]	Roles
333	Use less jargon and scientific language	[49]	Roles
334	I model my business continuity plan modelled on similar plans by larger companies who they had connections with whether through existing working relationships or via networking	[49]	Roles
335	Respondents tended not to know exactly what their insurance covered, and felt uncomfortable about relying on insurance for unexpected calamities	[49]	Roles
336	It was felt that whatever it was that companies had done so far was due to their own initiative including proactively seeking information... In the view of those we spoke to, no one was forcing business to adapt and, as a result, 'it can't be that important'.	[49]	Roles
337	Respondents expressed the concern that they don't know where to start from and were reluctant to take action until the impacts on their business were better understood	[49]	Roles
338	They would consider planning more carefully for climate change if other companies did, if their customers demanded it, and if it protected their supply chain and revenue	[49]	Roles
339	Government's role was also considered to be important - especially in terms of providing information as well as direct support. While some thought that the large companies in the private sector need to lead as much as the Government, others thought that it was the Government's exclusive responsibility, it's 'duty', to lead on climate change adaptation and to set an example	[49]	Roles
340	Business associations and industry-specific networks were widely mentioned as useful sources of information and support.	[49]	Roles
341	It is the government's role to complete climate change impact analysis, and make clear what my local risks are	[2]	Roles

B.2. Q-SET SELECTION

B.2.1. STATEMENTS CATEGORIZED BY TYPE

The Q-set categories are problem definition, uncertainty, financial value, opportunity value, institutional barriers, and signal barriers, as shown in the last column of table B.2.

Then, a first selection of the Q-set was created, which was then edited for balance and comprehensiveness. This balancing occurred iteratively, via consultation with two persons experienced with the Q methodology. The the same time, the consultation provided feedback that was essential to editing the statements in the Q-set for conciseness and clarity.

B.2.2. VALIDATION OF THE Q-SET

As a final step, the Q set was validated with three industry experts, in order to ensure that the final set of statements were relevant for the topic and P set to be interviewed.

For this concourse and scope of the Q interview (How do you see the role of business in climate change adaptation), it was possible to narrow down the Q-set to 22 statements while adhering to the principles of coverage and redundancy.

Table B.2: Categorization of Q set statements

Number	Statement	Category
1	The risks as a result of climate change are small for my business	Problem definition barriers
2	I take enough climate adaptation measures to keep my business' risks acceptable	Problem definition barriers
3	I will take climate adaptation measures only if I experience negative effects of climate change	Uncertainty barriers
4	There is enough information about climate change to estimate its effects	Uncertainty barriers
5	It is necessary to take climate adaptation measures as soon as possible	Problem definition barriers
6	I am ultimately not responsible for taking climate adaptive measures	Institutional barriers
7	It is the role of my insurer to cover the cost of possible damage as a result of climate change	Institutional barriers
8	It is clear to me what the government expects from businesses with respect to climate adaptation	Signal barriers
9	Regulation prevents taking climate adaptation measures	Institutional barriers
10	Decision-making within my organization prevents taking climate adaptation measures	Institutional barriers
11	It is the role of the government to communicate the risks of climate change	Signal barriers
12	I am only prepared to take climate adaptation measures if someone requires it of me	Institutional barriers
13	I will be prepared to take climate adaptation measures only if there is favorable subsidy available	Financial value
14	Building codes need to change before I can take climate adaptation measures	Institutional barriers
15	By taking climate adaptation measures I can distinguish myself from competitors	Opportunity value
16	By taking climate adaptation measures I can distinguish myself from labor competition	Opportunity value
17	By taking climate adaptation measures I can increase the value of my real estate	Financial value
18	By taking climate adaptation measures I can save money	Financial value
19	By taking climate adaptation measures I can ensure my business continuity	Financial value
20	By taking climate adaptation measures I can protect my assets	Financial value
21	I see planned work as an opportunity to take climate adaptation measures	Opportunity value
22	I think that sustainability is a bigger priority than climate adaptation	Problem definition barriers

C

APPENDIX: Q SORT DESIGN

C.1. Q-SORT DESIGN

C.1.1. DISTRIBUTION: FORCED AND STANDARDIZED

A forced, and standardized distribution was used because it “permits a fully commensurate and less ambiguous comparison of Q sorts" [87]. This means that it is possible to compare multiple Q-sorts directly. Further, for the respondents it offers “convenient and pragmatic ranking" [87] that, to some extent, “reduces the extra burden of formulating their own distribution" [87].

C.1.2. NUMBERING: NORMAL AND SYMMETRICAL

Under the assumption that people feel extremely strongly, positively or negatively, only about a small percentage of a given list of items, a normal distribution is a natural choice. This means that we assume that respondents tend to feel mostly neutral about the majority of items.

Choosing to number the Q-sort columns with positive and negative numbers makes use of the “significance of distensive zero" [87], a “hub from which and around which positive and negative meaning distend" [87]. As a respondent, it makes the Q-sort an intuitive experience.

C.1.3. RANGE AND SLOPE

The design of the Q sort was determined to 9 statements wide and 4 statements tall, with a relatively flat distribution. The flat distribution is appropriate for topics “to which the participant group are likely to particularly expert and knowledgeable" [87]. Because this study is asking participants about their own experiences with climate adaptation and decision making, it is expected that they are able to answer quickly and easily about their own experience and opinion on the matter. This allows for “fine-grained discriminations at the extremes of the distribution where feelings run high" [87].

D

APPENDIX: PARTICIPANT ANALYSIS

D.1. INVITATION TO PARTICIPATE

Participants were approached in a variety of ways: direct calls, direct emails, via business parks, via branch organizations, via business associations, and via social media communications (e.g., LinkedIn, CityDeal newsletter), or the snowballing method. A portion of respondents were identified by tapping into the researcher's colleagues' network (N = 10), where snowball sampling was used to identify further respondents (N = 2), and the remaining respondents were approached directly using contact information that was available online or in response to the social media posting (N = 2).

The following infographic was used to describe the study, see fig. D.1.

Figure D.1: Infographic used in the study invitations

D.2. PARTICIPANT ANALYSIS

The final participant set for the interview study (N = 14) included individuals who completed the Q sort activity during an interview (N = 11) and who completed the Q sort activity independently online (N = 3).

The sectors represented by the participant group are shown in table D.1, the sizes of the organizations represented by the group (as measured by the number of employees) are shown in table D.2, and the the locations of the work places of the participants are shown in table D.3.

Table D.1: A summary of the respondents by sector

Sector	# Respondents
Agriculture, forestry and fishing	1
Industry	4
Construction industry	2
Rental and trade in real estate	1
Advice, research and other specialist business services	2
Health and welfare services	1
Culture, sports and recreation	1
Infrastructure and services	2

Table D.2: A summary of the respondents by size of organization

Size of organization (Est. # of employees)	# Respondents
1-10	3
11-50	3
51-100	2
101-500	1
501-1000	0
1001-5000	4
5000+	1

Table D.3: A summary of the respondents by province

Province	# Respondents
Overijssel	2
Flevoland	1
Gelderland	1
Zuid-Holland	1
Noord-Brabant	6
Limburg	2
Multiple Provinces	1

The participants were also asked questions about their experience with the following effects of a changing climate: heat stress, drought, and heavy rainfall. For each extreme weather event, they were asked to rank their business according to whether or not they thought they were vulnerable to the effect, whether or not they had previously experienced the effect, and whether or not they had taken some action in response to the effect. The summary of these responses are shown in table D.4.

The results show that for the participant group, the climate change effects heat stress and heavy rainfall (with associated flooding) are the two main concerns. Further, the responses show that most respondents (7/11) have come up with a response to heavy rainfall effects on their business, while a minority of respondents (3/11) have come up with a response to heat stress effects on their business.

Table D.4: A summary of the respondents experience to climate change effects

	Heat stress	**Drought**	**Heavy rainfall**	**I don't know**	**Not applicable**
Vulnerable to	11	3	11	0	1
Previously experienced	9	4	10	1	2
Responded to	3	0	7	2	3

The participants were also asked that, in the event they experienced one of these climate change effects, what the effect was on their business, shown in table D.5.

Table D.5: A summary of the effects that the respondents faced

	Effect was...
Nuisance ("Hinder")	5
Nuisance ("Overlast")	8
Damage	7
I don't know	1
Not applicable	2

D.3. DISTRIBUTION OF THE RESPONDENTS OVER THE PROFILES

The demographic information collected about the participants during the interviews is used to describe which participants score significantly on a given profile in table D.6 and table D.7. These tables show that neither the industry nor size of the organization is the determining factor that decides whether a participant's response loads significantly on one factor versus another. That is to say, that generalizations about whether a certain industry or size of organization is more or less open to climate change adaptation than another industry or size of organization are not possible.

Finally, the information about participants business' experience with the effects of a changing climate are summarized in table D.8. This table shows that the businesses who load significantly on factors 1, 2, and 3 tend to have previous experience with climate change effects in the form of extreme weather while businesses who load significantly on

factors 4a and 4b tend to have less experience with climate change effects. It is important not to draw too strong of a conclusion from this data, however, as the sample sizes are too small to be statistically significant.

The alternate ranking method described in section 5.4.3 is indicated for two respondents who performed the sorting activity from primed point of view.

Table D.6: The sector distribution of the participants over the factors

Factor 1	**Factor 2**	**Factor 3**	**Factor 4a**	**Factor 4b**
Business park management	Industry	Construction industry	Culture, sports and recreation	Advice, research and other specialist business services
Infrastructure and services	Health and welfare services	*alternate ranking as SME in construction industry	Industry	
Industry	Business park management			
*alternate ranking as SME located on business park	Infrastructure and services			
	Agriculture, forestry and fishing			

Table D.7: The size distribution of the participants' organization over the factors

Factor 1	**Factor 2**	**Factor 3**	**Factor 4a**	**Factor 4b**
1-10	1-10	11-50	51-100	1-10
11-50* alternate ranking	51-100	11-50* alternate ranking	1001-5000	
101-500	1001-5000 (2)			
1001-5000	5000+			

Table D.8: The distribution of experience with climate change effects over the factors

	Factor 1	**Factor 2**	**Factor 3**	**Factor 4a**	**Factor 4b**
Vulnerable to...	Heat stress (3/4)	Heat stress (4/5)	Heat stress (2/2)	Heat stress (2/2)	Heat stress (0/1)
	Drought (1/4)	Drought (2/5)	Drought (0/2)	Drought (0/2)	Drought (0/1)
	Heavy rainfall (3/4)	Heavy rainfall (4/5)	Heavy rainfall (2/2)	Heavy rainfall (2/2)	Heavy rainfall (0/1)
Have experienced...	Heat stress (3/4)	Heat stress (3/5)	Heat stress (1/2)	Heat stress (1/2)	Heat stress (0/1)
	Drought (1/4)	Drought (3/5)	Drought (0/2)	Drought (0/2)	Drought (0/1)
	Heavy rainfall (4/4)	Heavy rainfall (3/5)	Heavy rainfall (1/2)	Heavy rainfall (2/2)	Heavy rainfall (0/1)
Have responded to...	Heat stress (1/4)	Heat stress (2/5)	Heat stress (0/2)	Heat stress (0/2)	Heat stress (0/1)
	Drought (0/4)	Drought (0/5)	Drought (0/2)	Drought (0/2)	Drought (0/1)
	Heavy rainfall (3/4)	Heavy rainfall (4/5)	Heavy rainfall (0/2)	Heavy rainfall (0/2)	Heavy rainfall (0/1)
The effect was...	Hinder (3/4)	Hinder (1/5)	Hinder (1/2)	Hinder (0/2)	Hinder (0/1)
	Overlast (2/4)	Overlast (4/5)	Overlast (1/2)	Overlast (1/2)	Overlast (0/1)
	Schade (3/4)	Schade (2/5)	Schade (0/2)	Schade (2/2)	Schade (0/1)

E

APPENDIX: THE SUPPORTING INFRASTRUCTURE FOR THE Q STUDY

E.1. INFRASTRUCTURE FOR THE REMOTE Q-STUDY

The supporting infrastructure for the remote Q study (shown in fig. E.1) will be described in the following sections.

E.1.1. RSVP FORM

In email communications with potential participants, this is the first interaction that they have with the study. The RSVP form used in this study is hosted by Qualtrics, via the Qualtrics XM account made available to researchers from TU Delft via the TU Delft institution account. The link to the form is `https://tudelft.fra1.qualtrics.com/jfe/form/SV_8e2BIRs6bxJ2f0J`, which is now inactive to prevent further sign ups for the study. A screenshot of the form is shown in fig. E.2.

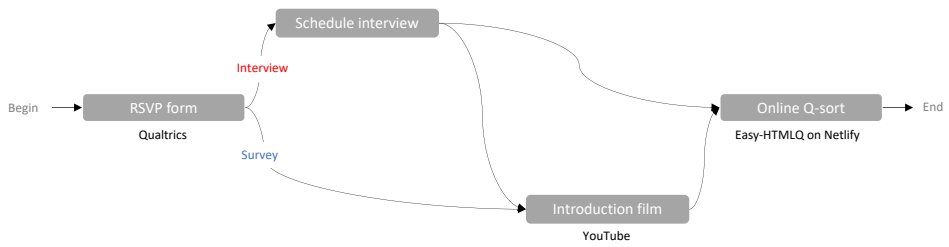

Figure E.1: Infrastructure for the online study and data collection process

Figure E.2: A screenshot of the RSVP form options

In the RSVP form participants are given the option to participate in the study via an interview or a survey, see fig. E.3. If the survey option is selected, they are immediately directed to the materials and link to the online Q-sort, see appendix E.1.2 and see appendix E.1.4. If the interview option is selected, they are directed to a form where their contact information can be submitted for the researcher to use when scheduling an interview.


Beste respondent,

Bij deze het enquêtemateriaal:

1. Een video waarin wordt uitgelegd wat er tijdens het interview gebeurt: https://youtu.be/OrBri7yhc3I. Het duurt 3,5 minuten. Ik zou u willen vragen dit vooraf te bekijken.

2. De link naar de online enquête: https://castanos-scriptie.netlify.app. Het duurt gemiddeld 30 minuten om de enquête te voltooien.

3. In stap 5 is er een vraag "Ik wil graag toelichting tot mijn reactie via een telefonisch gesprek geven." Gelieve het vakje aan te vinken als u wilt deelnemen aan een vervolginterview van 15 minuten. Het zou mij enorm helpen om de resultaten te interpreteren.

Als er nog vragen zijn, hoor ik ze graag (emma.castanos@arcadis.com).

Met vriendelijk groet,
Emma

Figure E.3: A screenshot of the interview instructions, should a participant select to complete the study as a survey

E.1.2. INTRODUCTION VIDEO

An introduction video (`https://youtu.be/OrBri7yhc3I`) was created to overcome the fact that when someone participates via a survey instead of during an interview, the researcher cannot prompt them with an introduction and instructions that would normally be introduced during the beginning of an interview.

The introduction video describes extreme weather events as a result of climate change that are relevant for businesses. It introduces climate change adaptation as a potential solution for these challenges, and it describes how the study is focused on identifying the respondent's perspective on the costs and benefits of climate adaptation, as well as

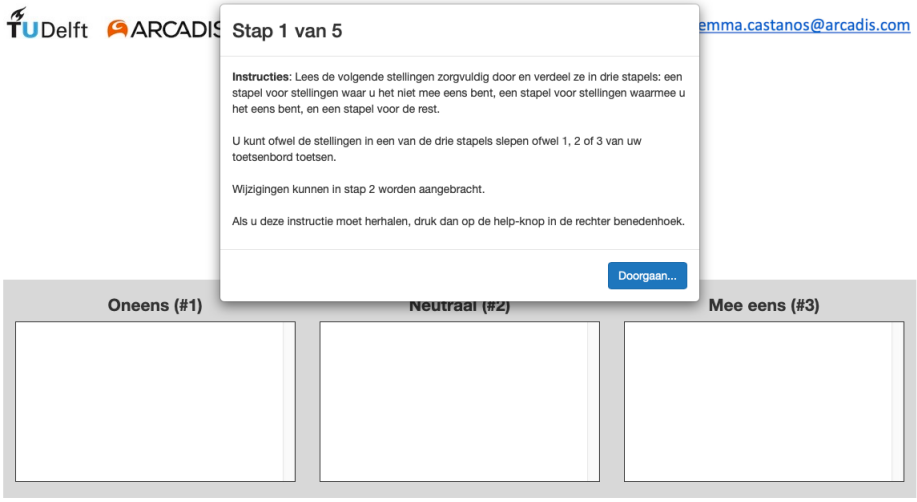

Figure E.4: An example of the instructions that appear during the online Q sort

their expectations about the roles of other actors in the management of business parks.

The video concludes by introducing the main components of the survey, and describing what task the respondent will complete in each step.

E.1.3. INSTRUCTION TEXT

In addition to the instruction video, the accompanying help and instruction text originally included in the "Easy-HTMLQ" HTML files, see appendix E.1.4, were translated to Dutch. These instructions appear at the beginning of each step of the online Q sort. This is another tool to overcome the fact that an online Q sort, especially when completed as a survey, needs clear prompting so that the respondent can complete it independently.

E.1.4. EASY-HTMLQ

The HTML and javascript code template that is hosted on the researcher's website for the purposes of this study was downloaded from the "Easy-HTMLQ" Github page of Shawn Banasick, `https://github.com/shawnbanasick/easy-htmlq`. The files made publicly available by Mr. Banasick were edited in order to match the Q set statements and forced distribution specific to this study.

Mr. Banasick's "Easy-HTMLQ" files are an adaptation of the "HTMLQ" files that were originally developed by aproxima (`https://www.aproxima.de/index.php`) and available on their Github page, `https://github.com/aproxima/htmlq`. The added benefit of Mr. Banasick's version of the online Q sort, is that the Google Firebase console (appendix E.1.6) can be used to store participant-submitted data.

STEP 1

In step 1, the participants are asked to sort the 22 statements of the Q set into disagree, agree, and neutral piles.

STEP 2

In step 2, the participants are asked to drag the statements onto the forced distribution grid.

STEP 3

In step 3, the participants are given a chance to review their sort, and make and changes if necessary.

STEP 4

In step 4, the participants are asked to describe they they ranked their "most agree" and "most disagree" statements as they did.

STEP 5

In step 5, the participants answer some follow-up survey questions, for survey demographic purposes.

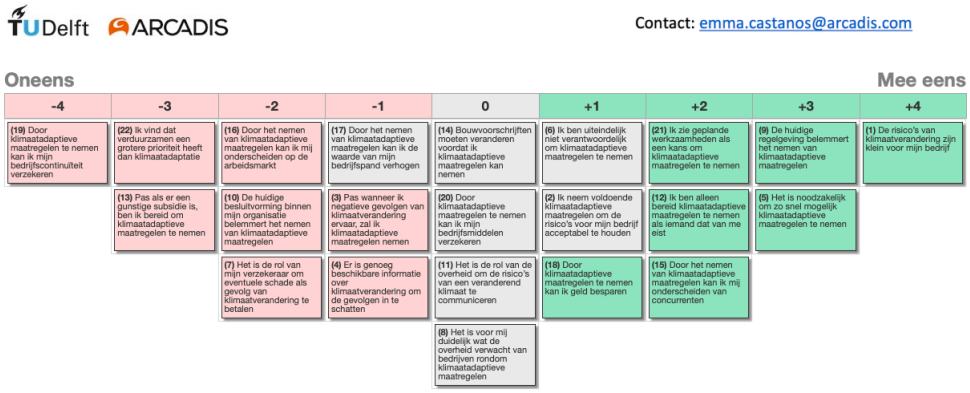

Figure E.5: A screenshot of an example Q sort completed using the “Easy-HTMLQ" web back-end

E.1.5. WEBSITE

For this study, the online Q sort HTML files are hosted on the web hosting platform Netlify, https://www.netlify.com.

The survey and interview for participants to complete for the study are available on the researcher's website, https://castanos-scriptie.netlify.app/#/.

E.1.6. REAL-TIME DATABASE

Google Firebase (https://firebase.google.com) is service used to host the real-time database used for data collection in this study. The saved Q sort and follow-up survey data can be exported as a JSON file for data analysis.

E.2. ONLINE Q-STUDY SUPPORT

Many thanks are in order for Shawn Banasick and Sue Ramlo, who made resources publicly available intended to help researchers set up their online Q studies!

SHAWN BANASICK

Mr. Banasick has developed many Q methodology related resources that are available on his Github page (https://github.com/shawnbanasick), including Ken-Q, which can be used to analyze Q sorts.

SUE RAMLO

Ms. Ramlo has posted tutorial videos on her Youtube channel (https://www.youtube.com/channel/UCeGHkvwvjCwV2FKtxEZ6OqA) that walk through the steps of setting up an online Q study using the resources of Mr. Banasick.

F

APPENDIX: FACTOR ANALYSIS

F.1. FROM Q-SORTS TO FACTORS

F.1.1. CORRELATION MATRIX

Table F.1: Correlation matrix of the Q sorts

Q sort	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	100	33	31	47	-8	31	12	11	0	40	2	31	43	46
2	33	100	30	54	-22	35	2	-23	-2	51	-21	10	33	53
3	31	30	100	8	-46	-2	19	4	17	20	22	14	21	22
4	47	54	8	100	19	46	46	16	30	55	-32	29	69	42
5	-8	-22	-46	19	100	32	34	20	19	15	-10	-2	19	-22
6	31	35	-2	46	32	100	55	28	23	36	-14	26	53	14
7	12	2	19	46	34	55	100	22	50	36	-5	13	68	13
8	11	-23	4	16	20	28	22	100	-9	7	1	44	36	-17
9	0	-2	17	30	19	23	50	-9	100	8	24	-1	19	-12
10	40	51	20	55	15	36	36	7	8	100	-10	22	60	54
11	2	-21	22	-32	-10	-14	-5	1	24	-10	100	-21	-19	-1
12	31	10	14	29	-2	26	13	44	-1	22	-21	100	8	10
13	43	33	21	69	19	53	68	36	19	60	-19	8	100	38
14	46	53	22	42	-22	14	13	-17	-12	54	-1	10	38	100

F.1.2. UNROTATED FACTOR MATRIX

Table F.2: Unrotated factor matrix

Q sort	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
1	0.531	-0.2976	-0.0098	0.1248	0.0549	0.135	0.053

2	0.4579	-0.596	0.0929	-0.31	0.2536	-0.4312	0.0892
3	0.188	-0.1909	0.4608	0.5267	0.2487	-0.02	-0.0094
4	0.8895	-0.0807	-0.0758	-0.082	0.0177	-0.1013	0.086
5	0.1081	0.5463	-0.1886	-0.3596	0.2985	0.2004	0.3698
6	0.6776	0.2738	-0.08	-0.0126	0.0511	-0.0312	0.1451
7	0.6516	0.5341	0.333	0.0569	0.1844	-0.0481	-0.0436
8	0.2219	0.2147	-0.3631	0.2531	0.1764	0.1829	-0.2817
9	0.1897	0.291	0.266	0.0657	0.0546	-0.2527	0.2155
10	0.7284	-0.1878	0.1361	-0.1364	0.0221	0.2014	0.0369
11	-0.1345	0.0661	0.2909	0.3874	-0.1642	0.2623	0.4933
12	0.3723	-0.0689	-0.4255	0.4337	0.2704	-0.0398	-0.0181
13	0.8785	0.1719	0.1387	-0.0438	0.0114	0.2581	-0.1642
14	0.4011	-0.5461	0.2141	-0.1314	0.1744	0.1626	0.0539
Eigenvalues	3.9187	1.6484	0.9316	0.9727	0.4204	0.5596	0.5786
% Explained Variance	28	12	7	7	3	4	4
Cumulative % Expln Var	28	40	47	54	57	61	65

F.2. DETERMINING SIGNIFICANT FACTORS

F.2.1. EIGENVALUES

The **Eigenvalue (Kaiser-Guttman) criterion** uses a factor's eigenvalue as a proxy for its significance, where factors with an eigenvalue greater than 1.00 are significant enough to be kept for further analysis.

Based on the eigenvalues shown in table F.2, this would indicate that factors 1 and 2 are to be kept for rotation.

While this criterion is widely accepted [87, p. 105], there is also the possibility that this cutoff can lead to the exclusion of "significant factors" [11, p. 233]. A complete explanation for the selection of more than two factors is in the main text, see chapter 5.

F.2.2. HUMPHREY'S RULE

Humphrey's rule uses a calculation of the cross-product of a factor's two highest loadings as a proxy for its significance. In order to be deemed significant, the absolute value of the cross-product of a factor's two highest loadings should be greater than twice the standard error [11].

For this study, the calculation of the standard error is:

$$stderror = \frac{1}{\sqrt{\#ofitemsinQset}}$$

$$stderror = \frac{1}{\sqrt{22}}$$

$$stderror = 0.2132$$

And thus, two times the standard error is:

$$stderrorx2 = 0.4264$$

The inequality to evaluate when using Humphrey's rule is:

$$stderrorx2 \stackrel{?}{=} highestloadingxsecondhighestloading$$

Taking factor 1 as an example, the verification using Humphrey's rule is as follows:

$$stderrorx2 \stackrel{?}{=} 0.8895x0.8785$$

$$0.4264 \stackrel{?}{=} 0.8895x0.8785$$

$$0.4264 < 0.7814$$

Thus, the cross product of the two highest factor loadings is greater than twice the standard error, for factor 1.

F.3. FACTOR SELECTION TO ROTATION

F.3.1. FACTOR LOADINGS

The factor loadings after the selection of four factors and the splitting of the bipolar factor are shown in table F.3. The sorts marked with "X" loaded significantly on a factor at $p < 0.05$.

Table F.3: Factor loadings of the factors selected for analysis

Q sort	Factor 1		Factor 2		Factor 3		Factor 4a		Factor 4b	
1	0.114		0.5314	X	0.271		0.1321		-0.1321	
2	-0.077		0.8047	X	-0.1052		-0.071		0.071	
3	0.1538		0.181		0.0381		0.7097	X	-0.7097	
4	0.4606		0.6677	X	0.3631		-0.1424		0.1424	
5	0.3731		-0.2353		0.0159		-0.5293		0.5293	X
6	0.568	X	0.2638		0.3485		-0.1645		0.1645	
7	0.8938	X	0.097		0.1078		0.0633		-0.0633	
8	0.1257		-0.1002		0.5096	X	-0.0759		0.0759	
9	0.4191	X	-0.0579		-0.0486		0.12		-0.12	
10	0.3771		0.6696	X	0.1079		-0.0276		0.0276	
11	0.0673		-0.1983		-0.0326		0.4607	X	-0.4607	
12	-0.0066		0.1449		0.6953	X	0.0899		-0.0899	
13	0.7111	X	0.5017		0.25		-0.0514		0.0514	
14	-0.0348		0.7021	X	-0.1073		0.1289		-0.1289	
%Explained Variance	17		20		8		8		8	

F.3.2. FACTOR SCORE RANKS

The factor score ranks of each statement in the Q-set are shown in table F.4. This table is organized in order of descending consensus. That is, the statement at the top of the table has the most consensus the factor scores (the lowest variance, in the column “Z-score variance"), and the statement at the bottom of the table has the least consensus (the highest variance) among the factor scores.

This table shows that participants are generally in agreement about the role of barriers (statements 9, 10, and 14). Further, they give an early indication that the statements that will distinguish any given profile from another will be about the prioritization of climate adaptation (statement 22), the availability of information (4), the role of the government and insurer (7 and 12), and the benefits of decreased risk of damage and increased marketing value (20 and 15). The complete ranking of all statements from the Q-set with respect to their level of consensus-disagreement are shown in appendix G.

Table F.4: Factor score ranks, ordered by descending levels consensus (captured by the Z-score variance)

			Factor 1		Factor 2		Factor 3		Factor 4a		Factor 4b	
#	**Statement**	**Z-score variance**	**Z-score**	**Rank**	**Z-score**	**Rank**	**Z-score**	**Rank**	**Z-score**	**Rank**	**Z-score**	**Rank**
9	Regulation prevents taking climate adaptation measures	0.087	-0.66	-2	-0.381	-1	-0.173	0	-0.796	-2	0	0
10	Decision-making within my organization prevents taking climate adaptation measures	0.121	-0.624	-1	-1.133	-2	-1.432	-4	-0.869	-2	-0.463	-1
2	I take enough climate adaptation measures to keep my business' risks acceptable	0.143	0.266	1	0.867	1	-0.181	0	-0.09	0	0	0
14	Building codes need to change before I can take climate adaptation measures	0.28	-0.364	-1	-0.006	0	-1.062	-2	0.326	1	-0.926	-2
8	It is clear to me what the government expects from businesses with respect to climate adaptation	0.291	-0.242	0	0.148	0	-0.008	0	-0.326	-1	-1.389	-3

5	It is necessary to take climate adaptation measures as soon as possible	0.315	-0.035	0	0.913	2	-0.354	0	0.724	1	-0.463	-1
16	By taking climate adaptation measures I can distinguish myself from labor competition	0.338	0.413	1	0.9	2	-0.543	-1	-0.163	0	0.926	2
13	I will be prepared to take climate adaptation measures only if there is favorable subsidy available	0.402	-0.933	-2	-1.468	-3	-0.527	-1	-0.724	-1	0.463	1
3	I will take climate adaptation measures only if I experience negative effects of climate change	0.513	0.146	0	-1.247	-3	0.889	2	0.09	0	0.463	1
21	I see planned work as an opportunity to take climate adaptation measures	0.582	1.799	4	0.642	1	1.786	4	0.236	0	0	0
19	By taking climate adaptation measures I can ensure my business continuity	0.589	1.692	3	-0.321	-1	1.07	2	0.959	2	1.852	4

6	I am ultimately not responsible for taking climate adaptive measures	0.618	-1.557	-4	-0.23	0	-0.708	-2	0.796	2	-0.926	-2
1	The risks as a result of climate change are small for my business	0.673	-1.452	-3	-0.62	-1	-0.008	1	-2.082	-4	0	0
11	It is the role of the government to communicate the risks of climate change	0.738	0.754	1	0.899	2	0.897	2	-1.358	-3	0.463	1
17	By taking climate adaptation measures I can increase the value of my real estate	0.739	1.377	3	1.343	3	0.362	1	-0.796	-2	1.389	3
18	By taking climate adaptation measures I can save money	0.899	0.777	2	0.27	1	-0.362	-1	1.358	3	-1.389	-3
15	By taking climate adaptation measures I can distinguish myself from competitors	0.909	1.008	2	1.456	3	-0.897	-2	-0.652	-1	0.926	2

12	I am only prepared to take climate adaptation measures if someone requires it of me	0.976	-0.587	-1	-1.168	-2	-1.243	-3	0.253	1	1.389	3
20	By taking climate adaptation measures I can protect my assets	0.991	0.871	2	-1.163	-2	-1.416	-3	0.959	2	-0.463	-1
7	It is the role of my insurer to cover the cost of possible damage as a result of climate change	1.552	-1.076	-2	-1.474	-4	1.605	3	-1.122	-3	0.926	2
4	There is enough information about climate change to estimate its effects	1.614	-1.351	-3	1.67	4	0.527	1	1.684	4	-0.926	-2
22	I think that sustainability is a bigger priority than climate adaptation	1.759	-0.222	0	0.105	0	1.778	3	1.593	3	-1.852	-4

G

Appendix: Profile interpretation

G.1. Q-SORT INTERPRETATION: MAIN PROFILES

G.1.1. PROFILE 1: STRIKE THE IRON WHILE IT'S HOT

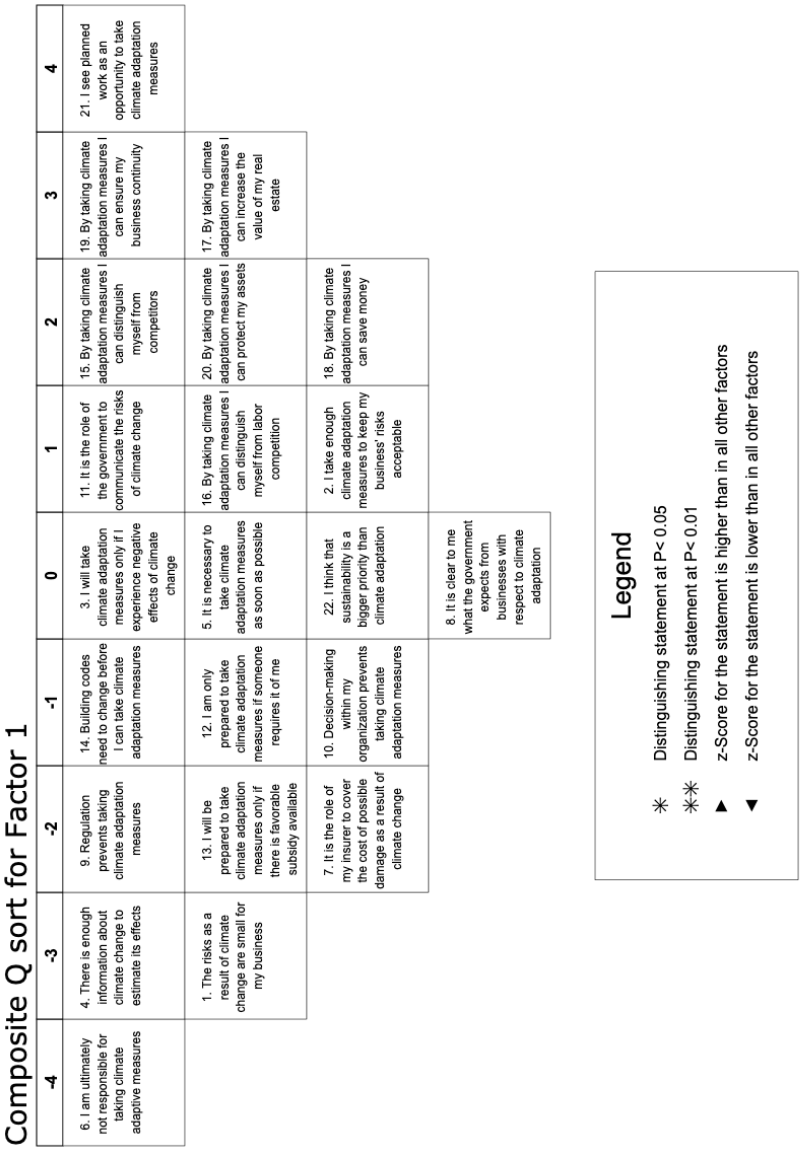

Figure G.1: Factor array for profile 1

G.1.2. PROFILE 2: SEEING THE PROBLEM, BUT NOT SOLUTIONS

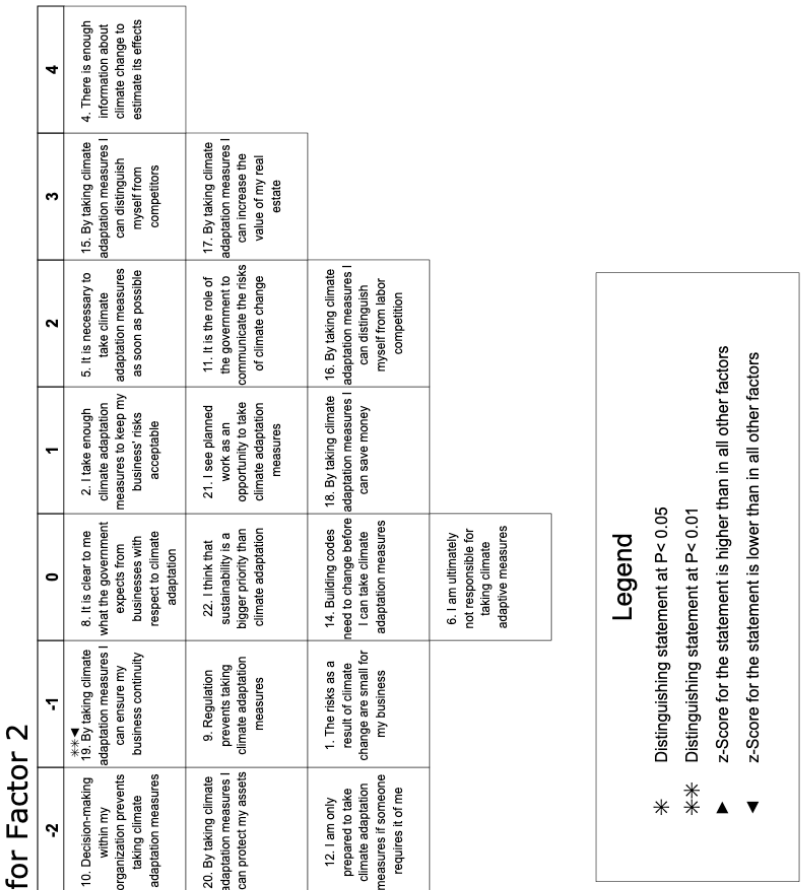

Figure G.2: Factor array for profile 2

G.2. ADDITIONAL PROFILES (3 & 4A & 4B)

For the following profiles it is important to note that during the analysis it was shown that they were not statistically significant. However, upon review of their characteristics,

it was decided to include them in the analysis and discussion of results because they offered unique viewpoints that were not represented in the first two profiles. A discussion of the rationale for the inclusion of the additional profiles as well as the implications of their inclusion can be found in chapter 5 and chapter 8, respectively.

G.2.1. PROFILE 3: WAITING FOR RETURN ON INVESTMENT

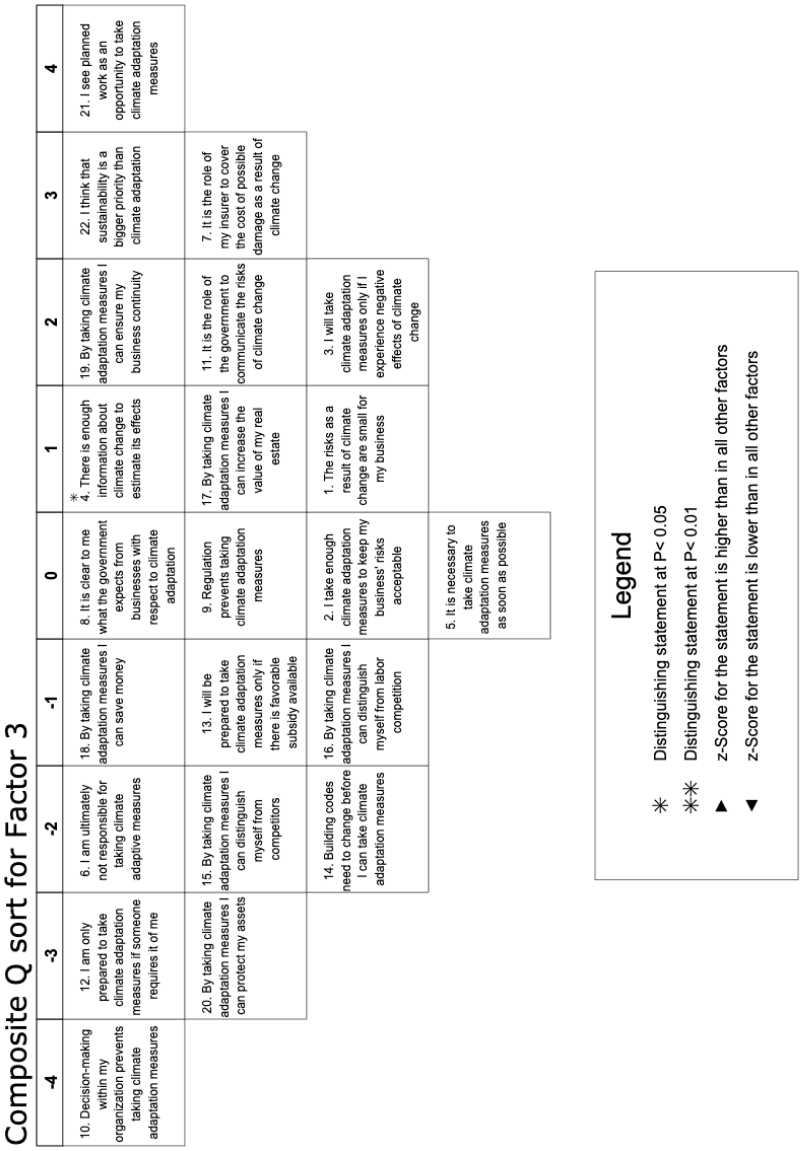

Figure G.3: Factor array for profile 3

G.2.2. PROFILE 4A: RISK NOT YET INTERNALIZED

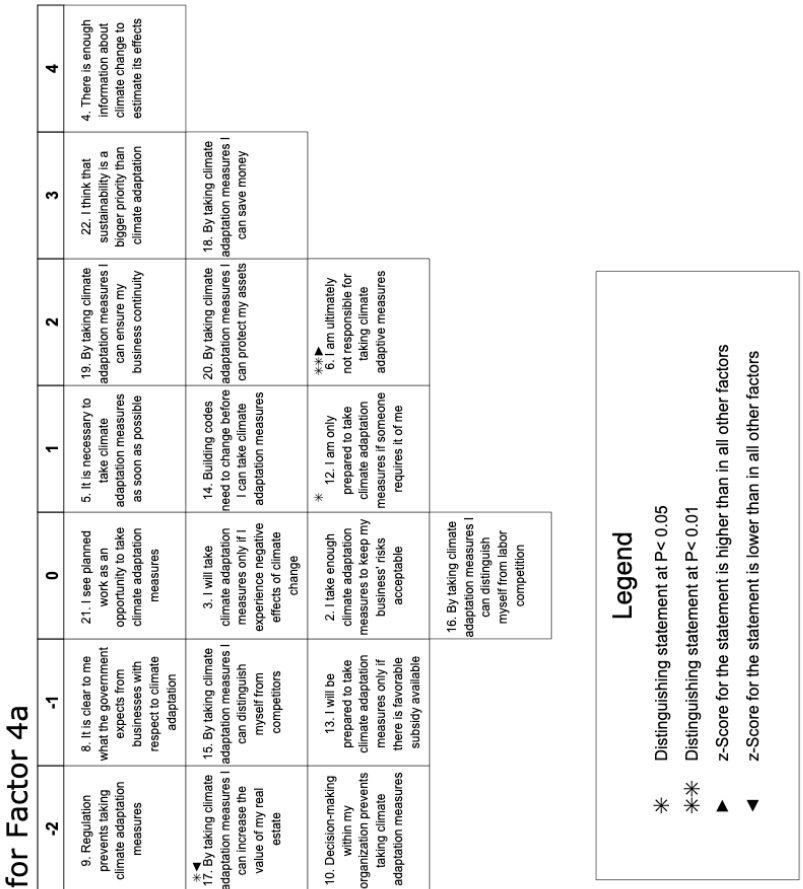

Figure G.4: Factor array for profile 4a

G.2.3. PROFILE 4B: RISK NOT YET RECOGNIZED

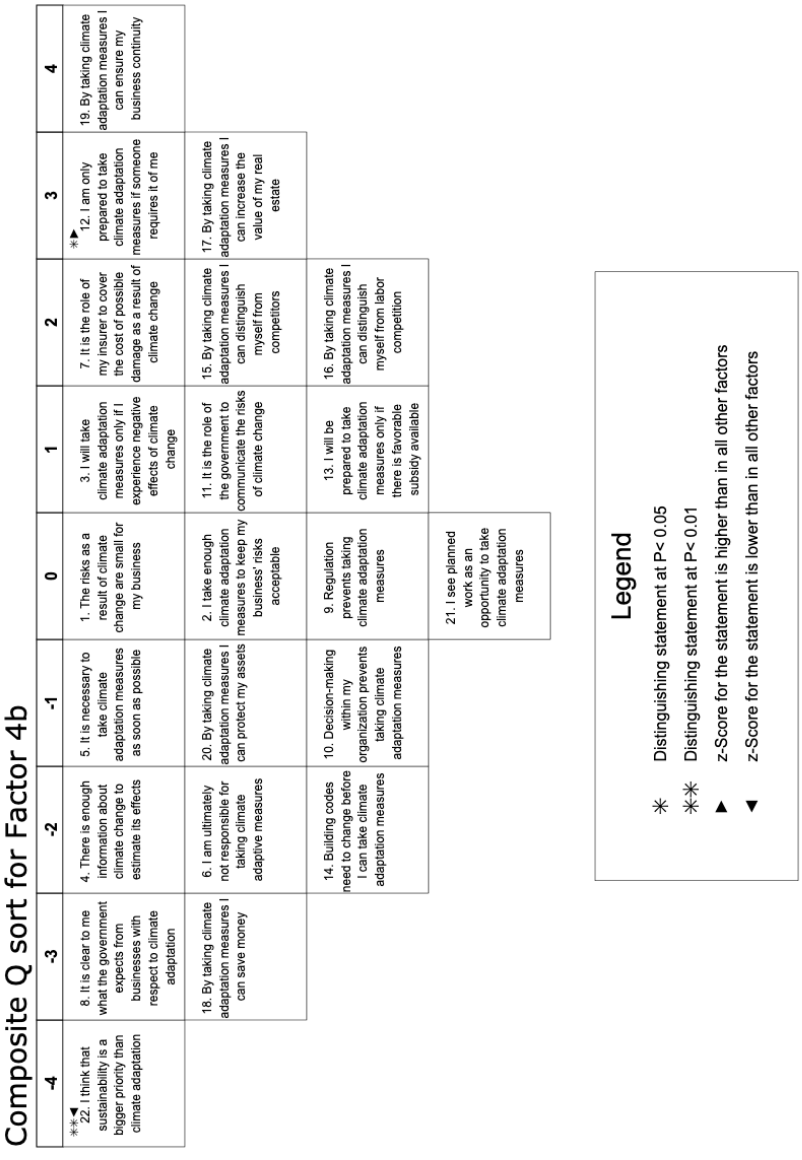

Figure G.5: Factor array for profile 4b