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An aerial photograph showing several white houses with red roofs surrounded by floodwater. A small white boat is docked at one of the houses. A blue plus sign is visible on the left side of the image.

Partnering for climate change
adaptations by Dutch housing
associations

Martin Roders

Partnering for climate change adaptations by Dutch housing associations

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Partnering for climate change adaptations by Dutch housing associations

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Summary

Partnering for climate change adaptations by Dutch housing associations

Introduction

Climate change can no longer be ignored. It is globally recognised that the evidence for climate change is unequivocal and that action needs to be taken in order to address its negative effects.

These effects, such as warmer and drier summers and more extreme rainfall, may threaten the quality of life of those living in urban environments. To limit these threats, a number of climate change adaptation measures can be taken to pre-empt the negative effects of climate change.

The challenge of increasing the implementation of climate change adaptation measures is addressed in this thesis by engaging the construction sector while focusing on the housing stock that is owned and maintained by Dutch housing associations. By implementing climate change adaptation measures, dwellings will become more resilient to some of the effects of climate change, becoming less vulnerable for damage and ensuring the comfort, safety and quality of life of their occupants. Because housing associations are regarded as societal entrepreneurs, these are expected to use resources and commercial profits to achieve societal aims that are in the common interest, such as making timely adaptations, so that changing climatic conditions cannot threaten the quality of their dwellings. Moreover, there are relatively few housing associations compared to the number of houses they own and maintain. In 2012, there were 381 housing associations that owned and maintained a stock of 2.4 million dwellings, representing 32% of the total Dutch housing stock. This means that approaching the Dutch social rented sector was seen as an effective way of generating a greater societal impact.

In the past decade, external influences such as the recent economic crisis and political pressure, have led housing associations to become more cost effective and to make changes in their organisational strategies, which has resulted in the adoption of more integrated project delivery methods, such as partnering. These integrated methods aim to involve the construction sector early in the development of plans so that they can contribute their expertise. This creates a more efficient construction and maintenance process and delivers dwellings of higher quality.

The housing associations cannot pre-empt all the effects of climate change alone. For adaptation measures at the neighbourhood level, they are dependent on collaboration with other stakeholders such as municipalities, but there are measures that can be applied at the building level, which falls within their range of influence. An example is the application of lighter colours on building façades in order to reflect radiation and reduce the air temperature close to the façades. The hazards of overflowing sewage systems caused by extreme precipitation can be reduced by applying measures to retain water temporarily, such as 'green roofs' or to ensure effective drainage such as open pavements. These measures reduce the peak load on the sewage system. Another effective measure is the use of materials that are not negatively affected by water so that if, despite all the precautionary measures, flooding does occur, the consequences would be less severe.

Problem formulation

This research assesses the potential of adopting a partnering approach as a governance tool with which to increase the implementation of climate change adaptation measures like those described above. The housing stock owned by Dutch housing associations is taken as a case study. Involving the construction sector through a partnering approach is promising, since construction companies are the ones who carry out the works. Their early commitment reduces the risks of miscommunication or failure and enhances opportunities for innovative solutions. By doing this, not only do housing associations take responsibility for their actions, but the construction sector as a whole gains more responsibility for solving societal challenges and is enabled to co-create solutions that can then be disseminated more easily.

The main research question is: *How can partnering in construction increase the implementation of climate change adaptation measures in dwellings owned by Dutch housing associations?*

Research approach and results

To formulate an answer to this research question, several separate studies were conducted. First, the characteristics of three types of governance were studied in a literature review, these being hierarchic, market and network governance. Based on these types of governance, many tools have been developed over time, but to increase the implementation of climate change adaptation measures in social housing, not all tools are equally successful, at least not from a theoretical point of view. To improve the implementation of measures, tools could be combined to create a more solid basis for action, and there is room for extra governance tools in the current palette.

Based on the literature review on partnering, it was concluded that this could be classified as a combined 'market' and 'network' type of tool. The market aspect refers to the knowledge of climate change adaptation that is gained by the participating construction companies, which can imply a competitive advantage for them. The network aspect is closely linked to collaboration within a partnering approach. In other contexts, the partnering approach has been shown to remove the barriers of fragmentation in the construction sector; to provide for a more efficient and integral construction process, and to allow for the easier flow of knowledge on climate change adaptation.

Next, the current state of knowledge among housing associations was studied with regard to climate change adaptation measures for the housing stock. A content analysis was conducted on the annual reports and policy plans of the 25 largest Dutch housing associations and revealed that they display no awareness of climate change adaptation in their policy documents. As such, they were categorised as 'unaware'. However, this does not mean that the building stock is not being adapted to climate change, because in the annual reports they state that they have applied climate change adaptation measures, although they do not name these as such. This means that applying adaptation measures is neither impossible nor unrealistic, as long as they are not implemented solely for climate change adaptation purposes, but for other reasons as well, such as energy-efficiency.

In contrast to the corporate policy documents, interviews with individual policy-makers showed that housing associations are aware of climate change at a global scale. However, in relation to climate change adaptation measures in their daily work, such as the impact of flooded streets and overheating interiors of dwellings, awareness is low. They could not name many threats or adaptation measures. However, once they had been made aware of the need for such measures, the employees were fairly well capable of assessing them, even though the implementation of measures was evaluated as unfeasible in most cases. The main reason provided was that the housing associations did not have policy guidelines in place for such adaptation measures. Moreover, in many cases there were financial and/or technical barriers that would have to be addressed first. There was a consensus among employees that all the measures would have a positive effect on the comfort of the dwellings.

Partnering in construction can help to increase the implementation of adaptation measures because it can overcome many of these challenges. For this reason, the way that housing associations and construction companies carry out refurbishment projects in a partnering approach was also studied. The researcher participated in a knowledge exchange project in which housing associations and construction and maintenance companies had formed dyads and carried out a refurbishment project. They exchanged their experiences on a regular basis through interviews and plenary sessions.

In the interviews, employees of housing associations and construction and maintenance companies were asked how they dealt with the success factors for partnering, which were derived from literature. These success factors were trust, leadership, partner capabilities, commitment, conflict resolution, coordination and communication.

Although they did not address all these success factors equally well, the study showed that Dutch housing associations and construction and maintenance companies are indeed capable of carrying out housing refurbishment projects in a partnering approach. This allows for the selection of the construction process as a governance tool with which to implement climate change adaptation measures. These measures are considered new products that can be installed with the aim of improving the technical and functional quality of dwellings. In that sense, they are perceived as product innovations, with the dwellings being the 'products' and/or assets of the housing associations. This perspective corresponds with the definition¹: "[An innovation is] a new idea that is implemented in a construction project with the intention of deriving additional benefits although there might have been associated risks and uncertainties. The new idea may refer to new design, technology, material component or construction method deployed in a project".

Subsequently, the employees of the housing associations and construction and maintenance companies were asked how they dealt with the implementation of innovations using surveys. Although several studies indicate that innovation can benefit when projects are based on an integrated construction process such as partnering, the current study concludes that partnering does not automatically lead to product innovation. Most of the respondents saw partnering itself as the innovative aspect of their projects – i.e. a process innovation. That process innovation required so much attention that there was less emphasis on opportunities for product innovations. This should be taken into account when developing governance tools to encourage the implementation of product innovations in dwellings such as climate change adaptation measures.

Moreover, the choice of partnering as a project delivery method as a governance tool is less likely to resolve issues regarding policy, which remain a barrier for the implementation of measures. In addition, other parties can also become involved, to generate resources for the implementation of measures by housing associations. The adoption of partnering as a project delivery method is therefore not the only possible governance tool.

1 Ling, F.Y.Y. (2003). Managing the implementation of construction innovations. *Construction Management and Economics*, 21(6), 635-649.

To increase the implementation of climate change adaptation measures, two more conceptual approaches were developed by the researcher in addition to the initially hypothesised partnering approach. These additional conceptual approaches involved policy development by housing associations vis-à-vis climate change adaptation measures and collaboration with external actors who face the same challenges in order to enhance efficiency in solving these issues together. The feasibility of the three conceptual approaches was verified by means of a SWOT analysis performed with practitioners from housing associations and construction companies as well as external players such as water authorities, insurance companies and municipalities. The results of the SWOT analysis made it clear that single-pronged conceptual approaches are unlikely to be successful because they involve serious weaknesses or threats. A combination of conceptual approaches is much more likely to remove the barriers that obstruct the implementation of climate change adaptation measures.

The conceptual approaches were therefore combined and renamed as implementation strategies. In on-line questionnaires carried out among all Dutch housing associations, it was assessed if the housing associations found it likely that these strategies would indeed lead to the implementation of climate change adaptation measures. In general, the respondents assessed the feasibility of all strategies as unlikely to neutral. There was no strategy that clearly stood out as more feasible for the implementation of climate change adaptation measures. However, a considerable number of housing associations assessed one or more implementation strategies positively and saw opportunities for the implementation of measures, albeit framed differently, such as measures to increase energy-efficiency or enhance comfort.

Conclusion

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Based on the findings outlined above, the answer to the main research question is: Partnering in construction can increase the implementation of climate change adaptation measures in dwellings owned by housing associations, when it is understood as a catalyst for information-sharing and increased efficiency in the construction process.

By looking for shared interests between housing associations and the construction sector, the chances of implementing adaptation measures increase. However, if other stakeholders are involved as well, and if housing associations embed climate change adaptation in their policy guidelines, the likelihood of implementation would increase even more. Although none of the implementation strategies stood out clearly as the strategy most likely to result in the implementation of climate change adaptation measures, a considerable number of housing associations assessed various implementation strategies positively.

If the construction process becomes more network-based, which is the case when a partnering approach is adopted, many more parties can become involved and contribute to the implementation of climate change adaptation measures. In such a situation, it no longer matters who introduces the subject during the plan development and construction process, as long as it ends up there and action is taken. To implement these measures more easily, the framing is very important. Climate change adaptation is not enough reason in its own right to begin implementing measures. Insulation to prevent overheating in the summer is considered an 'extra' measure - the necessity of which is still questioned by policymakers, for example. However, if the same measure is framed as an energy-saving measure, it is also a cost-cutting measure, which increases the likelihood that policymakers will start making plans to implement it!

Scientific implications of the results

This thesis has contributed to the development of governance tools to increase the implementation of climate change adaptation measures in dwellings, while current adaptation strategies predominantly target the national or local levels of the built environment. Moreover, this thesis has examined the adoption of partnering as a project delivery method and a governance tool with which to bridge the theoretical fields of network governance and integrated construction and maintenance processes. It extends the palette of governance tools that traditionally consists of information tools, tools relating to the division of property rights, incentives and regulatory tools. It has proven that housing associations can successfully adopt partnering approaches. As such, partnering is a feasible approach by which to increase the implementation of innovative measures such as climate change adaptations.

Practical implications

The assessment of the five implementation strategies showed that adapting housing for climate change has a low priority as a separate policy field. It is a relatively new area for policymakers, so they may be reluctant to believe that measures are likely to be implemented. Moreover, many other topics may take a higher priority for them, such as improving energy-efficiency and thereby also the affordability of dwellings, and/or preparing the dwellings for an ageing population. In the literature on climate change adaptation, it is suggested that mainstreaming climate change adaptation is the best course, which implies attaching the adaptation policy to existing policy frameworks. This would make policymakers aware of the topic of climate change adaptation and they could look for synergies between measures that were already planned and measures related to climate change adaptations.

The refurbishment and maintenance process of housing associations provides opportunities for the mainstreaming of adaptation measures. Housing associations are facing an ageing stock that needs to be improved if it is to continue to meet the

ever increasing basic requirements of tenants in terms of quality and comfort and increasingly strict energy-efficiency standards. Since climate change is occurring gradually, there is still time to adapt the building stock gradually, in step with the renovation and maintenance cycles of the housing associations.

Bringing in external players, especially municipalities and water authorities, would appear to be a highly feasible approach, given their shared interest in the quality of life in local areas. Bringing together the construction partners requires governance tools that inform them of the benefits of partnering. Particularly if construction companies are to be responsible for the renovation and the maintenance for the rest of the service life of the dwellings, they could focus on improved design solutions that aim to create resilient dwellings, and/or using materials that would be less affected by the effects of climate change. The role of tenants in the implementation of climate change adaptations is primarily that they might exert 'bottom-up' pressure by requesting action from housing associations. But for this to happen, they would likely need to be informed about the effects of climate change on their dwellings and/or neighbourhoods, in order for them to be motivated to ensure that their homes are climate change resilient.

Samenvatting

Ketensamenwerking voor de implementatie van klimaatadaptaties door woningcorporaties

Introductie

Net als op wereldwijd niveau, zal ook in Nederland het klimaat de komende decennia gaan veranderen. Hierdoor kunnen effecten als droogte, extreme neerslag en hoge temperaturen ervoor zorgen dat het leefklimaat in stedelijke gebieden achteruit gaat. Om die achteruitgang zoveel mogelijk te beperken, zijn er voor de actoren in dit stedelijke gebied maatregelen te treffen met betrekking tot klimaatadaptatie. Een belangrijke partij in het aanbrengen van adaptatiemaatregelen op woningniveau zijn woningcorporaties. Zij beheren met relatief weinig organisaties (ca. 400 corporaties) relatief veel woningen (32% van de Nederlandse woningvoorraad). Door maatregelen aan hun woningen te treffen, dragen zij bij aan het verzorgen van een waardevaste en gezonde woning en een prettige leefomgeving voor de huurders, wat past bij hun maatschappelijke verantwoordelijkheid.

Geen van de gevolgen van klimaatverandering kan worden tegengegaan door de corporaties alleen. Zij zijn afhankelijk van samenwerking met andere instanties zoals waterschappen en gemeenten, maar toch zijn er op woningniveau wel maatregelen te treffen. Een voorbeeld is het aanbrengen van lichte kleuren op gevels zodat zonnestraling gereflecteerd wordt. Hierdoor gaat de omgevingstemperatuur omlaag. De schadelijke gevolgen van overstromende rioleringen door extreme neerslag kunnen worden beperkt door het toepassen van adaptatiemaatregelen die water tijdelijk vasthouden, zoals 'groene daken'. Hierdoor neemt de piekbelasting op de riolering af. Een andere maatregel tegen de schadelijke gevolgen van wateroverlast is het toepassen van materialen die niet aangetast worden door water.

Probleemstelling

Dit onderzoek beoordeelt de potentie van het selecteren van ketensamenwerking als aanbestedingsmethode voor onderhouds- en renovatiewerkzaamheden als governance instrument om de implementatie van klimaatadaptaties te laten toenemen. De Nederlandse sociale woningvoorraad dient als case studie. De betrokkenheid van de bouwsector als gevolg van aanbesteding op basis van ketensamenwerking is

veelbelovend, omdat deze partijen het werk ook daadwerkelijk uitvoeren. Hun vroege betrokkenheid beperkt de risico's op miscommunicatie en faalkosten en het vergroot de mogelijkheden om innovatieve oplossingen toe te passen. Met deze aanpak nemen niet alleen woningcorporaties actie, maar krijgt de hele bouwsector meer verantwoordelijkheden om maatschappelijke vraagstukken op te lossen. Bovendien wordt de bouwsector in staat gesteld om oplossingen te co-creëren en informatie hierover te delen.

De onderzoeksvraag is: *Hoe kan ketensamenwerking zorgen voor een toename in het aanbrenge van klimaatadaptaties aan woningen van woningcorporaties in Nederland?*

Onderzoeksanpak

Om een antwoord op deze onderzoeksvraag te formuleren, zijn meerdere deelstudies uitgevoerd. In een literatuuronderzoek zijn de kenmerken van drie governance benaderingen bestudeerd: de hiërarchische, markt en netwerk governance benadering. Op basis van deze benaderingen zijn veel instrumenten ontwikkeld, maar theoretisch gezien zijn niet alle instrumenten bruikbaar om te zorgen voor een toename in het aanbrenge van klimaatadaptaties door woningcorporaties. Om de implementatie van maatregelen te verhogen, zouden meerdere instrumenten gecombineerd kunnen worden om zo een sterkere aanleiding te bieden om actie te ondernemen. Ook is er ruimte voor extra governance instrumenten om het huidige palet te verbreden.

De literatuurstudie naar ketensamenwerking wijst uit dat deze manier van werken gezien kan worden als een gecombineerd markt en netwerk governance instrument. Het marktaspect verwijst naar een concurrentievoordeel wat deelnemende bedrijven krijgen wanneer ze kennis genereren over klimaatadaptatie. Het netwerkaspect is nauw verbonden met de manier van samenwerken binnen een ketensamenwerkingsaanpak. Ketensamenwerking kan de versnippering in de bouw tegengaan, het zorgt voor een efficiënter bouwproces en het zorgt voor een soepele kennisverspreiding over klimaatadaptatie binnen de keten.

Bewustzijn

Om te achterhalen in hoeverre corporaties in Nederland zich bewust zijn van klimaatverandering en de bijbehorende uitdagingen, is een 'inhoudsanalyse' uitgevoerd op hun beleidsdocumenten. Voor de analyse zijn de 25 corporaties geselecteerd die de meeste woningen beheren. De documenten die zijn gebruikt, zijn de jaarverslagen met daarin een beschrijving van de uitgevoerde projecten en activiteiten van het afgelopen jaar en de beleidsplannen, waarin woningcorporaties hun plannen voor de komende drie tot vijf jaar presenteren.

De meeste woningcorporaties tonen zich niet bewust van klimaatverandering in hun beleidsplannen. Dit betekent echter niet dat de woningvoorraad niet aangepast is. Uit de jaarrapporten bleek namelijk, dat sommige corporaties wel degelijk adaptatiemaatregelen hebben aangebracht, al was dit niet onder de noemer 'klimaatadaptatie', maar bijvoorbeeld als energiebesparingsmaatregel zoals het aanbrengen van isolatie. In de winter houdt dit de warmte binnen en bespaart dus stookkosten en CO₂ uitstoot, maar in de zomer houdt het de warmte buiten waardoor oververhitting kan worden voorkomen en is het een adaptatiemaatregel.

Omdat er geen 'klimaatbewustzijn' zichtbaar is op bedrijfsniveau, zijn 12 beleidsmakers en beslissers van corporaties geïnterviewd om te achterhalen of dit op medewerkersniveau misschien wel het geval is. In tegenstelling tot de beleidsdocumenten van de corporaties zijn de medewerkers zich meer bewust van klimaatverandering, vooral op mondiaal niveau. Zij zijn in staat om enkele gevolgen te noemen, zoals het opwarmen van de aarde en het stijgen van de zeespiegel. Echter, ze zijn zich niet bewust dat er ook op woningniveau gevolgen merkbaar kunnen zijn, die zij zelf geheel of gedeeltelijk kunnen beïnvloeden, zoals oververhitting van woningen.

Het lage adaptatiebewustzijn in de beleidsdocumenten en van de medewerkers, betekent dat de implementatie van maatregelen momenteel niet of nauwelijks plaatsvindt, hoewel dit op basis van hun sociale doelstellingen wel van corporaties verwacht mag worden. Niet alleen het gebrek aan bewustzijn vormt een belemmering voor het aanbrengen van maatregelen. Zelfs als de corporatiemedewerkers weten wat de gevolgen van klimaatverandering zijn en zelfs als ze weten welke maatregelen getroffen kunnen worden, dan nog vinden zij het invoeren van de maatregelen in de meeste gevallen niet haalbaar. De belangrijkste redenen zijn dat woningcorporaties geen beleid hebben dat stuurt op het invoeren van adaptatiemaatregelen, dat er financiële belemmeringen zijn en/of dat het aanbrengen van maatregelen technisch niet haalbaar lijkt. Een belangrijk argument om maatregelen juist wel in te voeren, is dat de deze een positieve invloed hebben op het binnenklimaat van de woning en het leefcomfort van de bewoners.

Ketensamenwerking

Het betrekken van de bouwsector vroeg in het bouwproces gebeurt momenteel op kleine schaal door woningcorporaties. Om het huidige bouwproces, gekenmerkt door hoge faalkosten, communicatie en coördinatieproblemen te vernieuwen en te verbeteren, worden projecten in ketensamenwerking uitgevoerd. Ketensamenwerking is: "(...) de samenwerking tussen partners, betrokken bij het bouwproces, met als doel de prestatie van de gehele keten te optimaliseren". De genoemde prestatie heeft zowel betrekking op de kwaliteit van de woning, als op bijvoorbeeld de winstgevendheid van de uitvoerende partijen. Doordat de efficiency binnen een dergelijk proces toeneemt, ontstaat er financiële ruimte om adaptatiemaatregelen te financieren en doordat de

uitvoerende partijen vroeg in het project betrokken worden, kunnen zij hun expertise inbrengen om het technisch mogelijk te maken om maatregelen door te voeren.

Aan de hand van een aantal succesfactoren uit de literatuur is onderzocht hoe zeven koppels van woningcorporaties en hun bouw- en onderhoudspartijen omgaan met ketensamenwerking. De partijen deden mee aan een kennisuitwisselingsproject waarvoor zij in de periode 2011-2012 een renovatieproject in ketensamenwerking uitvoerden.

De succesfactoren die goed zijn ingevuld, zijn leiderschap, alle projecten worden ondersteund door de directies van de ketenpartners; communicatie, in alle projecten is een duidelijke overlegstructuur opgezet; en partnercapaciteiten, in de meeste projecten zijn onder- en nevenaannemers als partners geselecteerd op basis van goede ervaringen uit eerdere projecten of ze zijn geselecteerd op basis van heldere kwaliteitscriteria. De succesfactor coördinatie verdient verdere uitwerking, want niet ieder koppel heeft de projectdoelen helder geformuleerd, waardoor gemeenschappelijke belangen minder goed in beeld komen. Lange termijn 'commitment' dient ook nog verbeterd te worden. Ofschoon in drie projecten de samenwerking tot stand kwam tussen partijen die elkaar kenden van projecten uit het verleden, zijn er voor de toekomstige onderhoudsfase geen bindende afspraken gemaakt in geen van de projecten. Ook de succesfactor conflictbeheersing dient nader vormgegeven te worden. Het onvolledig invullen van deze succesfactor kan voortkomen uit het feit dat de projecten nog als experiment zijn beschouwd waarbij alle partijen de wil hebben om het tot een goed einde te brengen. Op de langere termijn bestaat echter het risico dat conflicten optreden. Het kan ook te maken hebben met een hoog niveau van vertrouwen dat aanwezig is tussen de partijen. Dit wijst erop, dat partijen vrijwel continu bezig zijn geweest met het werken met en invullen van de laatste succesfactor: vertrouwen. Dat was bij alle partijen bewust of onbewust aanwezig.

De deelnemers aan het kennisuitwisselingsproject vonden dat het belangrijkste voordeel van werken in ketensamenwerking was dat kosten en planning beter beheersbaar en voorspelbaar waren. Ze gaven verder aan, dat ze meer kwaliteit voor hetzelfde geld kregen en dat de medewerkerstevredenheid toenam.

Hoewel niet veel woningcorporaties in Nederland ervaring hebben met het uitvoeren van renovatieprojecten in ketensamenwerking, kan geconcludeerd worden dat degenen die het wel gedaan hebben, aangetoond hebben dat het een haalbare projectaanpak is.

Innovatie

.....

De deelnemers van het kennisuitwisselingsproject zijn in een enquête gevraagd naar de innovaties die zij in het ketensamenwerkingsproject hebben doorgevoerd. Ook is gevraagd naar de voorwaarden om innovatie goed door te kunnen voeren.

Klimaatadaptatie maatregelen kunnen namelijk beschouwd worden als innovaties volgens de definitie “Een innovatie is een nieuw idee dat in een bouwproject wordt geïmplementeerd (...). Het idee kan betrekking hebben op een nieuw ontwerp, techniek, materiaalcomponent of bouwwijze toegepast in een project”. Gebleken is, dat ketensamenwerking niet automatisch leidt tot innovaties op het gebied van betere woningen en dus zeker niet tot woningen waaraan klimaatadaptatiemaatregelen zijn aangebracht. De meeste deelnemers zagen aan het einde van het project de andere manier van samenwerken als de belangrijkste innovatie. Dit week af van hun verwachtingen aan het begin van het project, toen zij een beter product (de woning) als doelstelling hadden.

Ketenintegratie kan onder bepaalde voorwaarden, zoals het omschrijven van werkzaamheden op basis van prestaties om innovatie te stimuleren, bijdragen aan de implementatie van klimaatadaptaties. Maar omdat het bouwproces door veel partijen zelf als innovatief beschouwd wordt, moet daar eerst veel tijd en energie in gestoken worden, waardoor er weinig capaciteit overblijft voor het invoeren van productinnovaties om de woningen klimaatbestendig te maken.

Concept strategieën

Hoewel ketensamenwerking kan bijdragen aan het wegnemen van de barrières van technische complexiteit en financiering, vormt het ontbreken van een beleidskader nog steeds een hindernis voor het implementeren van maatregelen. Ook zijn er meer mogelijkheden om de financiële barrière te verwijderen.

Om het palet aan governance strategieën voor klimaatadaptatiemaatregelen te verbreden, zijn drie concept strategieën ontwikkeld. De eerste is het ontwikkelen van (voorraad)beleid waarin klimaatadaptatie is opgenomen. Een tweede is het intensief samenwerken met partijen als gemeentes, waterschappen en verzekeraars omdat zij ook (financieel) voordeel kunnen hebben bij een klimaatrobuuste voorraad. De derde strategie is gericht op het uitvoeren van projecten in ketensamenwerking, vanwege de beoogde toename in efficiency en de vanwege de technische kennis die vroeg in het bouwproces aanwezig is.

Met specialisten uit de praktijk is op de drie concept strategieën een sterkte-zwakte analyse uitgevoerd. Deze wees uit, dat ze afzonderlijk niet tot implementatie van maatregelen leiden. Daarom zijn ze bij elkaar gevoegd tot 4 implementatiestrategieën, inclusief een extra strategie waarin de huurder een centrale rol heeft.

Een internetenquête onder 379 woningcorporaties in Nederland heeft uitgewezen dat de effectiviteit van de implementatiestrategieën niet door alle respondenten wordt onderkend. Hoewel er geen strategie uitspringt als meest haalbaar, blijkt wel, dat veel corporaties minimaal één strategie positief beoordelen.

Conclusie

Gezien het voorgaande is het antwoord op de onderzoeksvraag: Ketensamenwerking kan ervoor zorgen dat er meer klimaatadaptaties aangebracht worden aan corporatiewoningen door de manier van werken te beschouwen als katalysator voor het verspreiden van informatie onder de samenwerkingspartners en door een verhoging van de efficiëntie van het bouwproces. Door de belangen van woningcorporaties en bouw- en onderhoudsbedrijven op elkaar af te stemmen, neemt de kans op implementatie van adaptatiemaatregelen toe. Indien andere stakeholders ook in het proces betrokken worden en indien woningcorporaties klimaatadaptatie in hun beleid opnemen zal de kans op implementatie van maatregelen nog verder toenemen.

Als er in ketensamenwerking gewerkt wordt, is het bouwproces meer netwerk georiënteerd en zijn er meer partijen betrokken in de planontwikkeling en uitvoering, die kunnen bijdragen aan de bevordering van de implementatie van adaptatiemaatregelen. In dat geval maakt het niet meer uit wie het onderwerp klimaatadaptatie ter tafel brengt, maar dat het onderwerp op tafel komt. Om de maatregelen op een eenvoudige manier geïmplementeerd te krijgen is het echter belangrijk dat ze op een goede manier 'geframed' worden. Dat wil zeggen dat er een goede reden gevonden wordt om ze te implementeren. Dit hoeft niet per se omwille van klimaatadaptatie te zijn, maar het mag ook vanuit het oogpunt van energiebesparing of comfortverbetering zijn. Bijvoorbeeld, isolatie om oververhitting in de zomer tegen te gaan wordt beschouwd als een 'extra' maatregel waarvan de noodzaak betwijfeld wordt. Maar als deze maatregel als energiebesparingsmaatregel aangemerkt wordt, bespaart het geld en daardoor wordt het een kosteneffectieve maatregel!

Wetenschappelijke implicaties van de resultaten

In dit boek zijn governance instrumenten ontwikkeld om de implementatie van klimaatadaptatiemaatregelen op gebouwniveau te bevorderen, terwijl de meeste huidige adaptatiestrategieën zich vooral richten op het nationale of stedelijke niveau van de gebouwde omgeving. Verder ziet dit boek het kiezen voor ketensamenwerking als een governance instrument, waardoor het een brug slaat tussen de wetenschapsgebieden governance en bouwprocesinnovaties. Het verbreed het palet van governance instrumenten dat bestaat uit informatieve instrumenten, instrumenten met betrekking tot verdeling in eigendomsverhoudingen, (financiële) stimuleringsinstrumenten en regelgeving. De studie naar ketensamenwerking heeft aangetoond dat woningcorporaties en bouw- en onderhoudsbedrijven op deze manier projecten kunnen uitvoeren, waardoor ketensamenwerking een haalbare methode is om de implementatie van innovaties zoals klimaatadaptaties te bevorderen.

Praktische implicaties van de resultaten

De beoordeling van de vijf implementatiestrategieën heeft aangetoond dat adaptatie een lage prioriteit heeft als apart beleidsveld. Het is een relatief nieuw onderwerp voor beleidsmakers, waardoor zij het niet zo waarschijnlijk vinden dat adaptatiemaatregelen snel ingevoerd worden.

Bovendien zijn er andere onderwerpen die een hogere prioriteit kunnen hebben, zoals het verbeteren van de energieprestatie vanwege de betaalbaarheid van de woningen, of om de woningen aan te passen aan de levenssituatie van oudere bewoners. In de literatuur over klimaatadaptatie wordt gesuggereerd om adaptatie mee te koppelen, dat wil zeggen, het adaptatiebeleid aan te sluiten bij een bestaand beleidsveld. Hierdoor worden beleidsmakers bewust van het onderwerp 'adaptatie' en kunnen ze zoeken naar synergiën tussen adaptatiemaatregelen en maatregelen voor deze andere onderwerpen.

Het onderhouds- en renovatieproces van woningcorporaties biedt kansen om adaptatiemaatregelen mee te koppelen. Woningcorporaties hebben te maken met een gedateerde woningvoorraad. Deze dient voortdurend verbeterd te worden om in de pas te blijven lopen met de alsmaar toenemende basiskwaliteit die door huurders – en de maatschappij in haar algemeenheid – verwacht wordt. Ook moeten de woningen aan steeds strengere energieprestatie eisen voldoen. Omdat klimaatverandering geleidelijk optreedt, is het nog goed mogelijk om de woningvoorraad aan te passen en aansluiting te zoeken bij de renovatie- en onderhoudscycli van woningcorporaties.

Het betrekken van externe partijen, vooral gemeentes en waterschappen, lijkt in grote mate haalbaar, gezien hun gemeenschappelijke belangen op het gebied van leefbaarheid in buurten. Voor het samenbrengen van bouwpartijen zijn governance instrumenten nodig die hen over de voordelen van ketensamenwerking informeren. Vooral als een bouw- of onderhoudsbedrijf verantwoordelijk wordt voor de renovatie en het onderhoud van een woning gedurende de rest van de levensduur, kan het zich richten op verbeterde ontwerp oplossingen en detailleringen voor klimaatrobuuste woningen. Ook kunnen materialen geselecteerd worden die beter bestand zijn tegen de gevolgen van klimaatverandering.

De huurders kunnen hun rol pakken door 'bottom-up' te vragen om het aanbrengen van maatregelen aan hun woningen. Daar hebben zij wel informatie nodig over de invloed en gevolgen van klimaatverandering op hun eigen woning of woonomgeving, zodat zij zich met de gevolgen kunnen identificeren.

1 Introduction

Climate change is causing the global temperature to rise. As a consequence, warmer and drier summers and more extreme rainfall are occurring. By adapting their dwellings to climate change, housing associations are taking measures to pre-empt the negative effects of climate change. By doing so, these dwellings are becoming more climate-resilient, making them less vulnerable to damage and ensuring the comfort and safety for the tenants. This process means that climate change adaptation is part of maintaining the future value of the building stock of housing associations and it is also part of fulfilling their social remits.

This thesis considers how housing associations in the Netherlands might handle the implementation of climate change adaptations in their building stock. The feasibility of using the construction and maintenance process to increase implementation is explored. After all, the construction sector, which is made up of those companies responsible for the design, construction and maintenance of buildings, are the ones who carry out the work and apply the physical measures that make dwellings climate-proof.

In this chapter, the central topics of this thesis are introduced: climate change and adaptation to climate change, as well as the organisational strategies of Dutch housing associations regarding maintenance and refurbishment work. Then the problem formulation of this thesis will be explained, as well as its aim, the research questions that it will address and its value for science and society. Subsequently, the research approach will be explained, providing an overview of the whole thesis. Since the research in this thesis was part of a larger programme, Knowledge for Climate – Climate Proof Cities, a brief explanation about this programme concludes this chapter.

§ 1.1 Climate change

§ 1.1.1 Impact and resilience

There is clear scientific evidence of a changing climate at both the global and national levels. The Intergovernmental Panel on Climate Change (IPCC) states that “warming of the climate system is unequivocal” and that: “the human influence on the climate

system is clear". (IPCC, 2014). The top 10 warmest years in global terms since records began included 9 years in the 21st century (NOAA, 2014). The Royal Dutch Meteorological Institute (KNMI) reported that the long-term mean temperature in the Netherlands rose by 1.8°C between 1901 and 2013, while the global increase was 0.9°C. The period 2005-2014 included five years that were ranked among the ten warmest years since records began in 1706 (KNMI, 2014).

The expected effects of climate change are numerous. The sea level will rise, threatening low-lying areas and river deltas (Klein Tank *et al.*, 2014). This effect will be more pronounced in countries where major rivers handle more run-off water in winter (Bessembinder, 2008), threatening adjacent areas, as is the case in the Netherlands. All in all, the areas at risk of sea and river flooding include 55% of the land area of the Netherlands (PBL, 2011). Another impact is higher peak precipitation, which can cause localised flooding (Bessembinder, 2008).

Temperature increases will affect both the natural environment (PBL, 2009) and the climate in cities (Salcedo Rahola *et al.*, 2009). Rather than the costly damage to properties caused by natural catastrophes such as flooding, the main effects of heat in urban environments relate directly to human health issues, especially among vulnerable groups such as elderly people (Stafoggia *et al.*, 2006). Expected hazards include heat stress, summer smog, and an increase in allergies and viruses. One positive effect of a warmer climate is reduced illness and mortality in winter (PBL, 2009). With an increase expected in the world's urban population (UN, 2012), including that of the Netherlands (Groenemeijer, 2012), it is important to focus on the threat that climate change poses to cities and their urban environment. Urban environments and buildings can be adapted to make them more climate-resilient, meaning that they have the capacity to "(...) cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation" (IPCC, 2014).

§ 1.1.2 Adapting buildings to climate change

Buildings and urban environments are subject to constant adaptation during their lifespan (Straub, 2001; Pereira Roders, 2007). These adaptations may simply counteract natural degradation, but they can also accommodate changing user requirements, or enhance quality, comfort or luxury. Lately, buildings have been subject to adaptation in order to improve their energy performance and reduce CO₂ emissions.

This thesis focuses on another type of adaptation, namely adaptations in preparation for climate change, defined as: “The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities” (IPCC, 2014). Climate change adaptation may occur as a natural or spontaneous reaction to the effects of climatic change that are already occurring. This situation is called ‘autonomous adaptation’ (Lindley *et al.*, 2007). If action is taken according to a plan that is defined as preventing damage or disturbance caused by the impact of climate change, it is known as ‘planned adaptation’ (Lindley *et al.*, 2007). Another distinction can be made on the basis of the timing relative to the occurrence of impacts. Adaptation can be considered ‘anticipatory’ when it takes place before any impact has occurred, and it can be considered ‘reactive’ if it takes place after the impacts have occurred (Fankhauser *et al.*, 1999).

An example of a planned climate change adaptation measure for buildings is the application of lighter colours on the facades to reflect solar radiation. This lowers the temperature in the vicinity of the facades (Watkins *et al.*, 2007). The application of ‘green roofs’ that store water temporarily to reduce the peak load on the sewage system (MWH, 2012) can also be considered an adaptation measure, because this reduces the harmful effects of sewage overflow caused by extreme precipitation. Another measure is the use of materials that are not affected by water (MWH, 2012), to prevent damage to buildings caused by water ingress.

§ 1.1.3 Governance of adaptation

Because of the significant financial damage and socio-economic disturbance in urban environments that could be caused in the (near) future by the impact of climate change, simply waiting for property owners to implement autonomous or reactive adaptations involves a high degree of risk. Governance strategies therefore need to be developed to increase anticipatory climate change adaptation measures.

A framework that unites all these strategies still requires development. A major reason for this is that the topic of climate change adaptation remains in an early stage of conceptual development compared to, for example, climate change mitigation (Biesbroek *et al.*, 2010; Wilson and Termeer, 2011), which is defined as “a human intervention to reduce the sources or enhance the sinks of greenhouse gases” (IPCC, 2014). In the case of mitigation, research efforts have resulted in many governance strategies, which, if not equally successful (www.climateactiontracker.org), have shown that they can raise general awareness of climate change mitigation among policymakers and stakeholders at all levels. The Kyoto Protocol is a prime example

of a governance strategy on a worldwide scale, the European 'Energy Performance of Buildings Directive' (EP, 2002) is an example at the European level, and the 'Energy Performance Coefficient', which is part of the building code in the Netherlands, is an example at the national level.

The governance framework for climate change adaptation is still evolving. In 2009, in its White Paper on adaptation to climate change, the European Union proposed the establishment of a European Adaptation Strategy (CEC, 2009), based on the National Adaptation Strategies (NAS) of the Member States. These were given until 2013 to prepare a national strategy, but the progress made by the Member States was too limited to establish the European Adaptation Strategy. Although many of the 2009 recommendations have been implemented and several NASs have been developed, hardly any of these provide for concrete implementation plans or monitoring and evaluation programmes. The Member States have now been given until 2017 to prepare their NASs (EC, 2013). This date is also the cut-off point for the Dutch national strategy (CCPC, 2013).

The absence of a large-scale climate change adaptation policy does not necessarily mean that no adaptation measures have been applied in urban environments. Policies on more public green space and more open water have already been introduced in the Netherlands, Germany, the United Kingdom and elsewhere (Runhaar *et al.*, 2012). So although it would seem that the application of measures is feasible, examples of this seem largely incidental. Enserink *et al.* (2010) state that for the large-scale application of adaptation measures, a policy framework is necessary. Since there is no policy, it is unlikely that climate change adaptation measures will be purposefully applied in either the urban environment or for dwellings, leaving them vulnerable to the impacts of climate change and facing a high risk of negative consequences. To make a living environment climate-resilient, climate change adaptation measures should be applied at all levels, from national to regional, to city, neighbourhood and finally to utility and residential building levels.

§ 1.2 Dutch housing associations

When focusing on the implementation of climate change adaptations at the residential building level, social housing organisations are important stakeholders. They own large stocks of housing and their decisions will therefore affect a large percentage of citizens. This is particularly the case in many North-West European countries such as Denmark, Sweden, the Netherlands and Germany, where the rented sector owns and manages almost half of the housing stock (Dol and Haffner, 2010). A large share

of the housing stock in the Netherlands is owned and maintained by social housing organisations. Because there are relatively few housing associations compared to the number of homes which they own and maintain, the Dutch social rented sector is easy to approach, making it an interesting object for study in this thesis. In 2012, there were 381 housing associations in the Netherlands and the housing stock they owned and maintained consisted of 2.4 million dwellings. On average, a housing association owns 6,300 dwellings (www.cfv.nl), while the largest owns approximately 80,000 dwellings. Moreover, housing associations operate according to long-term maintenance plans involving consistent investment (Straub, 2001), which could be extended to include the adaptation measures needed to address the expected gradual progression of climate change (Klein Tank *et al.*, 2014; IPCC, 2014).

Although Dutch housing associations are private institutions in the non-profit sector, they are not completely independent. The government has control over rent policy and the performance of housing associations by means of the Social Rented Sector Management Order (BBSH). In return for this control, social housing associations receive benefits such as risk coverage through the Social House-Building Guarantee Fund (WSW), making them eligible for low-interest loans (Priemus, 1995).

§ 1.2.1 Organisational strategies and partnering

The adoption of climate change adaptations by housing associations can be considered part of their organisational strategy. This strategy consists of: “approaches for the management and redevelopment of the housing stock in order to contribute to increasing the socioeconomic and environmental sustainability of housing provision” (OTB, 2014).

Adaptation to climate change will require housing associations to change their organisational strategies. During the last two decades, the strategies have proven flexible enough to accommodate to external influences. Economic development has led to societal pressure for dwellings of better quality, providing tenants with more choice options in finish of kitchens and bathrooms for example. Moreover, legislation requires better performance in terms of energy-efficiency, sustainability and fire- and burglary-safety (De Wildt and Luijkx, 2011). These higher requirements have led to an increase in the cost of maintenance and refurbishment (De Jong, 2013). The strong market demand for construction has also increased price levels (De Wildt and Luijkx, 2011). Until the late 1990s and early 2000s, housing associations had several strategies to compensate for the impact of increasing costs. The interest rates on loans decreased; they developed new dwellings and sold them; and they sold some of their existing stock. After the credit crunch of 2008, new dwellings as well as existing ones

became more difficult to sell, and when sold, the prices achieved were 20 to 30 percent lower (De Wildt and Luijckx, 2011). Banks also tightened their lending (Aedes, 2009), and the government imposed several levies on the housing associations (Boelhouwer and Priemus, 2013; De Wildt and Luijckx, 2011). Generating more income by increasing rents was not an option because the rents were controlled by the national government, which only allowed an increase of close to inflation (Aedes, 2009; De Jong, 2010). All these developments have meant that housing associations had very little scope to invest and as a consequence they had to focus on increasing their efficiency. To do this, several steps were taken, such as re-focusing on their core activities (Nieboer and Gruis, 2014), as well as reducing staff numbers (CFV, 2013). Moreover, they have reduced their spending on maintenance and refurbishment work (CFV, 2013). For this type of work, housing associations have begun to explore the possibilities of 'partnering' (Rodgers et al. 2013), an approach that aims to involve the construction sector early in the plans for developments to make use of their expertise and ensure that the construction process delivers dwellings of higher quality more efficiently (Egan, 1998; Chao-Duivis and Wamelink, 2013).

§ 1.3 Problem formulation

Experts predict that climate change will affect the future value and comfort of the dwellings of housing associations. To pre-empt these negative effects, housing associations can implement anticipatory adaptation measures in their dwellings. However, to date, little is known about the level of awareness of climate change among housing associations and what their plans are when it comes to climate change adaptation measures in the (near) future. Given this lack of knowledge, there is no departure point for the development of governance measures to create or improve this awareness, which it is assumed will eventually lead to the proactive implementation of climate change adaptation measures. Without governance measures, it is unlikely that housing associations will prepare their dwellings to withstand the negative effects of climate change in the best possible way; in fact, without such measures, the chances are that they will only act reactively, after they have experienced a disaster. However, if they were to plan their action strategically and in a coordinated fashion, synergy benefits could be achieved.

Although there are many tools for governance available, not all are equally successful from a theoretical point of view. For example, the results of information tools are not always clear or quantifiable. Many incentives require a financial investment, which is more difficult in times of economic recession such as those experienced recently. Regulatory tools are less favourable because of the ongoing drive towards deregulation

This thesis widens the palette of tools that is available by adding one - known as 'partnering' - which can complement or even substitute other less effective tools. The additional tool will be the adoption of an integrated project delivery method for carrying out refurbishment work. Due to its characteristics, this tool is predicted to suit the trends that are currently evident among leading housing associations.

The underlying working hypothesis for this research is: 'Carrying out refurbishment projects using a partnering approach increases the implementation of climate change adaptation measures.' On the one hand, it has been shown that partnering increases the efficiency of the construction process, creating scope for investment in adaptation measures. On the other hand, partnering brings in more parties that can develop innovative solutions to make dwellings more climate-resilient. By doing so, it is not only housing associations that take responsibility for these actions, but the construction sector as a whole will gain more responsibility and become more able to co-create solutions that can then be disseminated more easily.

§ 1.4 Aim of the research and research questions

The aim of this research is to assess the potential of adopting the partnering approach as a project delivery method for maintenance and refurbishment work to increase the implementation of climate change adaptation measures. The housing stock owned by Dutch housing associations is taken as a case study. As such, this research will contribute to the growth of knowledge in the fields of governance of climate change adaptation at the building level and the use of partnering in construction as a means of addressing societal challenges. Furthermore, the dwellings owned by Dutch housing associations can become more climate-resilient, which will increase the future value of dwellings as well as the comfort and quality of life of the occupants.

The main research question is: *How can partnering in construction increase the implementation of climate change adaptation measures in dwellings owned by Dutch housing associations?*

To find an answer to the main research question, further research questions were formulated, as listed below. The first two questions aimed to establish the playing field of governance. The majority of the research questions were addressed sequentially, but questions 3 and 4 (awareness-oriented questions) were addressed in parallel with questions 5 and 6 (partnering oriented questions). Figure 1.1 is a graphic representation of the research design.

Prior to the development of an answer to the research question regarding the way the implementation of adaptation measures could be increased, in this thesis hypothesised by applying a partnering approach, sub-studies were conducted to establish the current state of the art of the implementation of adaptation measures in social housing.

- 1 *Which types and tools of governance could increase the implementation of climate change adaptation measures by housing associations?*
- 2 *How can partnering in construction become a valuable tool of governance with which to increase the implementation of climate change adaptation measures by housing associations?*
- 3 *What is the level of awareness of climate change among housing associations?*
- 4 *How do policymakers from housing associations assess the feasibility of climate change adaptation measures?*
- 5 *How do housing associations and construction companies carry out refurbishment projects using a partnering approach?*
- 6 *How can product innovations be implemented in housing refurbishment when a partnering approach is used?*
- 7 *Which strategies could be effective in removing the barriers to the implementation of climate change adaptation measures?*
- 8 *How do housing associations assess the likelihood that theoretical strategies for removing barriers to implementation actually increase the implementation of adaptation measures?*

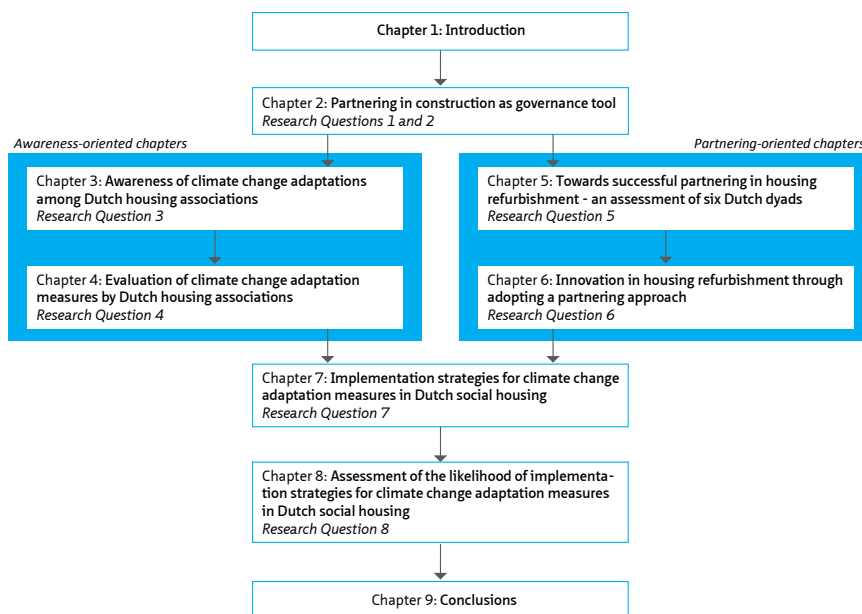


FIGURE 1.1 Schematic overview of the thesis

§ 1.5 Scientific relevance

This research contributes to extending our knowledge concerning the governance of climate change adaptation. Although the body of literature is increasing rapidly (Berrang-Ford *et al.*, 2011), this research topic is at an early stage of theoretical development (Biesbroek *et al.* 2010). Regarding the implementation of adaptation measures, in its 2009 White Paper on adaptation to climate change, the European Union proposed the establishment of a European Adaptation Strategy to be ready by 2013 (CEC, 2009). However, at that time the National Adaptation Strategies (NASs) of the Member States were still under development and many NASs were still lacking crucial governance elements regarding implementation and monitoring of measures (EC, 2013). This thesis focuses primarily on the implementation of measures, and more precisely, on the building level, as this remains underexplored (Biesbroek *et al.*, 2013). Moreover, it studies the role of housing associations as large property owners in the implementation of adaptation measures.

This thesis is an example of the shift in focus from top-down approaches, where scenarios dictate the action to be taken, towards a more bottom-up perspective, where adaptation measures are applied on the basis of the vulnerability of the local situation or object. Under the latter approach, stronger engagement by local stakeholders and policymakers is necessary (Veraart *et al.*, 2014).

With its focus on partnering, this research demonstrates how housing associations and construction companies collaborate in the Netherlands.

The research forms a bridge between literature on network governance (e.g. Jones *et al.*, 1997; Provan and Kenis, 2007; Meuleman, 2008) and literature on integrated construction processes (e.g. Egan, 1998). In this sense, it not only explores the problem of climate change adaptation in theoretical terms, but it also provides and tests solutions in the area of implementation. The research adds strategies based on partnering in construction to the palette of governance strategies. The ‘instrumental’ use of the construction process to solve societal problems remains underexplored in the partnering literature since this has tended to be descriptive, focusing on the critical success factors of good collaboration or on best practices in partnering projects (Bygballe, 2010).

The research carried out in this thesis contributes to the improvement of the quality of dwellings. As such, it is consistent with the research carried out by of the Faculty of Architecture of Delft University of Technology, specifically under the header of Organisational Strategies of the Research Program Housing in a Changing Society (OTB, 2014). More precisely, it builds on insights generated by Nieboer (2009) and Van der Kuij (2014) regarding policy strategies of Dutch housing associations. It also

relates to the work of Vrijhoef (2011) regarding the use of integrated construction processes to increase efficiency and it also relates to the work of Mlecnik (2013) and Salcedo Rahola (2015), who, although they focus on the energy-efficiency of dwellings, consider the construction process as a valuable route by which to achieve specific goals. It also builds on the work of Straub (2001), who focused his research on the improvement of the technical management of housing associations on the basis of their strategic stock policies.

The governance issue relates to the work of Van Bueren (2009), from the Faculty of Technology Policy and Management (Delft University). She looked for ways to improve policy making for sustainable development from a network governance perspective.

§ 1.6 Societal relevance

This research reveals the level of knowledge on climate change adaptation among housing associations. If housing associations know how climate change may influence the quality, comfort and safety of their dwellings, they may also be inclined to take proactive measures to protect these dwellings from any negative impact. Systematically implementing climate change adaptation measures could be important to housing associations for several reasons. Firstly, it may contribute to their social remit. Housing associations are regarded as societal entrepreneurs and are expected to use their resources and commercial profits to achieve societal aims that are in the common interest (Van Overmeeren, 2014). It would therefore be reasonable to expect them to commit themselves to making timely adaptations in order to prevent changing climatic conditions from threatening the quality of their dwellings. Secondly, the application of climate change adaptation measures could be viewed as a legal obligation, since under the Social Rented Sector Management Order housing associations are required to provide their tenants with quality housing both now and in the future (MinIKR, 2005). Thirdly, if they fail to implement adaptation measures, they may be jeopardising the future value of their dwellings, since the price of property in flood-risk areas is statistically lower than in non-flood-risk areas (Bosker *et al.*, 2013). Adaptation measures could thus increase the value of their housing stock in flood-risk areas in addition to improving the quality of life of their tenants. Fourth, from a more economic perspective, the impacts of climate change are expected to become a serious threat to nations' creditworthiness (Kraemer and Negrila, 2014). And last but not least, housing associations own and maintain many dwellings that were built in the past when no-one gave a second thought to the impacts of climate change that are now predicted. For example, the housing stock of the Netherlands is primarily post-war (modernist), and modularity and repetition are its main characteristics. This implies that the same

design and details for the dwellings have been implemented in different cities that face different climate change challenges. The currently projected effects of climate change - increased heavy rainfall and higher temperatures - will indeed put the quality of the indoor environment at risk due to damp and mould, and they may also accelerate the degradation of buildings and push up maintenance costs for many years to come (Jones *et al.*, 2013; Hertin *et al.*, 2003).

The focus will be on the development of measures relating to the existing building stock, since new construction represents only 1 percent of current total building stock (CBS, 2014). This means that a substantial proportion of the 2050 building stock is already standing today, but it was built in an era when climate change was not a concern. Moreover, because buildings are assets that are intended to last for many years, sometimes even centuries, they can be made climate-resilient once, but could still become vulnerable to changing climate circumstances again during their lifespan (Fankhauser *et al.*, 1999). Since housing associations take a long-term perspective when it comes to the maintenance and refurbishment of their properties (Straub, 2001), adaptation measures could be planned relatively easily and at an early stage in order to prevent future problems caused by climate change.

§ 1.7 Research approach

The research conducted in this thesis can be characterised as an intrinsic case study (Stake, 2005) which "(...) is undertaken because, first and last, one wants better understanding of this particular case." The case in this thesis involves assessing the potential of adopting partnering as a means of increasing the implementation of climate change adaptation measures in the Dutch social housing stock. It was not set up to formulate general conclusions on the most effective governance tool or to develop strategies aimed at several kinds of property owners. Although case study research may involve multiple cases selected in order to make comparisons between them (Lewis, 2003), in this thesis, the case that was studied is considered as a single one, namely Dutch housing associations. Other cases may focus on privately owned housing or commercial and/or industrial buildings. The social housing sector in the Netherlands was selected because of its scale and the social responsibilities of housing associations, which might lead them to take action of their own accord.

Within the case study, several sub-studies were conducted with the aim of discovering the level of knowledge and awareness of housing associations regarding climate change adaptation, and how the partnering approach is applied by housing associations during refurbishment work. After studying these two aspects, the focus shifts to governance,

namely the development of implementation strategies for climate change adaptation measures. The feasibility of these strategies was assessed by policymakers at Dutch housing associations.

The explorative character of this thesis has resulted in a multi-method approach to data collection, using qualitative research methods such as content analysis, interviews, SWOT analysis and surveys. For every research question, the selected method was the one expected to generate the best results with the resources available. Since the aim is not to make a comparison between the studies, but rather an incremental process of deduction, this approach was found to be appropriate.

The first two research questions are as follows: “Which types and tools of governance could increase the implementation of climate change adaptation measures by housing associations?” and “How can partnering in construction become a valuable tool of governance with which to increase the implementation of climate change adaptation measures by housing associations?” These will be answered on the basis of a literature review on governance and partnering in construction, respectively. The results of this review are reported in a theoretical chapter in order to underpin the perception of the construction process as a useful tool of governance. On both topics, a narrative literature review (Peat, 2002; Grant and Booth, 2009) was used, including mainly peer reviewed articles, reports and books with the aim to reveal knowledge generated in previous research, to avoid duplication of work and identifying research gaps, which – as opposed to a systematic review – is characterised by the lack of a specific search strategy or explicit criteria which is used to include or exclude certain papers. Although this method is criticised by Hofmann et al. (2011) as ‘not reproducible’ and ‘not transparent on e.g. the criteria for selecting studies and the methodology used for combining their results and drawing conclusions from these’, it was considered appropriate for the purpose of creating a starting point for the research and determining the boundaries within which this research was undertaken.

The focus shifts to housing associations for the next research question: “What is the level of awareness of climate change among housing associations?” This question was explored by carrying out a content analysis (Bryman, 2008) of the policy plans and annual reports of the 25 largest housing associations. These documents report on completed projects and future plans, respectively, so they are a good indicator of awareness at corporate level. The 25 largest housing associations were selected so that as many dwellings as possible were represented and the state of the largest possible section of the social housing stock would be known. In total, the selected associations own 881,000 dwellings, which is around 37% of the Dutch social rented housing stock. Moreover, the sample included housing associations from across the whole country, reducing geographical bias. Given their size, these housing associations had numerous policymakers in their organisations who could signal the issue of climate change and the action that is needed to adapt dwellings to these changing circumstances.

Since this study was carried out early in the research of this thesis, a quick scan was considered appropriate to become acquainted with the state of awareness of the housing associations. This served as a starting point for further developments regarding governance strategies to increase the implementation of adaptation measures, which are further elaborated in the thesis.

To complement the knowledge on which climate change adaptation measures have been implemented or planned for implementation as reported in the policy documents of housing associations, it was decided to 'dig deeper' into the organisations and retrieve information from individual policymakers. At this stage, interviews were considered the most appropriate research method to answer the research question: "How do policymakers from housing associations assess the feasibility of climate change adaptation measures?" Interviews generate 'information on individual, personal experiences from people about a specific issue or topic' (Hennink *et al.*, 2011, p. 109). Furthermore, since the sample for the previous research resulted in a fairly homogeneous response, it was decided to differentiate between the size of housing associations with the aim of retrieving a broader range of answers that can provide input for the development of governance strategies. The housing associations that were invited to participate were selected on the basis of their size and geographical location. The criteria used to select employees of those housing associations for interview were their involvement in policymaking on technical measures and a field of work that encompassed the entire building stock of the housing association. In total, twelve individual policymakers were interviewed in structured interviews consisting of both open and closed questions.

For the two research questions on partnering, it was possible to participate in a knowledge exchange project where seven dyads of housing associations and construction companies carried out a housing refurbishment project while deploying a partnering approach. The participants shared their experiences through semi-structured interviews with open questions undertaken face-to-face with the researcher. Twice a year, a plenary meeting was organised, where all participants were invited to share their experiences. The knowledge exchange project offered the opportunity to follow projects over the long term and gain a clear view of the different ways that housing associations and construction companies carry out their projects.

It is explored how the success factors of partnering, as derived from the literature, are employed in practice in order to answer the question: "How do housing associations and construction companies carry out refurbishment projects using a partnering approach?" To do this, the success factors listed by Kim *et al.* (2010) served as a general framework for evaluation. These factors are: trust, leadership, partner capabilities, commitment, conflict resolution, coordination and communication. The most appropriate data collection method involved structured face-to-face interviews consisting mainly of open and some closed questions. These questions provided

insight into the type of projects that were underway, the approaches adopted in those projects, and the way in which success factors were given shape. In addition, the results of the interviews were cross-checked in a plenary meeting.

Building on the knowledge and experience gained during the first year of the knowledge exchange project, in the second year it was possible to explore whether a partnering approach leads to more than efficiency - in this case whether it actually led to innovation.

The implementation of climate change adaptations can also be perceived as an innovation, so the results of the study on the implementation of innovations could provide valuable results for the implementation of climate change adaptations.

The research question that was to be answered was: "How can product innovations be implemented in housing refurbishment when a partnering approach is used?" Since this study was carried out in a later phase of the knowledge exchange project, the researcher already had some knowledge about the projects and the partnering approaches that were used. This meant that the data were collected by means of surveys consisting mainly of open and some closed questions sent out by e-mail or conducted by telephone, which was considered a more efficient method than arranging 22 face-to-face interviews with individuals all over the country. The survey focused on the innovations that were achieved in the project, as well as the conditions for (stimulating) innovation. The outcomes of the surveys were validated in a plenary session.

The next research question was: "Which strategies could be effective in removing the barriers to the implementation of climate change adaptation measures?" Based on the outcomes and experiences gained through the previous explorative research questions, conference visits and project meetings with practitioners and scientists involved in the Climate Proof Cities consortium, three conceptual approaches were developed that could potentially lead to the implementation of adaptation measures. These conceptual approaches were first developed theoretically and then validated using SWOT analysis. Again, interviews were considered the most appropriate way to explore the SWOTs of these approaches and to gain as much feedback as possible. Semi-structured face-to-face interviews were held with practitioners active in the fields of housing associations, construction companies and external players such as water boards, insurance companies and municipalities. The topic guide during the interviews was structured in the same way as a SWOT analysis.

Since the SWOT analysis for the conceptual approaches was based on the opinions of relatively few practitioners, while the focus of the thesis is the entire social housing sector in the Netherlands, an additional study was conducted to follow up the SWOT analysis. Based on the insights derived from the SWOT analyses, the conceptual

approaches were transformed into implementation strategies in order to increase the implementation of climate change adaptation measures in the social housing stock. The final research question to be answered was: “How do housing associations assess the likelihood that theoretical strategies for removing barriers to implementation actually increase the implementation of adaptation measures?” Data were collected through on-line questionnaires, which was the most feasible way to retrieve data from a large number of participants. The questionnaires were based on closed questions, but there was always an opportunity to add comments. The study addressed the entire population of 389 housing associations, 379 of which were contacted. No contact details could be retrieved for the other ten, which were therefore omitted from the sample. The participants were contacted by e-mail. Most invitations were personally addressed to the employees of the housing associations who were considered capable of assessing the implementation strategies, such as real estate managers.

In Chapters 2-8 of this thesis, the answers to the research questions are reported. A schematic overview has already been presented in Figure 1.1. The ninth and final chapter summarises the results of the preceding chapters and places the results from the entire case study in a wider context including its scientific and societal relevance. Conclusions are drawn and recommendations for further study are also presented in the final chapter.

Except for the first and last chapters, all the chapters were written as papers that can be read individually. Some overlap, especially in the introductions, is therefore likely. In Table 1.1 an overview is presented with the publication status of the papers.

	THEME OF PAPER	PUBLISHED AT CONFERENCE	PUBLISHED IN JOURNAL
2	Literature review on governance and partnering	SENSE PhD Training School 2011, Amsterdam	-
3	Awareness among housing associations	MISBE 2011, Amsterdam	Open House International, 2012
4	Evaluation of adaptation measures	-	Structural Survey, 2013
5	Partnering by housing associations	CIB 2012, Cape Town (South Africa)	-
6	Innovation by partnering approach	-	-
7	SWOT analysis conceptual approaches	CIB 2014, Kandalama (Sri Lanka)	-
8	Assessment likelihood implementation strategies	-	Building and Environment, 2015

TABLE 1.1 Publication status of the papers

§ 1.8 Knowledge for Climate

This thesis was part of Knowledge for Climate, a Dutch research programme “for the development of knowledge and services that makes it possible to climate-proof the Netherlands” (<http://knowledgeforclimate.climate-research-netherlands.nl>). The programme was subdivided into several themes, such as Climate Proof Cities (CPC), which hosted this thesis. The aims of CPC are: “strengthening the adaptive capacity and reducing the vulnerability of the urban system against climate change and to develop strategies and policy instruments for adapting our cities and buildings” (Albers *et al.*, 2015).

A particular characteristic of Climate Proof Cities is that the following themes were developed in parallel, subdivided between several work packages: the functioning of the urban climate system; the vulnerability of Dutch cities to climate change; solutions to adapt to climate change and the implementation of the solutions in the urban environment were elaborated in parallel (see Figure 1.2).

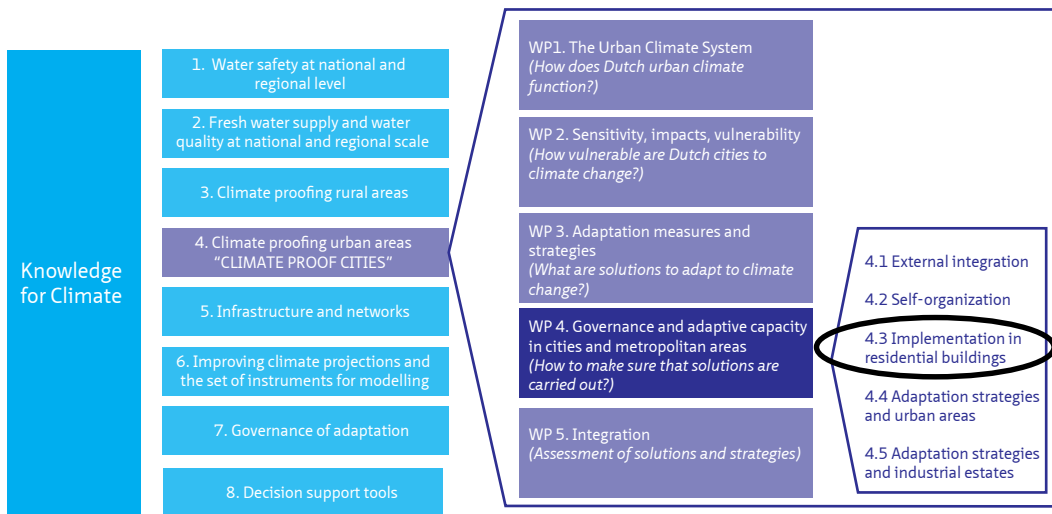


FIGURE 1.2 Position of the research within Knowledge for Climate

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2 Partnering in construction as governance tool

Chapter 2 presents a literature review on the concepts of governance and partnering in construction. Because the thesis consists of papers on a specific topic that have been written independently of one another, such a general literature review was not appropriate in those papers. This chapter was updated at the end of the research, to include the most recent and most elaborated insights that were collected during the research.

§ 2.1 Introduction

Climate change can no longer be ignored. It is globally recognised that the evidence for climate change is unequivocal (IPCC, 2014) and action needs to be taken to address its negative consequences (UNFCCC, 2011). The challenge of stimulating this action is taken up by this thesis - albeit at the level of individual buildings rather than at the global level - by engaging the construction sector in the implementation of adaptation measures in the social housing stock. To achieve this, the research fields of climate change adaptation, governance and partnering in construction are brought together. The effects of climate change in the Netherlands were briefly explained in the introduction and will be further elaborated in Chapter 3.

Climate change adaptations have different characteristics from other adaptation measures relating to, for example, energy-efficiency. For the latter, the requirements for dwellings are generic. They have been established on the basis of theory and standardised values that are similar for dwellings throughout the country. For example, the thermal resistance of the outer wall of every new dwelling should be $3.5 \text{ m}^2 \text{ K/W}$ (MinIKR, 2014). Measures for climate change adaptations, however, depend on conditions in the local environment (Pinkse and Kolk, 2012), which necessitates knowledge of the local situation so that the right measures are chosen. This not only requires a process that includes built environment professionals, but also local policymakers and the scientific community (Bosher and Dainty, 2011). To date, the scientific community has played a very important role in this because of the relative newness of the topic, and because knowledge is constantly evolving. According to Stone (2012), much information on the impact of climate change in cities is still unknown or difficult to retrieve at the national level, since it is only known locally. This

presupposes that in the coming years there will be a constant influx of information into the construction process in order to make the building stock more resilient. Apart from 'top-down' information from scientific research carried out at a local, regional or national level, knowledge can also be actively retrieved from people living in a neighbourhood, using a 'grassroots community based approach' (Bosher, 2012). The involvement of local stakeholders can create a window of opportunity to implement measures, especially if people have already experienced the negative impact of climate change, for example when there has been occurred flooding after heavy rainfall. In many cases, action is only taken after extreme events have occurred (Amundsen *et al.*, 2010). From all perspectives, an integrated process without the traditional barriers between parties and/or phases will enhance the free flow of knowledge between stakeholders (Bosher and Dainty, 2011).

This chapter aims to provide a theoretical basis for the notion that the construction process can serve as a useful governance tool. To do this, three types of governance will be explored: hierarchic, market and network governance. These three types represent how the government has interacted with society in the past - and continues to interact with society - in order to resolve societal problems. The adoption of climate change adaptation measures can be considered as just such a societal problem. In the following section, a number of governance tools are described that are based on these types of governance. The tools focus on taking the desired action, rather than on the relationship between state and society. Next, 'partnering' in the construction sector will be explored - a term that describes the collaboration process between clients, such as Dutch housing associations and the construction sector, which may be suited to increasing the adoption of climate change adaptation measures. To conclude, the theoretical fields of governance and partnering will be combined. By matching the partnering approach with the types of governance and placing it in the framework of governance tools, this thesis shows how the approach could be a valuable tool with which to increase the adoption of climate change adaptation measures by Dutch housing associations.

§ 2.2 Methodology

A literature review was carried out on the subjects of governance and partnering in construction. The narrative review (Peat, 2002; Grant and Booth, 2009) included mainly peer reviewed articles, reports and books with the aim to reveal knowledge generated in previous research, to avoid duplication of work and identifying research gaps. This type of literature review has no specific criteria for the inclusion or exclusion of sources, contrary to systemic reviews. Although the narrative review

method is criticised by Hofmann et al. (2011) for being ‘not reproducible’ and ‘not transparent on e.g. the criteria for selecting studies and the methodology used for combining their results and drawing conclusions from these’, it was considered appropriate for the purpose of creating a starting point for the research and setting boundaries within which the research for this thesis would be carried out. In addition, climate change as a subject of research can be characterised as a ‘wicked problem’, meaning that it has no single solution and it is difficult to consider it ‘solved’, and it is even questionable whether it can be solved at all. Solutions are classified as good or bad rather than true or false (Rittel and Webber, 1973). This means that as many options as possible must be explored to arrive at the best solution.

Firstly, a concise overview of the main types of governance will be given, as derived from the literature on public administration. Throughout this thesis, a type of governance is understood as the organisation of actors in a hierarchic, market or network governance setting (Barbazza and Tello, 2014). Then, a list of governance tools will be presented that have been derived from the literature on environmental governance and climate change mitigation. Tools have the ability to create specific relationships between actors (Barbazza and Tello, 2014). Since the tools for implementing changes were derived from literature with a different focus than climate change adaptation, for each tool an explanation is given on how it could be applicable to the adoption of climate change adaptations in social housing. In governance literature, notions as ‘governance strategies’ and ‘governance arrangements’ are common as well, but this thesis will use the notion ‘governance tool’ to describe a singular approach to create the relationship between the actors. Should there be a combination of tools, then reference is made to ‘strategies’.

To classify the integrated construction processes of the front-runners as studied in this thesis, a literature review was carried out. Based on this review, it was concluded that ‘partnering’ corresponds most closely to the collaboration of Dutch housing associations with their partners in the construction sector. In section 2.6, the literature review on partnering is elaborated.

§ 2.3 Governance

‘Governance’ has its origins in public administration (Meuleman, 2008: p 1). Over the years, several scholars (e.g. Rhodes, 1997; Lowndes and Skelcher, 1998; Stoker, 1998; Mayntz, 2004) have formulated definitions, and this inspired Meuleman (2008) to propose the following definition; “Governance is the totality of interactions, in which government, other public bodies, private sector and civil society participate, aiming

at solving societal problems or creating societal opportunities.” The scope of the definition, including “any kind of interactions”, allows governance to be treated as an overarching notion while the type of interaction within the framework is indicated by the sub-categories of hierarchic, network or market. This provides the possibility to explore the entire field of work of housing associations while implementing climate change adaptations for their dwellings. Moreover, under Meuleman’s definition, no actor has a central position, although the final effect of governance is clear: “solving societal problems or creating societal opportunities”. For this thesis, the final result is adapting dwellings to make them less vulnerable to climate change and improve the quality of life of tenants. This definition includes many elements that match the perception of governance as used in this thesis, although this thesis proposes to add an instrumental element to it. In fact, interactions do not happen of their own accord; they are caused to happen on purpose, by means of tools. Governance is therefore re-defined as: the totality of interactions between government, other public bodies, private sector and civil society, deliberately established using tools, aiming at solving societal problems or creating societal opportunities.

Three major types of governance can be distinguished that have characterised the interactions between the government and societal institutions - namely: hierarchic, market and network governance. These types are explored in the following sections.

§ 2.3.1 Hierarchic governance

The field of hierarchic governance is characterised by the strong role of the government in a ‘command-and-control’ setting (Jordan *et al.*, 2003) and the presence of regulatory processes (Pahl-Wostl *et al.*, 2009). This type of governance is associated with notions such as authority, task division, coercion (Meuleman, 2008). Hierarchic governance was the predominant form of Western public administration in the period after World War II. It became successful because of its efficiency, standardization and delivery of universal services to society and therewith improving the quality of life of many citizens (Keast *et al.*, 2006). The best way to achieve this was by using a strict regime of clear rules, which ensured that everyone knew what to do (Meuleman, 2008). As such, the government interacts with societal autonomy in a unilateral way: orders are passed down from the government to society.

Hierarchic governance contains some inherent barriers to sustained success. The regulatory framework is fairly rigid, so it is difficult to adapt to changing circumstances in society and introducing new regulations is subject to high transaction costs (Pahl-Wostl, 2009). This becomes problematic when addressing problems caused by multiple actors that cannot be solved by one actor or the government alone

(Driessen and Vermeulen, 1995) or if the problems are 'wicked', meaning that it is not possible to draw a line between right or wrong (Van Bueren, 2009). Furthermore, hierarchic governance can be perceived as limiting and can lead to feelings of a lack of freedom (Fischer *et al.*, 2011). It also stifles innovation because it predefines the desired outcomes of a process and does not encourage actors to engage with societal objectives (Van Bueren, 2009). These difficulties gave rise to the emergence of new types of governance, of which market governance was the first to mature.

§ 2.3.2 Market governance

In the 1980s, market governance came to occupy a position as an alternative to the rigid hierarchic type of governance. In that period, the role of national governments moved towards becoming more service-oriented (Meuleman, 2008). Market governance focuses on applying private-sector principles such as efficiency, effectiveness and economy (Keast *et al.*, 2006). In Public Administration, this type of governance is metaphorically referred to as 'market' governance, describing a situation where the relationship between public agencies and their customers is based on self-interest, just as happens in a 'real' marketplace (Denhardt and Denhardt, 2000). In a 'perfect' market environment, transactions are based on competition and there is no long-term human or social contact between buyers and sellers (Hirschman, 1982). There is no space for bargaining or negotiation (Hirschman, 1982), and price is the medium that creates an equilibrium between supply and demand (Buitelaar and De Kam, 2009). Market governance encompasses business-oriented areas such as competition, customer-orientation, privatisation, deregulation, decentralisation and performance contracting (Keast *et al.*, 2006; Meuleman, 2008). This type of governance leaves more freedom to enterprises and citizens to decide on what they think is best to do. The government can support the market parties by providing information and can stimulate the market to adopt certain behaviour by providing subsidies (Van Bueren, 2009). But in the end, the enterprises and citizens decide for themselves.

Over time, it turned out that the principles of market governance were undermining the quality of service that the government is expected to deliver. For example, decentralisation resulted in specialised service agencies from the government which had to compete for funding with other agencies from that same government, ultimately leading to greater fragmentation within the government sector (Keast *et al.* 2006). Moreover, the inherent values of public administration, namely those attached to public interest and social cohesion, also came under pressure as citizens had to compete with each other for services (Keast *et al.* 2006).

§ 2.3.3 Network governance

Both the hierarchic and market forms of governance proved their effectiveness, but at the same time each was associated with certain problems (De Carvalho, 1998). The understanding of the limits of both types of governance formed a basis for the emergence of a third type of governance in the 1990s: network governance. Network governance is associated with themes such as relationships, trust, cooperation and mutual benefits (Meuleman, 2008). It is characterised by the involvement of a number of societal actors, such as governments, organisations and institutions working together in initiatives, projects and programmes, aiming to support the public decision-making process or influence private actors (Pattberg, 2010). As such, this type of governance provides an answer to a changing society in which individuals have become more independent and empowered and the position of the state has become less critical (Buitelaar and De Kam, 2009; Wilson and Termeer, 2011).

Under network governance, actors participate in the decision-making process. This gives them the possibility to defend the solution that suits them best, and implicitly enlists their support for the policy (Van Bueren, 2009). This support reduces the likelihood of unexpected resistance and therefore reduces uncertainties in the policy-making process (Pahl-Wostl, 2009). Moreover, networks are flexible in terms of the roles that actors can take on: depending on the project, they may sometimes assume more power or responsibility and sometimes less (Pahl-Wostl, 2009). In addition, network governance allows for a contribution to policy development that aims at resolving local issues (Keast *et al.*, 2006), the level at which climate change adaptation occurs as well (Klein *et al.*, 2005).

However, depending on the closeness of the relationships between the members, networks can become rigid and slow to respond (Duit and Galaz, 2008) and they can also become isolated entities poorly integrated with the rest of industry (Jones *et al.*, 1997). Since no actor has absolute power, the legitimacy of the network and its decisions may be disputed and accountability issues may arise as a result (Pahl-Wostl, 2009). Network governance may also reduce efficiency because the participatory process involves many resources and organisations (Provan and Kenis, 2007) and collecting, recording and communicating all the available information among all partners is time-consuming and maybe even impossible (Graafland and Nijhof, 2007).

§ 2.4 Governance tools

Based on the types of governance explored in the previous section, many tools have been developed by policymakers to enhance the way that changes are made to the built environment. In this section, a number of these tools are explored and analysed. These tools are already available and can be used to increase the implementation of climate change adaptations in social housing. Originally, these tools were not designed for the implementation of climate change adaptation measures, but this study provides a description of how they could be applied for that purpose.

For the sake of clarity, the governance tools are grouped into four main categories based on the division of tools presented by De Monchaux and Schuster (1997). Even though they group the tools against the background of built heritage, which is a completely different research field to climate change adaptations, the framework itself is useful because it provides a logical subdivision of the levels of state intervention into social autonomy.

The main categories are: information and communication tools, incentives, division of property rights, and regulation tools. They also present a fifth category: ownership and operation, where the government 'might choose to implement policy through direct provision, in this case by owning and operating (...) resources' (De Monchaux and Schuster, 1997). This category is not used in this thesis, because it is unlikely that a situation of ownership would occur in the case of climate adaptations in social housing, since one of the institutional functions of the housing associations is to manage and maintain their dwellings.

§ 2.4.1 Information and communication

The first category is information and communication tools. De Monchaux and Schuster (1997) describe these as tools with which to 'collect and distribute information intended to influence the actions of others'. With information tools, the employees of housing associations can be provided with the knowledge they need to take action more easily, because they know that improvements can be made. The tools in this category are:

National TV campaigns: Information is transmitted by television, providing easy-to-access knowledge on the effects of climate change and possible solutions that could be undertaken by citizens and/or institutions (Murphy *et al.*, 2012).

Demonstration projects: A dwelling that has successfully been adapted to accommodate the effects of climate change, which can be visited by those responsible for or participating in climate change adaptation projects (SEV, 2011).

Road shows: A (governmental) advisory body visits housing associations and provides information on the effects of climate change in the areas where housing associations own property. Successful examples of adaptation can also be shown (SEV, 2011).

Online tools: Websites providing information on, or simulations of the effects of climate change in a certain area (Murphy *et al.*, 2012; www.3di.nu).

Educational programmes: Programmes intended to educate the employees of housing associations on the subject of climate change adaptations (Schuster, 1997).

Communities of practice: A group of housing associations joins forces and searches for solutions on the implementation of climate change adaptations (SEV, 2011).

Deliberation: The opportunity to share opinions on a particular subject has been shown to affect the initial opinion of individuals when confronted with it. They become less sceptical and are more open to governance structures that are not completely government-based (Hobson and Niemeyer, 2011). A deliberation session on climate change could be organised by the housing association to provide feedback from their tenants and other stakeholders.

Tailored advice: Information provided by a specialist advisory body that knows the exact effects of climate change in a certain area and provides advice on how to adapt a dwelling, taking into account the characteristics of the dwelling such as size, age, orientation etc. (Murphy *et al.*, 2012).

Performance certificates: All existing dwellings in the European Union are required to have an energy performance certificate (EP, 2002). A similar framework could be put in place for climate change adaptation measures. In a competitive environment these certificates are a proof of quality, showing how one dwelling compares to another. Additionally, the certificates can be combined with a financial incentive, to encourage action.

§ 2.4.2 Property rights

The second group, property rights, is described as follows: ‘the state can establish, allocate and enforce the property rights of individual parties as these affect the (...) resources’. This kind of tool focuses on shared or split ownership or use of a property, as applies in some way or another in leasing, mortgaging and easement (Costonis, 1997). Tools in this category include the following:

Long lease: In the long lease system, the municipality is the owner of the land, while the premises are the property of a private entity or an individual. Municipalities use this system to control the development of the city and prevent speculation. Moreover, it generates a stable income over the long term (Gerber *et al.*, 2011). For climate change adaptation, a municipality might assume responsibility for maintaining a green area

owned by a housing association. The municipality assures that the green space retains its function as rain water infiltration area by ensuring that it is not covered with an impermeable surface such as tiles or tarmac. In this way, the sewage system will not suffer from overloading in the event of heavy rain and it does not need to be changed.

Social sales: In recent years, housing associations have sold dwellings to their tenants at reduced prices. These reductions are possible because the sale contract comes with conditions for split ownership of building and plot. For example, in a 'koopgarant' contract, the housing association sells the dwelling, but the plot remains the legal property of the housing association. The housing association guarantees that it will buy back the dwelling when the owner wants to sell it. This is guaranteed because the plot remains in the hands of the housing association. The dwelling is bought for the current market price, but any profit or loss between the time when the housing association sells the house and the time it buys the house back are shared (Zijlstra, 2011). The housing associations could include climate change adaptations as one of the conditions in the contract, especially in order to maintain the quality of the dwelling. Because the housing associations are obliged to buy back the dwelling in the future, it is important for them that the dwelling remains rentable or sellable.

Self-organisation: In some cities in the Netherlands, citizens are formally in charge of maintaining green areas that are owned by the municipality. This situation came about when the municipality proposed building on a particular green area but citizens protested against this. The green space was retained but the citizens were made responsible for maintaining it (Boonstra *et al.*, 2014). A similar situation could occur if a municipality wants to pave a certain area (to reduce maintenance costs or prevent people from hiding there). In the summer, the paved area would heat up, undermining the quality of life of the people living nearby. These people might convince the municipality to retain the green space provided they assume formal responsibility for its maintenance and safety, since they are the ones benefitting the most from it.

§ 2.4.3 Incentives

According to De Monchaux and Schuster (1997), the governance tools in the third group, based on incentives, are 'designed to bring the actions of other actors (...) in line with a desired policy'. They focus on the activities undertaken by housing associations. If they do the right thing, they will be rewarded. Incentives can be based on economics or simply have a social background, based on the image that housing associations have among their stakeholders. In the latter case, the governance tools are concentrated in the societal autonomy section, without much state intervention. The category of incentives includes the following tools:

Subsidies: Money to incentivise the implementation of climate change adaptations (Murphy *et al.*, 2012).

Green loans/mortgages: Money that can be borrowed at low interest rates, on the condition that it is used to invest in climate change adaptation measures (Murphy *et al.*, 2012).

Tax incentives: To stimulate investment in adaptation measures, the government can reduce the VAT rate, or allow tax deductions to make the investment financially more attractive (Murphy *et al.*, 2012).

Contests: In a contest, housing associations compete with one another to show who has applied the best adaptation measures. An independent jury assesses the quality of the proposals (SEV, 2011).

Social: Corporate Responsibility: To demonstrate to their stakeholders that they are committed to the comfort and well-being of their tenants, housing associations can apply climate change adaptation measures proactively (CEC, 2001).

Voluntary and negotiated agreements and covenants: The local or national government can draw up agreements or covenants with housing associations that require both parties to take steps to implement climate change adaptation measures. Two main types of agreements can be distinguished, voluntary and negotiated, the former being less binding than the latter (Bressers *et al.*, 2009).

Benchmarks: A benchmark compares housing associations to one another on the basis of unified parameters. The benchmark rates the performance of housing associations. Regarding climate change adaptation, a benchmark could be developed relating to the resilience of the housing association to climate change (Aedes, 2014).

§ 2.4.4 Regulation

The fourth group is regulation. De Monchaux and Schuster (1997) explain that ‘the state might choose to regulate the actions of other actors, particularly those private individuals or institutional entities that own and occupy (...) resources’. Laws and regulations can be imposed on housing associations. Directly related to the system of regulation are enforcement measures, which may include fines that have to be paid if the requirements on a certain topic are not met, for example. Regulation tools include the following:

Building Code – new construction: In this document, the national government prescribes the basic quality requirements of a new building. It can include requirements regarding climate change adaptation (MinIKR, 2014).

Building Code – renovation: The basic quality requirements for new construction projects as laid down in the Building code also apply in the case of major refurbishment works, so this is also an opportunity to enforce the implementation of climate change adaptation measures (MinIKR, 2014).

Enforcement of quality – existing stock: The government can order changes to existing buildings if these have shortcomings that threaten the safety or health of their inhabitants (Van Leeuwen *et al.*, 2014). Theoretically it is possible that climate

change will lead to unsafe situations for citizens, and measures to mitigate these effects are required. This could occur when a building becomes unstable after flooding, if raw sewage flows out of the sewage systems during a flooding event, or if interiors frequently overheat during heat waves.

§ 2.5 General evaluation of tools

Although all these governance tools have their advantages, many are currently less feasible in relation to the implementation of climate change adaptation measures by housing associations. For example, the outcome of tools based on information provision are very difficult to measure (Murphy *et al.*, 2012). What is more, cognitive dissonance (Festinger, 1962) can easily occur, by which is meant in this thesis that people tend to hear what they want to hear and ignore the warnings of the impacts of climate change. The disadvantage of subsidies is that the desired behaviour (the implementation of adaptation measures) is caused directly by the incentive (Maller and Horne, 2011), so if the incentive stops, so will the desired behaviour (Murphy *et al.*, 2011). Political incentives though, could be feasible, for instance if housing associations and municipalities sign a covenant (Bressers *et al.*, 2009) in which they agree to apply adaptation measures. Both parties have long-term shared interests, so they are willing to take action to help and reward each other.

The development of regulatory governance instruments is not consistent with the trend of deregulation in construction (Commission Dekker, 2008). Regulatory tools are associated with the risk that the building design will aim to fulfil minimum requirements and no more. This means that there is no margin for error during the construction phase or in the usage phase. A study in the Netherlands in 2007 showed that such a 'minimalistic building' can result in serious losses in quality. Compliance was investigated in 108 dwellings with the EPC (Energy Performance Coefficient), an instrument that indicates the energy performance. In 25% of the cases the EPC calculations were incorrect, even though they had been (or were supposed to be) verified in order to be awarded a building permit. In addition, the performance of the finished dwellings was unsatisfactory in 47% of cases (Kuindersma and Ruiters, 2007).

Moreover, as climate change is surrounded by uncertainty (Willows and Connell, 2003), setting clear rules, enforcing them, and the financial implications of those rules, makes the category of regulatory tools less likely as a starting point. In addition, the establishment of a new regulatory institution would involve high transaction costs (Pahl-Wostl, 2009).

This means that new tools need to be found to widen the palette of available tools and existing tools have to be combined to increase the adoption of climate change adaptation measures. After all, there is no single 'perfect' tool that will solve all the problems at once (CEC, 2009; Murphy *et al.*, 2012).

§ 2.6 Partnering

The construction process and the networks described in the network governance literature have in common that, according to Jones *et al.* (1997) both involve "... a select, persistent, and structured set of autonomous firms (as well as non-profit agencies) engaged in creating products or services based on implicit and open-ended contracts to adapt to environmental contingencies and to coordinate and safeguard exchanges. These contracts are socially – not legally – binding" (p. 914). According to Jones *et al.* (1997), four conditions need to be met for network governance to be feasible. The first condition is that demand is uncertain, which in the construction sector is caused by inherent fragmentation within the sector. Secondly, the buildings delivered by the sector are highly customised products assembled by people specifically skilled for that task. Thirdly, in order to complete a building, many specialist activities need to be carried out by workers over a limited period of time. Finally, the work is carried out by many workers simultaneously at a single location, leading to frequent contact between the workers.

The construction process that is currently followed, on the basis of detailed project descriptions and selections of the lowest bidder (Van de Rijt and Santema, 2013), is frequently criticised for not always delivering modern standards of quality and having high failure costs (Egan, 1998; Chao-Duivis and Wamelink, 2013). To enhance quality in construction projects, it is often suggested that construction firms cooperate in such a way that there are no company boundaries to limit the free flow of knowledge and experience (Blayse and Manley, 2004; Dulaimi *et al.*, 2002; Egan, 1998). A partnering approach is one of these forms of collaboration (Hughes *et al.*, 2012). Throughout this thesis, the definition of a partnering approach is used as developed by the Construction Industry Institute (CII, 1991) is used: "A long-term commitment by two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organization boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each other's individual expectations and values. Expected benefits include improved efficiency and cost-effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services."

In the construction sector, 'partnering' is the most widely used term to describe collaborative project delivery method (Jacobsson and Roth, 2014). Other methods are relational contracting, project partnering, strategic alliances, project alliances, programme alliances, integrated project delivery and early contractor involvement (Chen and Manley, 2014; Jacobsson and Roth, 2014; Lahdenperä, 2012). What the methods have in common is that contracts between the construction parties and the client are not transactional, but relational, being based on trust and the equal division of risks and benefits (Lahdenperä, 2012).

According to Kim et al. (2010), the following factors are vital to a successful partnering approach: leadership, commitment, coordination, trust, communication, conflict resolution techniques and partner capabilities.

Parallel to the body of literature that deals with the collaborative project delivery methods mentioned above, the 'terms supply chain management' (e.g. Vrijhoef and Koskela, 2000; Bankvall et al., 2010) or 'supply chain integration' (e.g. Briscoe and Dainty, 2005) are in use. Tennant and Fernie (2013) defined these methods by distinguishing between client-led and contractor-led supply chains. In the latter, the priority is optimising the supply chain between the contractor and his sub-contractors. In a client-led supply chain, the client has an important role in managing the supply chain and in these supply chains relational project delivery methods are common practice (Tennant and Fernie, 2013). In the Dutch literature, the widely used term is 'ketenintegratie' which means supply chain integration. According to Gruis (2011), supply chain integration comprises four dimensions: the integration of all phases of the construction process and of all companies in the supply chain; continuity in the work by means of multiple projects; transparent and equal sharing of risks. Within all these dimensions, the client plays a central role, so Gruis' characterisation can be considered as client-led supply chain integration. In this thesis, which is set in the Dutch context, the term 'partnering' has been used to translate 'ketenintegratie' rather than 'client-led supply chain integration', because the broader description of partnering leaves room for several secondary approaches. These are indeed present among Dutch housing associations (Rodgers et al., 2013), although in the majority of cases a dyadic approach is taken, namely a partnership between the housing association and the general contractor (Bygballe, 2010).

The collaborative project approach is interesting not only from the point of view of efficiency and effectiveness, but also when it comes to information sharing, because of the organisational learning effect. This occurs in partnering projects because the experience and tacit knowledge gained in one project is transferred to the next because the project team stays together (Bresnen, 2009). Learning is identified as important for improving organisational performance (Wu and Chen, 2014) and it enhances competitive advantage (Jerez-Gómez et al., 2005).

For the implementation of climate change adaptations in social housing, the learning effects of the partnering approach are important because these adaptations are new to the sector and they should be considered an ongoing social learning process (Hinkel, 2011). The dissemination of solutions will occur much more easily if the parties learn from one another and the problem is analysed from a range of viewpoints.

To date, some Dutch housing associations have begun to experiment with the partnering approach in their projects (Roders *et al.*, 2013; Vrijhoef, 2011). It can be expected that others will follow, considering the expected benefits of partnering according to the CII (1991) definition. Research has also proven that an integrated approach leads to lower costs (Thompson and Sanders, 1998) and shorter lead times (Salcedo Rahola, 2015). In addition, it is reasonable to expect that the adoption of partnering by housing associations will accelerate. Their current financial situation means that they have to become more efficient and the government is forcing them to focus on their core task: providing homes for those who cannot do this on their own. The refurbishment and maintenance of dwellings could easily be outsourced from that point of view.

§ 2.7 Discussion and conclusion

Although a number of governance tools are available that could stimulate the adoption of climate change adaptations by housing associations, there are serious issues that prevent the use of many of these. The likelihood of using financial incentives and regulation is decreasing, and the effectiveness of information tools are difficult to measure. This leaves room for the development of new governance tools, in order to maintain a wide palette of tools to encourage action on climate change adaptations.

The construction process as a governance tool would be a combination between a market tool and a network tool. The market aspect relates to the knowledge of climate change adaptation that is gained by the participating construction companies, which may imply a competitive advantage for them. The network aspect is closely linked with the collaboration that is central to the partnering approach.

Networks are considered an effective type of governance to deal with climate change issues because of their capability to deal with uncertainties. The flexible structure of networks and the participation of many different actors provides a good basis for innovative solutions, because problems are perceived from various viewpoints. The construction sector has had a long and continuous relationship with housing associations. For many years, housing associations have been adapting their building stock for reasons other than climate change adaptation. These adaptations have generally been carried out by the construction sector. Existing governance tools focus largely on building owners when addressing physical adaptation measures, assuming that it is the owners who will initiate a process where they order the construction sector to implement changes. However, the construction sector is highly fragmented, which creates several obstacles to the easy adoption of new measures. The partnering approach can remove those obstacles. All in all, it is worth exploring the feasibility of using the partnering approach as a governance tool.

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3 Awareness of climate change adaptations among Dutch housing associations

Chapter 3 defined a starting point for the development of governance tools. The method used – content analysis – was chosen to conduct a quick scan of the current awareness of climate change adaptation among housing associations. It was conducted at the beginning of the research, so over the course of the research, the situation regarding their awareness could have changed, but considering the economic crisis and the political situation relating to their finances and activities, it can be expected that the situation has not significantly improved.

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Abstract

Climate change: the question is not anymore if it happens, but what the impact is of its effects such as drought, heat waves and increased precipitation on the quality of our lives in cities, offices and houses. A significant share of the Northern European housing stock is owned and maintained by large stock owners, such as housing associations. It is their responsibility to be aware of changes and risks that might challenge the quality of life of their tenants. Moreover, in order to provide housing with a good market value in the future, adaptation to climate change can no longer be overlooked. With the aim to discover the level of awareness of climate change adaptation among Dutch housing associations, a content analysis was undertaken on the policy plans and the annual reports of the 25 largest housing associations. Subsequently they were classified according to their level of awareness. The analysis returned no topics that directly referred to climate change adaptation, which implies that all housing associations are categorised as being 'unaware'. Therefore, in order to reach higher levels of awareness and to incentivize the implementation of adaptation measures, appropriate governance strategies need to be developed. Future research will define the characteristics of these strategies in relation to the level of awareness of the housing associations. Adoption of the measures could be easier if adaptation measures are combined with maintenance activities, as this has been the case with mitigation measures.

Keywords: Awareness, Adaptation, Climate Change, Mitigation, Social Housing.

§ 3.1 Introduction

There is clear scientific evidence of a changing climate at both the global and national levels. The Intergovernmental Panel on Climate Change (IPCC) states that “warming of the climate system is unequivocal”. It reports that during the twelve-year period between 1995 and 2006, eleven years ranked among the warmest since the first measurements in 1850 (IPCC, 2007). The Royal Dutch Meteorological Institute (KNMI) found out that the long-term mean temperature in the Netherlands has risen by 1.7°C since 1900, while the global increase has been 0.8°C. In the period 2003-2008, three years ranked among the ten warmest years since records began in 1706 (KNMI, 2008). This evidence means that policymakers can no longer postpone activities and must start addressing the impact of climate change. Stakeholders such as housing associations play a major role in securing the quality of life in our cities because they own large stocks of housing and their decisions will therefore affect a greater percentage of citizens. This is particularly the case in many North-West European countries such as Denmark, Sweden, the Netherlands and Germany, where the rented sector owns and manages almost half of the housing stock (Dol and Haffner, 2010). In the Netherlands, the duty to secure the quality of dwellings is a legal obligation for housing associations (MinIKR, 2005). Therefore, they need to be aware of the changes that may adversely affect the quality of life of their tenants. Moreover, in order to provide for financial continuity (MinIKR, 2005), they also need to treat their houses as assets that maintain a good market value in the future, which implies that, among others, resilience to climate change has to be taken into account.

Relative to the total building stock of 7 million dwellings, the social rented sector with its 2.4 million dwellings is considerably large in the Netherlands (www.cfv.nl). The size of the social rented stock, together with the fact that housing associations have legal duties concerning quality of life (MinIKR, 2005), underline the importance of the engagement of housing associations for the development and implementation of climate change adaptation strategies. Moreover, the Dutch social rented sector is relatively easy to approach since a large stock of dwellings is owned by just a few organizations. In 2012, there were 381 housing associations in the Netherlands, which owned on average 6,300 dwellings (www.cfv.nl). The largest housing association owns approximately 80,000 dwellings.

§ 3.2 Climate change in the Netherlands

The impacts of climate change are numerous. The sea level will rise, threatening the low-lying areas and river deltas (KNMI, 2006). This effect will be more pronounced in countries where major rivers experience more run-off in winter (Bessembinder, 2008), threatening the adjacent areas, as is the case in the Netherlands. All in all, the risk areas for sea and river flooding cover 55% of the land area of the Netherlands (PBL, 2011). Another threat comes from intensified peak precipitation, which can cause local flooding (Bessembinder, 2008).

Temperature increases will affect the natural environment (PBL, 2009) and the climate in cities (Salcedo Rahola *et al.*, 2009). The main impacts of heat relate directly to human health issues, rather than financial damage to properties caused by natural catastrophes such as flooding. Expected hazards include heat stress, summer smog, and an increase in allergies and viruses. A positive effect of a warmer climate is reduced illness and mortality in winter (PBL, 2009). Because 62% of the Dutch social housing stock is located in urban areas (with a density of > 1500 addresses per km², ABF, 2011), special attention is paid to the Urban Heat Island effect. This is the phenomenon by which the urban structure retains heat and is consequently warmer than the surrounding countryside. The largest temperature differences occur at the end of the day and can reach 10°C (Salcedo Rahola *et al.*, 2009). The Urban Heat Island effect is caused by several factors, being absorption of solar radiation, air pollution, 'street canyons', anthropogenic heat (cars, air conditioners, industrial processes etc.), heat-retaining materials, a lack of evaporative surfaces, and reduced wind speeds (Kleerekoper *et al.*, 2012).

The risk of flooding caused by the sea and major rivers will be tackled to a large extent as soon as the national government starts implementing the measures proposed by the 'Delta Commission' (Delta Commission, 2008), so the focus for housing associations will be to help to reduce the flood risks caused by precipitation.

Housing associations have the possibility to increase climate resilience by applying adaptation measures to their dwellings. By 'climate change adaptation' is understood "any action, either intentional or accidental taken to minimize the adverse effects of climate change or to take advantage of any beneficial effects" (HM Government, 2006).

The application of lighter colours on building façades in order to reflect radiation is only one of the range of measures which could be implemented by housing associations. By using lighter colours instead of darker colours, the surface temperature of the façade – and therefore the air temperature close to it – can be reduced by 3-4°C (Watkins *et al.*, 2007). Another related measure is careful consideration of the type of vegetation that housing associations plant in common gardens of e.g. apartment

blocks, in order to prevent allergies (MWH, 2012). The hazards of flooding caused by extreme precipitation can be reduced by applying adaptation measures to retain water temporarily, such as 'green roofs' (MWH, 2012) or to ensure effective drainage such as open pavements (www.klimatilpasning.dk; MWH, 2012) reducing the peak load on the sewage system. Another effective measure is to use materials that are not negatively affected by water so that if, despite all protective measures, flooding happens under extreme circumstances, the consequences are less intrusive (Pitt, 2007).

§ 3.3 Awareness

With the intention to reduce the effects of climate change (mitigation), policies have been adopted on both an international and a national scale. For example, the European Commission has approved Directive 2002/91/EC, known as the Energy Performance of Buildings Directive (EPBD) (EP, 2002). In the Netherlands, the EPBD has been applied to existing buildings since 1 January 2008. The EPBD has made it compulsory for housing associations to provide an energy label at each transaction (renting/selling) of their dwellings. In the Netherlands, the energy label is still merely a communicative instrument. This is mainly due to a lack of law enforcement and/or sanctions, and because there are no requirements relating to minimum energy performance (Tambach *et al.*, 2010). However, it does provide an insight into the energy performance of their dwellings. Most housing associations have 'labelled' all their units, so they now know the current energy performance of their building stock (Tambach *et al.*, 2010). For new buildings, legislation on energy performance is also in place. The building code prescribes the energy performance for new buildings using the so-called Energy Performance Coefficient. Buildings may only be built if they comply with the building code, so property owners and the construction industry are automatically aware of the legal mitigation measures, even if they appear to not work well enough to achieve the intended goals in the Netherlands (Daniëls and Kruitwagen, 2010). However, even if it were possible to stabilise greenhouse gas emissions, climate change and the associated effects would continue (IPCC, 2007). Consequently, measures have to be developed for adaptation. Policy on this theme is being made at both the international and national levels. The European Union has demonstrated its adaptation awareness by firstly launching a Green Paper on Climate Change in 2007, which set out ideas on adaptation measures (CEC, 2007), followed by a White Paper on Climate Change in 2009 (CEC, 2009), proposing legislation on the matter. At the national level, adaptation strategies are being developed in countries such as Denmark, Finland, France, Germany, Hungary, the Netherlands, Romania, Spain and the UK (Biesbroek *et al.*, 2010). Information is more diffuse at the local level, but adaptation strategies are already being implemented or under development

in world cities such as Cape Town, Durban, Quito, Tokyo, Walvis Bay and Windhoek (MIT, 2011) and European cities such as Madrid, Manchester, London, Stuttgart, Basel, Berlin and Freiburg (Carter, 2011). Another indicator that cities are becoming aware of a changing climate is their involvement in research projects such as Climate Proof Cities (www.knowledgeforclimate.nl), Klimzug-Nord (www.klimzug-nord.de) and GRaBS (www.grabs-eu.org). Since climate change adaptation emerged only recently as plan development field (Biesbroek *et al.*, 2010, Lindley *et al.*, 2007), much effort is still being channeled into setting up adaptation programmes, which may eventually lead to legislation.

§ 3.4 Methodology

In order to find out if the awareness of adaptation has already reached the operational level of policy making, a case study was carried out among housing associations in the Netherlands. The study consisted of a content analysis (Bryman, 2008) on policy documents from 25 housing associations to reveal their awareness of climate change and a classification of the associations according to their level of awareness. The sample comprised the 25 housing associations with the most rental units in 2008 (ABF, 2008). By selecting these 25, the sample contained as much dwellings as possible of which the state of adaptation would be known. If the sample would have been selected on another way, for instance randomly, it would almost certainly contain fewer dwellings. In total, the selected associations own 881,000 dwellings, which is around 37% of the Dutch social rented housing stock of 2.4 million dwellings (ABF, 2008). Moreover, the sample contained housing associations spread over the whole country, reducing geographical bias (Figure 3.1).

Two types of policy documents were selected for their ability to report on the projects implemented by the associations and their general strategies. The first type of documents were annual reports describing the associations' projects and their activities in the previous year. The second type was the corporate policy plan. In the latter, housing associations usually describe their planned strategies for the forthcoming 3-5 years. Although some housing associations had more up-to-date information available on their websites, it was decided to not use websites for this research because information on websites can change quickly, and it is not always clear whether this information has been approved by Executive Boards, as is the case for policy documents such as those mentioned above. The reference years were 2009 for the annual reports and 2010 for the corporate policy plans.



FIGURE 3.1 Geographical distribution of the 25 largest Dutch housing associations (each circle represents the main office of a housing association)

GROUP	DIRECT NOTION	INDIRECT NOTION	
Climate	Climate	Indirect Notion	
	Climate Change	Climate	
Adaptation	Heat	Climate Change	
		Green façade, green façades	
		Trees, mobile trees	
		Shadow, panes, pergolas, shelters, shades, blinds, shutters	
		Thermal Mass	
		Evaporative, evaporation, spray curtains, mist sprays	
		Cooling, night cooling	
		Cooling beams, walls, columns, slabs	
		Airconditioning	
		Floor height	
		Reflective surface, albedo	
		Flooding	Airtightness
			Sewage
			Flooding
		Guttering (increase dimension)	
	Parapet gutter, internal downpipe (reduce use)		
	Spouts, gargoyles		
	Drains		
	Rainwater, rain, rainfall		
	Water retention; storm water tanks		
	Basins, reed beds, ponds		
	Infiltration, infiltration facility, grit box, infiltration crate		
	Permeable and porous pavements		
	Materials (water resistant)		
Mitigation	CO ₂	Green roof, green roofs	
		CO ₂	
		Sustainable energy	
		Renewable energy	
		Solar energy, roof surface, roof inclination	
		Solar boiler	
		Wind energy, windmill	
		Geothermal	
		Biomass	
		Rest heat	
		Photovoltaic, pv	
		Living costs	Heat and cold storage
			Living costs
			Energy prices, energy costs

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GROUP	DIRECT NOTION	INDIRECT NOTION
		Energy saving, low energy, energy neutral, climate neutral
		Heating system
		Heat pump, heat pump boiler
		Compact building
		Sun room
		Thermal bridge
		Orientation, zoning,
		Position windows, daylight reflectors
		Energysaving light bulbs, HF/TL lighting, LED
		Passive house
		Low temperature heating, floor heating, wall heating
		Heat recovery (ventilation, shower)
		Smart ventilation system (CO ₂ driven, presence, time limits)
Insulation	Insulation	Energy performance, energy label
		Insulation
		Double glazing, insulated glazing, HR++ glazing

TABLE 3.1 Taxonomy of topics searched for in content analysis

The keywords were structured into a taxonomy (Table 3.1) which was subdivided into four main groups: climate, adaptation, mitigation and insulation. The first group, 'climate', was created in order to obtain a general view on the awareness of climate change among the housing associations and included the notion 'climate change'. This group also included the notion 'climate', in order to find words referring to climate change, but not literally expressing it, which is the case in a phrase like "This climate-friendly roof, (...)". (Eigen Haard, 2010). The keywords were selected in order to discover if housing associations are, with respect to their dwellings, aware of climate change, meaning "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UN, 1992). The second group, 'adaptation', focused on revealing the awareness of the impacts of climate change housing associations are required to adapt to. The group included the notions 'heat' and 'flooding', being to date considered the main impacts on the urban environment in the Netherlands (PBL, 2009).

As the social housing stock is mainly located in urban areas, housing associations have to deal with these impacts. However, not only the notions 'heat' and 'flooding' as such were searched for, but also notions referring to measures to adapt to the impacts of heat and flooding, in order to gain insight in the state of adaptation of the building stock. The adaptation measures are derived from a climate change adaptation checklist by the Greater London Authority (GLA, 2005). An example of this kind of measures is the notion 'tree', which was counted as an adaptation measure in the 'heat' category,

because trees have cooling capacities by means of shadow and evaporative cooling (Gill *et al.*, 2007). The search for this category of notions was carried out against the background that even though a housing association did not show awareness of climate change, (part of) its housing stock can be adapted, which in the end does provide more living quality for the tenants. The third group, 'mitigation', included the notions 'CO₂' and 'living costs', which would help to discover the awareness of climate change mitigation among Dutch housing associations. The selection of 'CO₂' was based on the establishment of the governmental policy focusing on CO₂ reduction in the 'Clean and Efficient' programme in 2007 (MinVROM, 2007). 'Living Costs' was selected as this topic came into consideration in the 'Agreement Energy Savings in the Social Rental Sector' between the Dutch national government and the housing associations in 2008. In this document the importance of taking energy saving measures was acknowledged in view of the development of living costs (MinVROM *et al.*, 2008). Living costs are defined as the total costs for living, such as rent or mortgage, including additional expenses for taxes, insurance, sewage, gas, water and electricity (Blijie, 2010). Being mitigation to date more developed as a research topic than adaptation (Biesbroek *et al.*, 2010), the governance of mitigation has been more institutionalised, resulting in funding and regulation schemes (Anguelovski and Carmin, 2011). The analysis has to point out if these governance measures have led to more awareness of climate change mitigation among housing associations. The reason to divide the mitigation topics into 'CO₂' and 'living costs' was to discover the motivation of the housing associations to apply the mitigation measures, being respectively the (global) environment, or the socio-economic circumstances of their tenants. Parallel to the adaptation group, in 'mitigation' was also searched for measures related to mitigation, in order to find out if housing associations were taking mitigation action without naming it as such. The notions related to energy saving are connected to 'living costs' because they refer to a better energy performance of the dwellings, meaning lower energy consumption and a lower energy bill for tenants, whereas the notions related to sustainable energy are connected to 'CO₂', because they imply less emissions, not necessarily resulting in lower energy bills for tenants. The measures were taken over from the 'Toolkit sustainable housing' (Hameetman *et al.*, 2006) and from the energy chapter of the guideline for education on sustainability: 'Basisdoc XS 2' (Stofberg and Duijvestein, 2008). 'Insulation', the last group, included the notion of 'insulation' and 'double glazing'. It was added separately because of its role in both mitigation and adaptation. Insulation measures were suggested in both the adaptation measures checklist by the Greater London Authority (GLA, 2005) and the mitigation reference documents by Hameetman *et al.* (2006) and Stofberg and Duijvestein (2008). Insulation is an adaptation measure because it keeps heat outside the dwellings on warm days, whereas on cold days it keeps the warmth (heating energy) inside the dwellings and thus can be considered as mitigation measure.

Every policy document was analysed according to the taxonomy. One disadvantage of content analysis is that one notion can have multiple meanings, which requires interpretation by the researcher. Moreover, notions that belong to one of the groups

in literal terms but do not refer to climate change were excluded from the results, in order to not 'contaminate' results but have a clear view on the climate change related topics. For example, the word 'climate' was excluded when referring to 'indoor climate' or 'social climate'. In order to classify housing associations according to their awareness of climate change, a suitable model was searched for, which had to have the ability to clearly represent the link between two variables, being aware/unaware and adapted/unadapted. One possibility was the BCGmatrix, which focuses on the positioning of business units of a company and market developments (Sarrico and Dyson, 2000). This model was not found suitable, because the values of the model deal with performance dimensions of business units, whereas in case of the awareness of the housing associations the state of the subjects (aware/unaware or adapted/unadapted) has to be represented. Another model was Hersey and Blanchard's situational leadership model, giving directions on the optimal leadership style suitable for a certain 'level of maturity of a subordinate' (Thompson and Vecchio, 2009). This model was not chosen to classify the housing associations because Hersey and Blanchard's model focuses on leadership strategies and not on the state of the subjects. However, the four stages of the learning model as described by Hughes (2002) did represent the state of the subjects to be classified, so this model was used as basis. This model links two variables, 'conscious / unconscious' and 'competent / incompetent' in a logical manner. Moreover, the 'conscious / unconscious' variable would also provide an opportunity to consider the adaptation strategies already being implemented by housing associations, without them being aware of their contribution of the measures to climate change adaptation (see Table 3.2).

LEARNING STAGE (HUGHES 2002)			ADAPTATION AWARENESS				
			Value	Strategies	Value	Projects	Total
1	Unconscious competent	One is not even aware that he or she lacks knowledge or skill	-	No or indirect references in policy plan (unaware)	-	No references in annual report (unadapted)	--
2	Innovation by partnering approach	One is aware that he or she lacks a knowledge or skill	+	Direct references in policy plan (aware)	-	No references in annual report (unadapted)	+-
3	SWOT analysis conceptual approaches	One acquires the missing knowledge or skill and applies it in articulated or codified ways	+	Direct references in policy plan (aware)	+	Direct and indirect references in annual report (adapted)	++
4	Assessment likelihood implementation strategies	One's knowledge or skill becomes second nature, applied seemingly without thought or effort	-	No or indirect references in policy plan (unaware)	+	Direct and indirect references in annual report (adapted)	-+

TABLE 3.2 Four levels of awareness of housing associations. Adapted from Hughes (2002)

Basically, appearance of notions in the annual reports determines whether the housing associations are being considered 'adapted' or 'unadapted', whereas appearance of notions in the policy plans determines whether housing associations are being considered 'aware' or 'unaware'. However, the indirect notions have to be treated differently in the annual reports and in the policy plans. In the annual reports, indirect notions refer to measures that have been applied already, so both direct and indirect notions lead to the 'adapted' category. On the contrary, in the policy plans, indirect notions refer to measures that will be taken in future developments but because the references are indirect, these do not imply more awareness, so in this case, only direct notions lead to the 'aware' situation. The highest level that can be reached in the learning process model is level 4, whereas for adaptation awareness level 3, 'aware, adapted' was considered the most suitable. The rationale for such a change of target is that on this level, the building stock is climate resilient and the housing associations are aware of the consequences of a changing climate. On the other hand, housing associations in level 4 are considered to have a climate resilient building stock, but because of their unawareness they are not alert to future changes that may negatively influence their tenants' quality of life (see Figure 3.2).

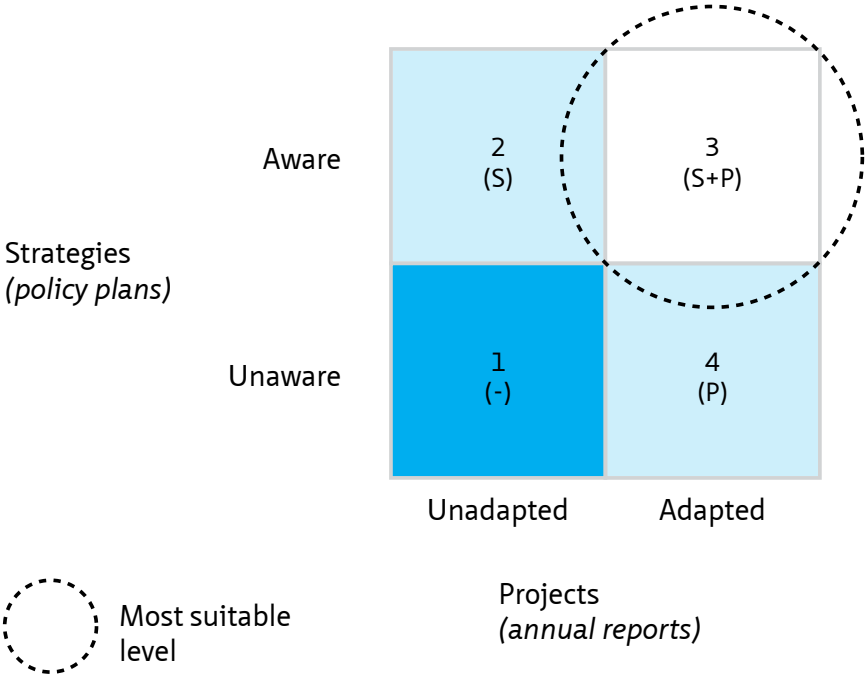


FIGURE 3.2 Schematic representation levels of awareness (S=Strategies, described in the Policy plans; P=Projects, described in the Annual reports)

§ 3.5 Findings

The policy plans of 19 (76%) housing associations were available for analysis. In these plans, 'climate'-related notions are mentioned by 3 housing associations (see Figure 3.3). Climate change is not mentioned in any policy plan, which is also the case for 'adaptation'-related notions. However, the policy plans do pay attention to 'mitigation'-related notions ('CO₂' and 'living costs'). 'Living costs' is mentioned in 13 plans while 'CO₂' is mentioned in only 8. 'Insulation' is mentioned by 7 housing associations in their policy plans.

Annual reports of 24 (96%) housing associations were available for analysis. These reports hardly referenced notions related to the main themes 'climate' and 'adaptation' (see Figure 3.4). In fact, only 10 of the reports mention 'climate' at all.

Zooming in, 'climate change' was referred to even less, being mentioned by only 3 housing associations. There are no direct references to 'heat' and 'flooding'. However, when we also take into account the indirect references (e.g. 'cooling'), 'heat' is mentioned by 11 housing associations and 'flooding' by 10. In total, 15 housing associations do refer to adaptation in their annual report, by mentioning notions related to 'heat', 'flooding' or both. Notions relating to mitigation, however, show up far more frequently. Direct references to both 'living costs' and 'CO₂' appear in 18 annual reports. Adding the indirect references, 'living costs' appears in all the annual reports analysed, while 'CO₂' appears in 19 of the reports. These high numbers are caused by notions related to energy, such as 'energy-saving', 'energy-efficient' and 'energy label'. 'Insulation' is mentioned by 22 housing associations.

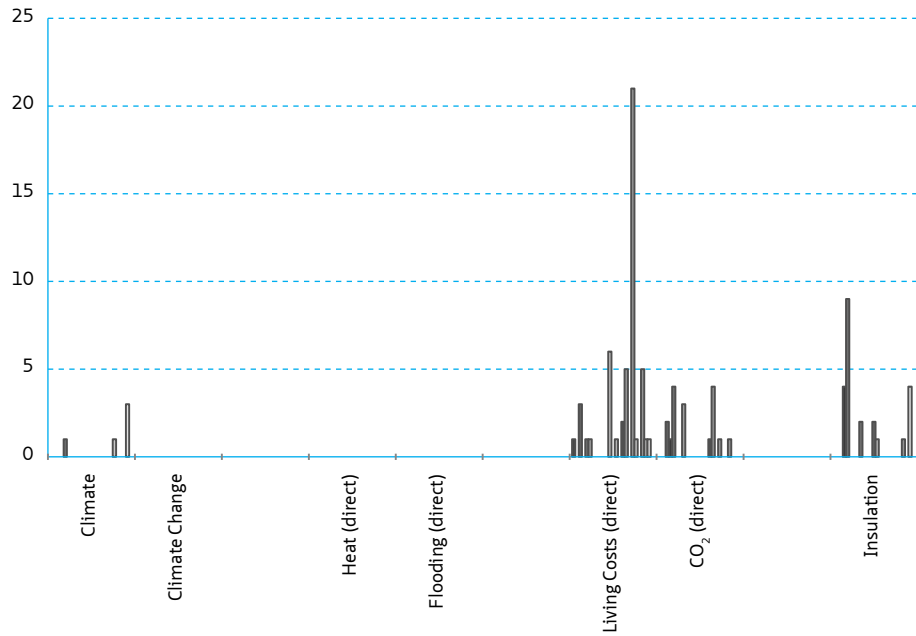


FIGURE 3.3 Content analysis of policy plans (each bar represents the number of notions found in the policy plan of one housing association)

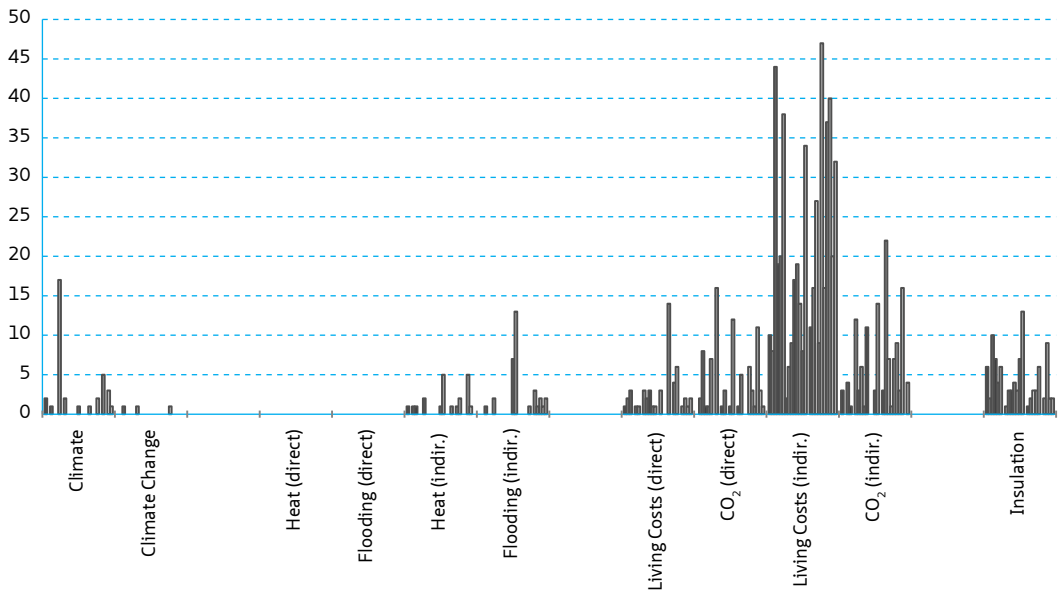


FIGURE 3.4 Content analysis of the annual reports of 2009 (each bar represents the number of notions found in the annual report of one housing association)

§ 3.6 Discussion

The categorization of the housing associations has taken place in steps. Firstly, the state of awareness of climate change adaptation was determined, which depended on the appearance of direct notions in the policy plans. However, as explained in the previous section, no notions were found so none of the housing associations was attributed to the 'aware' categories. Secondly, the state of adaptation was considered, by assessing the appearance of direct and indirect notions referring to climate change adaptation in the annual reports. It can be stated that 15 housing associations can be classified as being 'adapted', because they do refer to adaptation measures in their annual reports (Figure 3.5).

The awareness of adaptation among Dutch housing associations contrasts strongly with the awareness of mitigation, as notions related to this topic were frequently found in both the policy plans and annual reports. This indicates that the housing associations do have taken measures to a large extent and the majority is even aware of mitigation (Figure 3.6).

However, when the measures regarding insulation are taken into consideration, the number of housing associations classified as 'unaware / adapted' increases significantly, as shown in Figure 3.7.

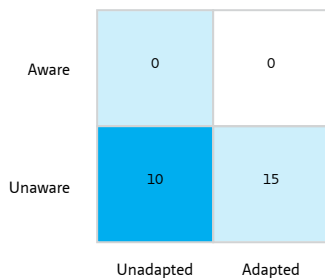


FIGURE 3.5 Classification of housing associations regarding 'adaptation'

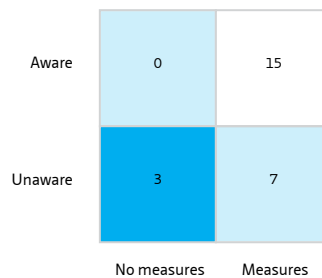


FIGURE 3.6 Classification of housing associations regarding 'mitigation'

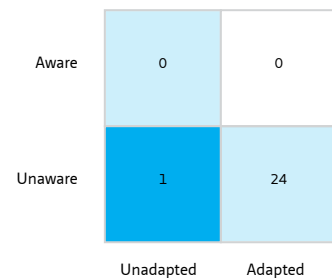


FIGURE 3.7 Housing associations with adaptation references including insulation

The figures above show that most housing associations in some way or another already apply adaptation measures on their dwellings, but they are not aware of it. For example, they may have taken these measures in projects without being aware that the measures also had adaptation characteristics, but in the analysis they were counted

as such (indirect notions). These measures were taken in order to enhance quality of life (e.g. planting trees, installing cooling equipment) or improve energy performance (insulation). This means that applying adaptation measures is neither impossible nor unrealistic; the question is rather whether the measures taken are the right ones and whether they are enough to make the dwellings climate-resilient. In order to make the entire building stock climate resilient, however, the right adaptation measures must be implemented as standard. These measures therefore have to be included in policy strategies and maintenance budgets.

Awareness is very important in order to take the right measures and to take all possible measures. Moreover, it may prevent maladaptation, which is adaptation that brings negative trade-offs. An example of this is air conditioning, a measure which is to adapt a dwelling to increased temperatures but this measure demands extra energy and therefore produces greenhouse gases, which in turn aggravate climate change (Barnett and O'Neill, 2010).

Even though many impacts are projected with 2050 or even 2100 as horizon (Klein Tank and Lenderink, 2009), adaptation measures can and should be taken as soon as possible. Since newly built houses account for less than one per cent of existing dwellings (www.cbs.nl), maintenance and refurbishment activities of the existing building stock offers the best opportunity to “mainstream” (Pinkse and Kolk, 2012) measures. By mainstreaming adaptations synergies are sought between the adaptation measures and the work that was already planned. In the case of mitigation, the notions related to energy saving measures (living costs, indirect) are more found than notions related to sustainable energy measures (CO₂, indirect), which might indicate that housing associations have chosen to mainstream mitigation measures with activities aiming to reducing living costs for their tenants. Moreover, improving the energy performance of dwellings by installing insulation is an effective strategy for mitigation as well as adaptation, preventing respectively heat loss in winter and heat stress in summer. It would be advisable to begin adaptation activities in dwellings that are the most sensitive to the hazards of climate change. For the Netherlands, sensitivity maps of urban areas are under development within the research project Climate Proof Cities (TNO, 2011).

§ 3.7 Conclusion

Dutch housing associations display no awareness of climate change adaptation in their policy documents. However, this does not mean that the building stock is not adapted to climate change. By categorizing the housing associations on the basis of their awareness, strategies can be developed in order to increase awareness among housing associations in a proactive way. As the subject of insulation shows, adaptation is possible and feasible, but housing associations need to be aware of climate change adaptation in order to know what to do to insure their tenants' quality of life and not miss opportunities to incorporate climate change adaptations when refurbishing or maintaining their housing stock. Governance strategies in the field of mitigation, such as the implementation of legislation concerning energy labels, seem to be an interesting point of reference, because housing associations have shown an awareness of climate change mitigation. However, further research is necessary to define which of these mechanisms are the most suitable for initiating or adding to the climate change adaptation measures implemented by housing associations.

The method used – content analysis – has proven to be effective for a quick scan of the current awareness of climate change adaptation among housing associations. However, because the method focuses on reports and these do not usually extend to the level of individual buildings, it is possible that adaptation measures are already being implemented on a larger scale, but they were not described in the analysed documents or misinterpreted by the researchers. Further research should focus on the level of individual buildings by, for example, interviewing project leaders who know the state of the dwellings or by carrying out a condition assessment of the buildings focusing on adaptation measures.

Thus, to conclude, besides raising awareness of climate change among housing associations, research needs to be carried out into the methods for adapting residential buildings effectively, because only in an 'aware-adapted' situation the quality of life of tenants can be maintained. This will enable housing associations to ensure that their building stock meets the needs of a modern society.

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4 Evaluation of climate change adaptation measures by Dutch housing associations

This paper is a follow-up to the previous chapter. Because Chapter 3 focused on reports which do not usually include detailed information on individual buildings, it was possible that adaptation measures were already being implemented on a larger scale but without these being described in the documents analysed. For this reason, in Chapter 4, policymakers at housing associations were interviewed on how they would assess the feasibility of a number of predefined climate change adaptation measures.

Although the thesis takes into account climate change adaptation measures relating to extreme rainfall and urban heat, this study only focused on heat-related problems because the measures to cope with the effects of both heat and rainfall were too many to cover in one interview. The heat issue was prioritised because the main effects relate directly to human health issues, while flooding tends to cause 'only' financial damage to properties. Moreover, heat-related measures can be adopted solely by the housing association, while water-related measures are in many cases a responsibility that is shared with municipalities, because they own the sewage system and are responsible for its performance. However, the barriers to the implementation of adaptation measures for heat and water-related impacts are similar in the sense that there is no policy framework for adaptation measures for either of them; the financial barriers are the same and for both topics counts that some measures are difficult to implement while others are more easy to implement.

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Abstract

Purpose – Research into climate change adaptation measures has resulted in the identification of 155 such adaptation measures that contribute to making the built environment more climate resilient. These measures mainly focus on new construction. This paper assesses the feasibility of the measures for the existing social housing stock in the Netherlands.

Design/methodology/approach – Interviews were conducted with 12 property managers and policy staff members from Dutch housing associations. The interviewees

judged 21 measures that were designed to adapt dwellings to heat-related problems caused by climate change, and they also answered questions regarding their awareness of climate change and regarding the feasibility of the measures.

Findings – Low awareness of climate change adaptations, the financing of the measures and the technical complexity of adaptation measures are perceived barriers to implementation. Several possibilities to remove these barriers are discussed.

Research limitations/implications – The sample of 12 interviewees provides valuable insight into the opinions of a select group of policymakers from housing associations. The judgments were made based on the personal experiences and expectations of the interviewees.

Originality/value – This paper provides valuable insight into the opinions of policymakers and decision-makers in Dutch housing associations on climate change adaptation measures in the existing building stock. These insights will be of use for policymaking at the local and national levels directed towards creating a resilient building stock.

Keywords – adaptation, climate change, social housing, technical measures.

Paper type – Research paper.

§ 4.1 Introduction

There is clear evidence that the global climate is changing (Füssel, 2009; Smith et al., 2009). The IPCC scenarios show an increase in temperature by up to 4°C globally by 2099 (A1FI scenario: IPCC, 2007). For the Netherlands, the predictions are that by 2050 the average temperature will have increased by 0.9°C to 2.8°C in summer (Klein Tank and Lenderink, 2009). One of the threats of climate change in the Netherlands is an increase in temperature in urban areas, the Urban Heat Island effect (UHI). This occurs because cities have a high concentration of construction materials in streets and buildings that retain heat. The largest temperature differences may reach up to 10°C at the end of the day (Salcedo Rahola et al., 2009). Too much heat can lead to serious health problems (Luber and McGeehin, 2008), as it can affect the human cardiovascular system (Hess et al., 2009) and cause respiratory problems (Stafoggia et al., 2006). Moreover, it may even lead to mortality (Anderson and Bell, 2009). Heat can cause lower labour productivity and dangerous conditions for workers (Health Council of the Netherlands, 2008). From a social point of view, heat can cause problems in the general living environment because of a direct relationship between increased temperatures, higher irritation levels and lower tolerance levels (Anderson, 1989). In addition to labour productivity problems and an unsafe working environment, the effects can occur in or around dwellings. Fortunately, people can change their behaviour to avoid these negative impacts of heat (see, for example, Department of Health, 2012; Oakman et al., 2010; MinHWS, 2007).

Moreover, these impacts can be reduced by carrying out adaptation measures on dwellings. Several studies have elaborated on these measures, such as external wall insulation and solar reflective wall coatings, which are effective at reducing the heat generated on sun-exposed walls (Porrit et al., 2012). Applying shading above windows has also been found to be an effective measure for reducing high temperatures and the hours of overheating in dwellings (Coley et al., 2012).

The Dutch Building Code deals with overheating as part of the Energy Performance Coefficient (EPC). Although there are no specific limits on overheating hours, overheating is expected to be prevented by translating interior temperatures over 24°C into a cooling demand. The higher the cooling demand, the higher the EPC value. To meet the requirements of the building code this value must be decreased, either by decreasing the overheating load or by introducing compensatory energy-saving measures (NEN, 2012; Van Wolferen, 2012). However, it should be emphasised that the EPC is a measure of energy efficiency, not of the comfort of the dwelling.

In the Netherlands, housing associations own and maintain 2.4 million dwellings (www.cfv.nl), equivalent to one-third of the total stock of 7.2 million dwellings (CBS, 2013). As such they are major potential providers of adaptation measures to dwellings. Moreover, the Social Rented Sector Management Order (BBSH) lays down the legal responsibilities of housing associations concerning quality of life and healthy dwellings (MinIKR, 2005). In this regard, special attention needs to be paid to the development of measures for the existing building stock, as new construction in the last ten years represents only 1 percent of current total stock (CBS, 2012). This means that at least 60 percent of the building stock which will be in use in 2050 has already been built today and these dwellings will have to be adapted.

The Dutch social rented sector is relatively easy to approach as, despite the number of dwellings, they are owned by just a few organisations. In 2012, there were 381 housing associations in the Netherlands, owning on average 6,300 dwellings (www.cfv.nl). Despite their important role and responsibilities, in a recent study of policy documents, Dutch housing associations demonstrated a limited awareness of climate change adaptation (Chapter 3). Consequently, if there are no changes in policy development, they are not expected to introduce physical adaptation measures to their dwellings that will reduce the harmful effects of climate change. Although governance instruments have been developed to implement climate change adaptations, the focus of the instruments to date has mainly been on the national (e.g. Biesbroek *et al.*, 2010) and municipal levels (e.g. Bulkeley, 2010). The owners of real estate who are in a position to take action and start implementing physical adaptations are currently not addressed. Several governance strategies, such as information provision, incentives or regulation, can be used to make housing associations take action. However, in this regard it is important to discover what housing associations actually know about physical adaptation measures so that effective governance strategies can be developed. The aim

of the study was to gain an indicative overview of the state of awareness among policymakers in housing associations throughout the Netherlands and gain insight into their initial perceptions of the feasibility of physical adaptation measures. The study focused on measures for the existing building stock, designed to make dwellings more robust to heat-related problems caused by climate change. The research question was: With respect to the existing building stock, how do policymakers from Dutch housing associations judge the feasibility of physical adaptation measures for heat-related problems caused by climate change?

§ 4.2 Physical adaptation measures

Recently, the Dutch Ministry of Infrastructure and Environment listed 155 adaptation measures for the built environment. The measures focus on the climate change issues present in the Netherlands: inner and outer dike safety, safety around water barriers, water hindrance, drought, salinisation, ground shrinkage, heat, water quality and air quality. In addition, the levels of intervention were delineated, starting with buildings as the smallest unit of intervention, followed by plot, street, neighbourhood, city and region (MWH, 2012).

The characteristics associated with each measure were derived from the literature and collected in a database for easy access. A factsheet was also produced for each measure, which contains a short general description of the measure and a report on the characteristics of the measure in terms of effectiveness, finance, feasibility, maintenance and organisation. Furthermore, the factsheets show the interrelationship with other measures and contain references to the sources in the literature from which the measure is derived.

Of the 155 measures, 21 focus on both heat and the level of the building (Table 4.1). The Ministry recommends the implementation of the measures when a building is first constructed because this limits the additional costs (MWH, 2012). This is specifically the case for 76 percent of the measures (symbolised by '+/-'), while another 14 percent are considered to have equal or lower costs than a conventional measure (measures with '+'), and 10 percent are more expensive (measures with '-'). Most measures (71%) are expected to have the same intensity of maintenance as conventional measures, represented by the '+/-', while 24 percent have an increased intensity of maintenance and 5 percent require less maintenance.

Measure	Description of measure	NEW BUILT	
		Costs of implementation	Intensity of maintenance
Heat and cold storage in the ground	Usage of ground mass for cooling in summer	-	+/-
Cooling by river water	Usage of river water for cooling in summer	-	+/-
Green roofs	A layer of vegetation on the roof, plants provide evaporative cooling	+/-	-
Green facades	Vegetation on a vertical structure attached to the facade, providing evaporative cooling and shade	+/-	-
Green spaces	Areas with trees and vegetation close to or in buildings where people can go and relax	+/-	-
Blue roofs	A layer of water on the roof for evaporative cooling	+/-	+/-
Shading of buildings	Using sheets of fabric or blinds	+/-	+/-
Spray systems on roofs and terraces	Spray water on the roof for evaporative cooling	+/-	+/-
Natural ventilation in buildings	Create natural ventilation system in case there is a mechanical system (adapted from original)	+/-	+
Insect screens	Provision of natural ventilation by opening windows without insects entering	+/-	+/-
Architecture	Changes in the design, such as materials used and the sizes of windows	+/-	+/-
High albedo material	Materials with light colours to reflect solar radiation	+/-	+/-
Insulated, heat reflecting buildings	Use insulation to keep the heat out	+/-	+/-
Mediterranean construction style	Adopt a mediterranean construction style which is prepared for a warm climate	+/-	+/-
Roof overhang	The overhang provides shade in summer	+/-	+/-
Bedrooms facing north	The north facade is not hit by the sun	+	+/-
No bedrooms on the upper floor	Heat accumulates in the highest point of the building and the upper floor is hit by direct sunlight	+	+/-
Extra sun blinds	Glass panels to reflect sunlight	+/-	-
Pitched roofs	Pitched roofs provide more shade compared to flat roofs	+	+/-
Water in an atrium	Evaporative cooling	+/-	-
Double facade	Additional outer skin of glass	+/-	+/-

TABLE 4.1 Source: MWH, 2012 Evaluation of the measures for new construction

§ 4.3 Methodology

Approach

The answer to the research question was derived through a qualitative research approach, as this is 'useful for exploring new topics or (...) for explaining people's beliefs' (Hennink *et al.*, 2011, p. 10). This approach is well suited to the aims of the research because, regarding their policy documents, the topic of climate change adaptation is new to Dutch housing associations (Chapter 3). In addition, the focus of the study was on the judgments of individual policymakers. Since there was no awareness of climate change adaptation among housing associations at the corporate level, people in the organisations were targeted who were critical to future policymaking on climate change adaptations.

To collect the data, three approaches were found potentially suitable: sending out questionnaires with open and closed questions, interviewing people using open questions and setting up a focus group discussion. The suitability of the questionnaires lies in the fact that they 'offer an objective means of collecting information about people's knowledge, beliefs, attitudes, and behaviour' (Boynton and Greenhalgh, 2004, p. 1312). However, some arguments against effective use of questionnaires, such as 'Problems of motivating respondents' and 'The need for brevity and relatively simple questions' (Gillham, 2000, p. 6), were also applicable to the current study. The risk of a lack of motivation among respondents to address all of the questions was high due to the newness of the topic. Moreover, judging the list of adaptation measures was complex, so guidance from an interviewer was expected to be necessary. A focus group discussion might also have been used as it is suitable for generating a range of views on a research topic (Hennink *et al.*, 2011). However, at this stage of low climate change awareness among housing associations, it was not expected that the policymakers would be willing to come together from across the country for a meeting. It was already difficult to find the right people willing to spend one hour in an interview in their own office. In summary, the decision was made to conduct interviews among policymakers from the housing associations in their offices, as this approach was expected to provide the best insights. Interviews generate 'information on individual, personal experiences from people about a specific issue or topic' (Hennink *et al.*, 2011, p. 109). The interviews were conducted in December 2012.

The sample

The research took a qualitative approach, which 'necessitates the recruitment of participants with specific characteristics that can best inform the research topic' (Hennink *et al.*, 2011, p. 84). Therefore, a non-probability sample was created using a purposive sampling approach, which resulted in a sample that was as varied as possible (Bryman, 2008).

The sampling consisted of two phases. In the first phase, the housing associations were selected on the basis of their size and geographical location (Figure 4.1). The aim was to include a small (< 2,700 rental units), a medium (2,700-6,845 rental units) and a large (> 6,845 rental units) housing association in the North, East, South and West of the Netherlands (Table 4.2). The selection on size was based on the number of dwellings a housing association possessed on 31 December 2011.

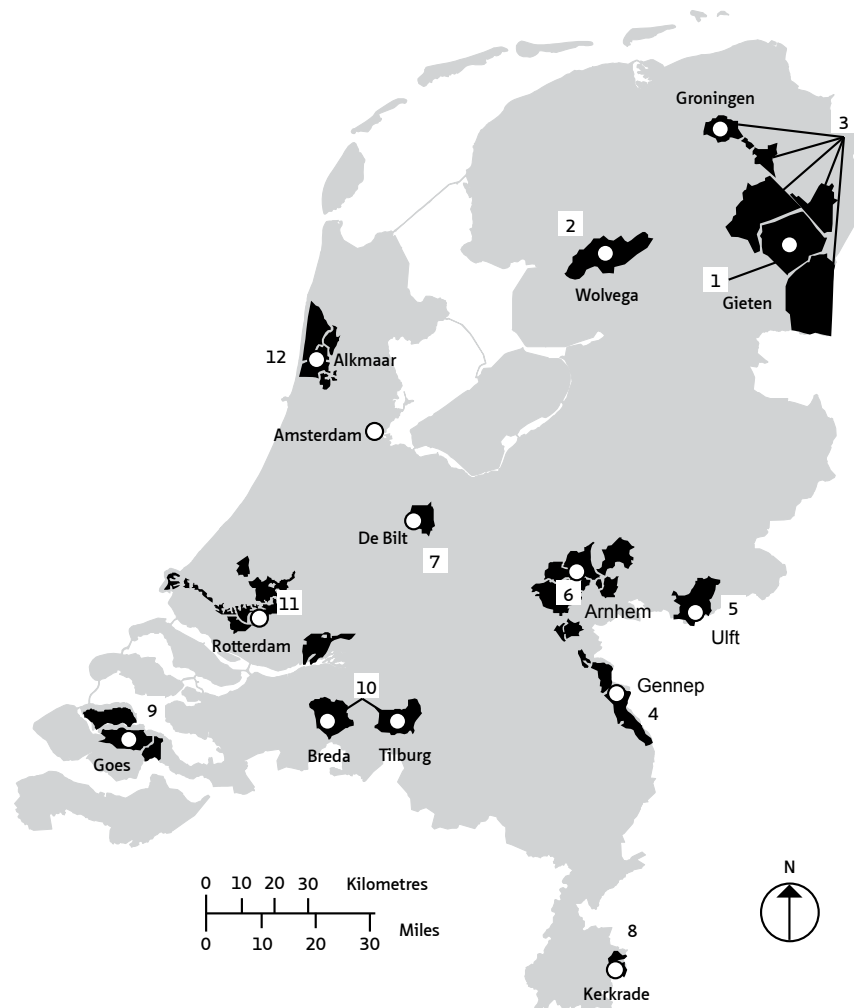


FIGURE 4.1 Working areas of housing associations (based on municipality borders)

The second phase entailed the selection of the interviewees. The selection criteria were involvement in policymaking concerning technical measures and a working field encompassing the entire building stock of the housing association. In the small and medium-sized housing associations the interviewees mainly had a decision-making background, holding positions such as property manager. In the larger housing associations, mainly technical advisors were interviewed, who, although having a lesser role in decision-making, held positions in which they dealt with the complete building stock of the housing association. In total, twelve people were interviewed. During the interviews, various arguments and responses were repeated, which from a qualitative analysis point of view means that the size of the sample sufficed. As Hennink et al. (2011, p. 88) state: 'The number of participants to recruit for qualitative studies is guided by a theoretical principle called saturation (...). This is simply the point at which the information you collect begins to repeat itself'.

NO.	FUNCTION	CITY	LOCATION	UNITS (31/12/2011)	CATEGORY
1	Director	Gieten	North	1,537	Small
2	Head Technical Services and Vice Director	Wolvega	North	2,809	Medium
3	Sustainability Coordinator	Groningen/ Hogezaand/ Stadskanaal/ Emmen	North	29,304	Large
4	Team Leader Real Estate and Development	Gennep	East	2,531	Small
5	Manager Real Estate	Uift	East	4,053	Medium
6	Policy Development Advisor	Arnhem	East	23,515	Large
7	Manager Real Estate	De Bilt	Centre	4,978	Medium
8	Technical Quality Manager	Kerkrade	South	5,948	Medium
9	Senior Real Estate Specialist	Goes	South	6,129	Medium
10	Senior Consultant Strategy and Policy	Tilburg/Breda	South	26,316	Large
11	Manager Real Estate	Alkmaar	West	10,069	Large
12	Technical Advisor	Rotterdam/Delft	West	37,663	Large

TABLE 4.2 Overview of interviewees and housing association characteristics

The interview

The interview consisted of several parts. It started with an introduction containing three open questions focusing on the level of awareness of climate change among the interviewees. The earlier study on policy documents of housing associations showed that in their corporate strategy, housing associations demonstrate a low awareness (Chapter 3), but that does not necessarily mean that every employee has a low awareness. These questions were thus introduced to gain an initial impression of the level of awareness of the interviewee and his or her general mind-set.

The awareness questions were followed by a short presentation on the threats of climate change, designed to create an equal level of awareness among all interviewees. The reasoning was that if the interviewees were aware of the threats of climate change they would be better able to judge the feasibility of adaptation measures. After the presentation, the list of climate change adaptation measures was judged by each interviewee.

The final section again contained open questions. The interviewees were asked which of the previously judged measures could be implemented directly, which measures were likely to be implemented and which measures were not likely to be implemented. Moreover, the interviewees were asked which measure they would implement if they had to choose one, and why they would implement that measure.

Judgments of measures

The measures were judged on eight factors which are considered decisive for the implementation of measures in the existing social housing stock. The factors costs of implementation and complexity of implementation were assessed to make it possible to compare the measures with respect to the existing stock and new construction. The factors: intensity of maintenance, disruption to quality of life of tenant during implementation of measures, and impact on comfort of tenants during period of use of the dwelling, were considered because they concerned tenant satisfaction, an important performance indicator regarding the service delivery of housing associations (Van Mossel, 2008). With respect to these first five factors, the interviewees could supply one of three possible answers: high, medium or low (see Table 4.3 for a description of the boundary values).

COSTS OF IMPLEMENTATION	
L	Limited unprofitable investment, ≤ €1,000; or profitable investment ≤ €5,000 and payback time < 10 years
M	Profitable investment ≤ €5,000 and payback time ≤ 25 years
H	Profitable investment > €5,000 or payback time > 25 years
X	Non feasible
COMPLEXITY OF IMPLEMENTATION	
L	Small effort to apply in existing situation (DIY or handyman of housing association)
M	Medium effort (specialised company, but low effort for company; ≤ 2 working days)
H	High effort (specialised company, high effort for company; > 2 working days)
INTENSITY OF MAINTENANCE FOR HOUSING ASSOCIATION	
L	Lower maintenance intensity than existing situation
M	Equal maintenance intensity to existing situation
H	Higher maintenance intensity than existing situation
DISRUPTION TO QUALITY OF LIFE OF TENANT DURING IMPLEMENTATION OF MEASURES	
L	Little/no impact on tenant's quality of life during implementation
M	Small disruption to tenant's quality of life during implementation
H	High disruption to tenant's quality of life during implementation
IMPACT ON COMFORT OF TENANT DURING PERIOD OF USE OF THE DWELLING	
L	Little/no impact or positive impact on comfort during period of use
M	Small negative impact on comfort during period of use
H	High negative impact on comfort during period of use

TABLE 4.3 Legend of judgment values

The next factor dealt with the necessity of asking the tenant for permission to apply the measures to the dwelling. A binary scale was applied (yes/no). The second last question was on expected difficulties in obtaining permission to apply the measures, also using a binary scale (yes/no). This is crucial information for the housing association, because without the consent of the tenant the measures cannot be applied. The last factor concerned the best moment to apply the measures (years).

The interviewees were encouraged to assess all measures, but in some cases it was obvious they had difficulties imagining the implementation of the measures. If so, the interviewer allowed them to answer that the measure was not feasible. The factsheets were used if more clarification of the measure was necessary.

§ 4.4 Results

Awareness of climate change

The answers to the questions on the awareness of climate change were post-coded. They could deal with any issue related to climate change.

On the question, 'What do you know about climate change?' most interviewees stated that the global temperature would rise. Some directly named impacts such as sea level rise and melting ice on the North and South poles. Al Gore's movie 'An Inconvenient Truth' was the main source of information for the interviewees. Other sources were education and the media.

When asked more specifically about their knowledge of the risks of climate change, all interviewees were able to name one or more risks, among which heat and flooding and/or sea level rise were mentioned most. Although all of the interviewees were aware of at least one of the risks, only one interviewee provided a positive answer to the question, 'Do you deal with the impacts of climate change in your daily work?' Others did not demonstrate that they dealt with the impacts of climate change in their daily work. Although three interviewees initially answered positively, after further questioning it became apparent that they were dealing with mitigation issues.

The final question in the awareness section was, 'Do you know of any adaptation measure?' 'Cooling' was mentioned and so were 'Insulation' and 'Crates for local water infiltration'. Flood prevention measures on a regional level (e.g. 'Increase dike height') were named as well. Six interviewees could not name any adaptation measure, but their responses focused on mitigation policies such as 'The energy efficiency of existing stock will be improved until 2026, we have reserved €25 million'.

Assessment of the measures for the existing building stock

Not all of the interviewees had the same opinion about the factors, therefore only those where consensus was apparent will be discussed. For this study, the criterion for consensus was that the score for the most frequently given response had to be double that of the second most frequent response (see Table 4.4).

The assessment found that it was not feasible to apply the measures 'Bedrooms facing north' and 'No bedrooms on the upper floor' in the existing situation.

MEASURE	COSTS OF IMPLEMENTATION	COMPLEXITY OF IMPLEMENTATION	INTENSITY OF MAINTENANCE	DISRUPTING QUALITY OF LIFE DURING IMPLEMENTATION	NEGATIVE INFLUENCE ON COMFORT DURING USE	PERMISSION NEEDED	PERMISSION DIFFICULT	MOMENT OF INTERVENTION (YEARS)
Heat and cold storage in the ground	H	H			L	Y	Y	25-40
Cooling by river water		H			L			25-40
Green roofs	M	M		L	L		N	25-40
Green facades				L	L	Y		
Green spaces				L	L		N	25-40
Blue roofs	H			L	L	N	N	25-40
Shading of buildings			M	L	L	Y	N	
Spray systems on roofs and terraces					L	N	N	
Natural ventilation in buildings			L		L	Y		25-40
Insect screens	M	L	L	L	L	Y	N	direct
Architecture	H		L		L	Y		25-40
High albedo material	M			L	L		N	25-40
Insulated, heat reflecting buildings	M		L		L	Y		25-40
Mediterranean construction style		H	L	H	L	Y	Y	25-40
Roof overhang		M			L			25-40
Bedrooms facing north	x	x	x	x	x	x	x	x
No bedrooms on the upper floor	x	x	x	x	x	x	x	x
Extra sun blinds	H				L	Y		
Pitched roofs			L	H	L	Y		25-40
Water in an atrium				L	L	Y	N	
Double facade	H			M	L	Y		25-40

H=high; M=medium; L=low; Y=yes; X=?; N=no

TABLE 4.4 Judgments with consensus of interviewees (Blank fields have no consensus)

Concerning the costs of implementation, it can be assumed that they were expected to increase, because in cases where consensus was apparent, the measures were expected to be of medium or high expense.

Opinions on the complexity of implementation were quite divergent; the judgments with consensus vary from low to high complexity. The judgments on the intensity of maintenance, on which consensus was apparent, indicated that a low intensity was expected. The interviewees reached consensus on disruption to the tenant's quality of

life during implementation of the measures, with the measures generally considered to have a low impact on the tenant. The interviewees showed a strong consensus on the influence of the measures on comfort during the use of the dwelling, having a low negative impact or even positive influence on the comfort during the use phase.

On the question of whether permission from the tenant was needed before implementing the measures, consensus was reached for fourteen measures. According to the Dutch Civil Code, housing associations must ask permission to make changes to a property if there is no urgent need. Interviewees stated that many of the measures required permission before implementation. Of these, permission was expected to be gained easily in eight cases, while in relation to two measures, gaining permission was expected to be difficult. The best moment of intervention was in combination with minor or major improvement works, which occur every 25 to 40 years. One measure was expected to be directly applicable as an independent activity.

Analysis of the feasibility of the measures

The measures 'Bedrooms facing north' and 'No bedrooms on the upper floor' were found to be unfeasible in the existing situation. To a large extent, this judgment has to do with the typology of Dutch social housing, which mainly consists of terraced houses and apartments, 42 percent and 32 percent respectively (Agentschap NL, 2011). Generally, the terraced houses have four spaces on the first floor, one of which is the bathroom. It is technically impossible to move all the bedrooms to the same (north) facade and have no bedrooms on the other facade. In addition, the measure 'No bedrooms on the upper floor' was found to be too intrusive to be feasible, as the layout of the terraces almost invariably has the living rooms on the ground floor and the bedrooms on the first floor. While apartments have a different typology, the problems with both measures remain. As most apartments are single-floor dwellings, moving bedrooms or living areas vertically is impossible: if the apartment is on the top floor, the bedrooms will automatically be on that floor as well.

One measure that was found feasible was 'Heat and cold storage in the ground'. However, it was found expensive because, when implemented, the whole heat delivery system in the dwelling would have to be changed from a high-temperature system to a low-temperature system. Many of the interviewees judged the 'Blue roofs' measure expensive, either because of the necessity to reinforce the underlying construction, or because of the permanent risk of water infiltration. Another measure that was judged expensive was 'Architecture', because this measure required changes to be made to the structure of the facade. The 'Extra sun blinds' measure was considered to be very expensive because the glass panels would require additional reinforcement of the facade. Finally, the 'Double facade' measure was also expected to be expensive, but was judged feasible nevertheless.

The 'Green roofs' measure was expected to have moderately high costs. Many interviewees were familiar with the measure and some had already implemented green roofs on some of their buildings. The 'Install insect screens' measure was judged to be moderately expensive. The success of this measure is highly dependent on the willingness of the tenants to use the screens. Many interviewees stated that responsibility for the maintenance and correct use of the screens would not lie with the housing association but with the tenants, with the housing association only supplying the screens. The installation of 'High albedo material' was also judged moderately expensive. The measure in itself was not perceived as complex, but the intensity of maintenance was expected to be high, mainly because of rapid aesthetic degradation caused by pollution. A well-known measure was 'Insulated, heat reflecting buildings', from the point of view of energy saving on heating. This measure had already been implemented by many housing associations. It was considered 'proven technology', resulting in moderate costs and entailing moderate complexity of implementation.

Open questions on feasibility

The open questions on feasibility were designed to trace a willingness to take action among the interviewees. By assessing the 21 measures on several factors, as described above, it was expected that the interviewees would be at least a little more aware of the possible ways in which their building stock could be adapted to the negative climate change effects concerning heat.

In response to the first question, 'Which of the measures can be applied directly?' the interviewees were allowed to name several measures. 'Green roofs', 'Blue roofs', 'Shading', 'Insulated buildings' and 'Natural ventilation in buildings' were all mentioned more than once, while 'Installing insect screens' was mentioned by half of the interviewees. On the issue of whether they would actually implement the measures, only four interviewees answered positively. One of the interviewees who gave a positive answer was already implementing green roofs, while another stated that insulation measures were being implemented. Two others were slightly positive, stating that they 'would think about it'. The main reason for the negative answers was a lack of funds. Another important reason was that implementing adaptation measures was not part of the policy of the housing association.

The second question, 'Which measures are likely to be implemented?' resulted in a range of answers. Two interviewees generalised, stating that only the measures applied to the exterior of the dwelling would be easy to implement, whereas others were more specific. 'Shading of buildings', 'Green roofs' and 'Natural ventilation in buildings' were most frequently mentioned. Implementation was found to be more likely when measures were 'relatively easy to implement' and when the interviewees were familiar with measures, knowing from experience that they would have a 'positive effect'.

In response to the third question on feasibility, 'Which measures are not likely to be implemented?' some interviewees merely stated that those measures that they had judged to be 'unfeasible' in the assessment would be unlikely to be implemented. Others were more specific, with 'Cooling by river water' mentioned most frequently'. The reasons for implementation not being likely were that the measure had a high level of complexity or there would be high costs of implementation. In addition, interviewees gave 'Convincing the tenants of the necessity of the measure' as a reason.

The final question in this section was 'Which measures would you implement if you had to choose?' The measures chosen most often were 'Insulated buildings' and 'Natural ventilation in buildings'. The reasons for selecting the measures were acquaintance with the benefits in terms of comfort and financial aspects.

§ 4.5 Discussion

Awareness

In comparison to their own corporate policy documents (Chapter 3), the individual employees showed a relatively good awareness of climate change and were able to name a number of impacts and risks. However, in relation to climate change adaptation measures in the daily work of the staff members and policymakers, awareness is low, especially considering the threats resulting from climate change and the obligations of housing associations under the BBSH to provide a healthy living environment. If the employees of housing associations are unable to recognise these threats in daily practice it is unlikely that they will start implementing adaptations. The open questions concerning awareness have shown that they are barely able to name one climate adaptation measure, let alone implement them.

The first step towards the implementation of climate change adaptation measures requires the creation of an awareness among the employees of housing associations. In this study, such an awareness was created among the interviewees by the interviewer providing a short presentation. Thereafter, the assessment of measures for adaptation to heat-related problems caused by climate change took place. The results show that once they had been made aware of the need for such measures, the staff members and policymakers were able to judge the measures, both in the assessment section, where they judged the eight factors, and in the open questions section, where they provided their opinions on the feasibility of the measures. Moreover, awareness is necessary in order to develop policy that will provide the basis for the implementation of measures.

In the current situation, the absence of policy was one of the reasons why interviewees judged measures as not likely to be implemented.

Financial aspects

Nevertheless, an awareness of climate change and an ability to judge the adaptation measures does not guarantee their implementation. Many interviewees stated that even though some measures could be implemented directly, they would not do so. High costs were one of the reasons measures were not likely to be implemented. Compared to the judgments of the measures when related to new buildings (Table 1), the judgments for the existing building stock show that concerns about the costs of implementation are greater (Table 4.4). As a result, the financing of the measures was found to be an important barrier to the implementation of climate change adaptations in the existing building stock.

Regarding the financing of the measures, the timing of the interviews in December 2012 was probably not the best because the housing associations were facing an uncertain future due to planned changes to be introduced by the new government, installed in November 2012. Plans to impose heavy levies on housing associations were expected, which would greatly affect their financial position. At the time of the interviews, the consequences of these levies were not yet known, and therefore all expenses were to be reviewed. Under such circumstances, the financing of climate change adaptation measures was not likely to be given a high priority, which proved to be the case. Another financial aspect relates to the difficulty of obtaining permission for the measures. Generally speaking, if the housing association plans to finance the measure by increasing the rent, the tenant will be more reluctant to accept it. Thus, if the housing association wants to implement a measure without running the risk that tenants refuse to contribute and thus compromise implementation, it must find alternative financial means.

One financial solution might be based on the fact that the measures are expected to increase the climatic resilience of the dwelling and thus theoretically increase the future value of the dwelling (Lützkendorf *et al.*, 2011) and make investment more feasible. In another financial framework, insurance companies might play a role, offering lower insurance rates if a dwelling is well adapted (McEvoy *et al.*, 2010). For the adaptation measures focusing on heat-related problems caused by climate change, health insurers or employers could also be potential allies in encouraging environments which lower the risks of health problems and labour productivity loss respectively. Another group of actors that might be approached as allies to remove the financial barriers to implementation are companies in the construction sector. If collaboration in this sector improves, efficiency is likely to increase (Hong-Minh *et al.*, 2001; Akintoye *et al.*, 2000), leaving room for greater investment in adaptation measures.

Regarding the difficult financial situation of housing associations to date, the prediction of long implementation cycles (25-40 years) might be advantageous, as new opportunities may arise over time. Moreover, many of the impacts are projected for 2050 or even 2100 (Klein Tank and Lenderink, 2009). Nevertheless, the question of whether the implementation of the measures will occur in time still remains.

Complexity

As stated above, the construction sector can play an important role in overcoming financial barriers, but involving this sector also has benefits in reducing the complexity of measures, another barrier that has been distinguished. Although this factor was not as strong as costs of implementation, the interviewees showed consensus in their concern about the increased complexity of implementation of several measures. Moreover, in the open questions on the feasibility of measures, high complexity was one of the reasons for considering that a measure was unlikely to be implemented. In contrast, the measures that were found likely to be implemented were judged as such because of their low complexity. In other words, housing associations should use their positions as clients to demand innovation from the construction sector (Blayse and Manley, 2004) to address both the issue of complexity and financial barriers.

Future of adaptation

Housing associations are not the only property owners dealing with the threats of climate change, as this is a worldwide phenomenon. The impact on dwellings will have to be dealt with, whether the dwelling is owned by a housing association, a corporate investor or an owner-occupier. Sooner or later, all of these owners will have to find solutions to adapt to the impacts of climate change. However, the professional role of housing associations, their legal duties concerning the quality of dwellings and their performance, measured by the quality of service delivery, make them an important starting point in the implementation of climate change adaptation measures. The assessment of the measures revealed that by removing the barriers, the implementation of climate change adaptations brings many benefits to the occupiers, as consensus was apparent for all measures concerning their positive effects on comfort during use. Moreover, in the open feasibility questions, an increase in comfort was precisely one of the main reasons for determining that a measure was likely to be implemented.

§ 4.6 Conclusion

The open questions on the feasibility of climate change adaptations and the judgment of the list of adaptation measures by specialists from housing associations elicited a wide range of responses. However, many interviewees showed a low awareness of the fact that adaptations should be part of their daily practice, meaning implementation of the measures is currently not taking place.

Taking into account the wide interpretative boundaries by focusing only on the factors on which consensus was reached, it was possible to cautiously make some general observations that provide an answer to the research question. At the moment of interview, the policymakers from housing associations who were interviewed did not find the implementation of measures for climate change adaptation feasible. To increase feasibility, first, awareness must be increased, which is a challenging task in which the national government can play an important role. Only then will housing associations start developing policy regarding adaptation measures. Second, financial barriers must be removed, for example by introducing financial schemes based on the increased value of a resilient building, perceiving insurance companies as allies and enhancing collaboration in the construction industry to generate more cost-efficient production. When encouraged appropriately, the construction sector is capable of finding innovative technical solutions, which makes it an important player in overcoming the barrier of complexity. Further and broader research on these issues is urgently required.

The data were collected by interviewing people. This was a suitable method to formulate an answer to the research question at the time, given the newness of the topic of climate change adaptation and low corporate awareness among housing associations on this topic. However, for future data collection, one or more focus group discussions, rather than interviews, should be considered, in order to obtain a more collective view of the position of housing associations on the implementation of measures to adapt to climate change. Moreover, future research should not only include employees of housing associations but also of other kinds of property owners, such as corporate investors and owner-occupiers.

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5 Towards successful partnering in housing refurbishment - an assessment of six Dutch dyads

Chapter 5 reports the experiences of six dyads of housing associations and construction and maintenance companies using partnering in construction. The study was carried out in the first year of a two-year knowledge exchange project that took place in parallel to the studies reported in Chapters 3 and 4. Over the course of the project, one more dyad joined, which explains the difference of one dyad compared to other chapters of this thesis.

The paper is an improved version of the conference paper presented at the CIB2012 conference in Cape Town, South Africa, referenced as:

Roders, M.J., Gruis, V.H., & Straub, A. (2012). Interpersonal aspects of partnering in housing renovation. In K. Michell, P. Bowen & K. Cathell (Eds.), *Delivering value to the community* (pp. 180-186). Cape Town: Department of Construction Economics and Management, Faculty of Engineering & the Built Environment, University of Cape Town.

Abstract

Supply chain partnering is seen as one method of handling the need for more efficient and transparent building processes. Although it has received considerable attention from practitioners and researchers, supply chain partnering is still in its formative phase within the construction industry. There have been a number of studies that focus on 'success factors' in partnering, but relatively few studies have focused on whether and how these factors are applied in practice. Moreover, almost no studies have been completed into supply chain partnering in housing refurbishment projects. An assessment was made of the partnerships between six Dutch housing associations and general contractors, on the basis of the success factors identified in literature: trust, leadership, partner capabilities, commitment, conflict resolution, coordination and communication. The conclusion is that most of these factors play a role, although there are considerable differences in the way in which the dyads used these factors in their partnering process. Conflict resolution techniques and coordination measures have not yet been developed. This may be due to the experimental stage of the dyads and/or the level of trust within the dyads, but it also implies a risk for the further development of the partnering process, should conflicts arise.

Keywords: Contractor, Housing association, Partnering, Refurbishment, Trust

§ 5.1 Introduction

More than a decade ago, several reports were drawn up calling on the construction sector to change its methods of working. Egan in the UK (1998) and Tang in Hong Kong (2001) concluded that the fragmentation of the construction sector, as well as limited investment in R&D, were preventing the construction sector from innovating and providing quality that would meet the standards of the 21st century. Reports in Australia and Singapore came to similar conclusions (Dulaimi *et al.*, 2002). In the Netherlands, a similar report “Van raad naar daad” (from advice to action) was written in 2004 by the “Regieraad Bouw” (Management Council for Construction). It aimed “to stimulate and maintain a momentum of change in the construction sector so that it can again carry the designation of healthy, transparent, and innovative” (Regieraad Bouw, 2004). These reports paved the way for an ample body of literature on process innovations such as partnering (Bygballe *et al.*, 2010). The majority of literature on partnering focuses on new-build, with some papers focusing on housing (e.g. Hong-Minh *et al.*, 2001; Barker and Naim, 2008). Literature on partnering in housing refurbishment is scarce, although the refurbishment of the existing building stock is an important issue, partly because it is perceived as a crucial factor in achieving targets for reducing CO₂ emissions by national governments (e.g. Murphy and Meijer, 2011). Moreover, to meet the changing demand for housing, we will have to rely increasingly on the existing housing stock, since the production of new dwellings is only a fraction of the existing stock and has fallen significantly in recent years (Thomsen and Vander Flier, 2009).

In many cases, the construction process for housing refurbishment is more complex than new construction. It is necessary to take account of an existing situation where every dwelling has its own characteristics. Moreover, the projects are very often located in urban contexts, which can lead to logistical constraints and in many cases people are still living in the dwellings that need to be refurbished. Depending on the extent of the renovation that is planned, steps also need to be taken to ensure that the households continue to have a decent place to live. In the case of radical refurbishment work, they will have to move to another dwelling temporarily. For more minor refurbishments, households can stay in their dwellings but disturbance must be reduced to a minimum. Another issue that can complicate the continuity of production is the tenure of the dwellings. Due to major differences in preferences and usage in the owner-occupied sector, achieving a continuous production flow is not easy for a contractor. In this respect, the rented sector is a better starting point in which to gain experience with partnering in housing refurbishment. The Netherlands has a building stock of 7.2 million dwellings, of which 32% are owned and maintained by housing associations. In 2012, 381 housing associations owned an average of 6,300 dwellings each (www.cfv.nl). The largest housing association owns approximately 80,000 dwellings. Thus, the Dutch housing association sector provides relatively favourable

conditions for supply chain partnerships and continuous production flows, because it includes many dwellings, in many series of relatively homogeneous properties, which are owned and managed by professional organisations. Furthermore, housing associations are increasingly aware of the expected benefits of a better end product and a more efficient building process through supply chain partnering. Over recent years, housing associations have already begun to develop supply chain partnerships in new-build, maintenance and refurbishment, although traditional procurement processes are still used for the majority of projects (e.g. Straub, 2009; Aedes, 2009; Vernieuwing Bouw, 2010).

The further development of supply chain partnering in the Dutch housing association sector, as well as the construction sector more generally, will benefit from the evaluation of successful examples. Many factors have been described in the literature as important for success in partnering in construction, focusing on various aspects of the partnering process. For example, Lönngren et al. (2010) describe success factors that are based on a successful production process. A literature review by Wong et al. (2005) sums up factors that relate to the collaboration between partners: trust relations, equity of benefits sharing, effective communication, and competent management. Chan et al. (2004) list the requirements that must be met for partnering to succeed in the Hong Kong construction industry. Chen and Chen (2007) and Black et al. (2000) have elaborated on 19 partnering success factors. Kim et al. (2010) provide an overview of the success factors and prove that there is consensus in the literature on these factors. They also show how the success factors need to be interpreted and evaluated. The success factors are: leadership, commitment, coordination, trust, communication, conflict resolution techniques and partner capabilities (Kim et al., 2010). Little attention, however, has been given to the questions of whether and how these factors are actually put into practice. Do clients and contractors consciously employ these factors to increase the likelihood of successful partnering? And how do they promote the establishment of success factors such as effective coordination, trust, leadership and communication?

This study aims to help fill the knowledge gap in the literature as well as the more general research gap that focus on supply chain partnering in the context of housing refurbishment. By doing this, the partnering processes of six dyads of Dutch housing associations and their contractors were evaluated, focusing on the way in which these dyads have encouraged the establishment of success factors, employing a framework adapted from Kim et al. (2010).

In the following section, the dyads involved in the study are described, as well as the way in which the partnering processes were assessed. The various success factors identified by Kim et al. (2010) are then discussed. Next, the approaches taken by the dyads in relation to each success factor are described. The final section includes the conclusions and implications for practice.

§ 5.2 Methodology

To gain insight into how the success factors are used in the practice of supply chain partnering in housing refurbishment projects, the approaches of dyads of Dutch housing associations and general contractors are compared with literature on partnering, with the work of Kim et al. (2010) providing a general framework for evaluation. The housing associations and general contractors were participating in a knowledge exchange project, in which they carried out a pilot project in a partnering setting in the period 2011-2012 and shared their experiences in plenary sessions which took place every 4-6 months. They were supported by researchers for theoretical underpinning. In addition to the dyads of clients and contractors, the supply chains involved other parties and sub-contractors. However, they were not involved in setting up these dyads. The data presented in this paper were gathered from the six dyads.

To investigate how the dyads dealt with the success factors for partnering, interviews were held with representatives of the housing associations and contractors. The interviews took place between May and September 2011. The housing associations and the general contractors were interviewed separately, so a total of twelve interviews are reported in this paper. In most of the interviews, a project manager and a strategic manager (mid-level or senior management) were present. Together, they were able to answer questions on both projects and organisation. The aim of the interviews was to chart the first experiences of working in an integrated supply chain. Although a semi-structured approach was used in the main part of the interview, the first question was an open question: the interviewees were challenged to say whatever they wanted about the notion of partnering. This question was introduced to establish the general position of the interviewees in relation to partnering. These opinions were therefore not biased or influenced by the questions posed during the interview. The discourses were analysed in order to create a picture of the mind-set of the interviewees. The answers from the semi-structured part of the interview were transcribed and sent to the interviewees for approval. Following their approval, the transcriptions were used as an input for the synthesis and conclusions.

§ 5.3 Case descriptions

To provide a context for this study, this section will provide additional information on the cases. The data was retrieved from company brochures and websites as well as during the interviews themselves.

The housing associations involved in the exchange project own between 4,000 and 80,000 dwellings. The general contractors involved have a turnover of up to €325 million and employ between 100 and 400 people. Two of the contractors started out in maintenance work and later widened their scope to include refurbishment work. In the case of the other contractors, most of their turnover comes from new-build, especially housing.

The projects carried out by the dyads were all housing refurbishment projects, dealing with several types of dwellings: in three projects, apartments were being renovated; in two projects, terraced houses; and in one project a combination of apartments and single room units for students. In the remainder of this paper, all types of dwellings are referred to as 'rental units'. The smallest project consisted of 60 rental units, while the largest concerned 310. In total, 990 rental units were renovated. The total building costs (without additional costs and/or taxes) for the projects involved were over €31 million, which represented an average investment of nearly €32,000 per rental unit, with a range from €20,000 up to €80,000 per rental unit. The main goals of the refurbishment activities were to extend the lifespan of the units, improve the social quality of the units and their surroundings and improve the energy efficiency of the units. The activities consisted of improving the building envelope technically and in terms of energy consumption, improving the building installations and renovating the kitchen, bathroom and/or toilet. Five projects were carried out with dwellings in an occupied state. In only two of the projects were the activities so intrusive that the rental unit was temporarily unavailable for living. In this case, the tenants were offered other dwellings during the refurbishment.

The numbers and types of companies involved in the partnerships and the project delivery methods used were different in each project (see Figure 5.1). In all the projects, the parties involved included at least one housing association and one general contractor.

In one project (Housing Association 1), collaboration began after a design-bid-build (DBB) process (Salcedo Rahola and Straub, 2013) for which the housing association drew up detailed project specifications. In contrast with the usual DBB approach, this process included an extra phase after the bidding and selection to optimise the design before it was implemented. Three projects (Housing Association 2, 3 and 5) followed a design-build (DB) approach (Salcedo Rahola and Straub, 2013), in which the general

contractor was commissioned to carry out the project based on their good relations with the housing association, which had been built up over previous projects. The housing association and general contractor decided which of the specialised contractors should be included in the partnership, based on the specialities needed to carry out the project.

In two projects, the work was carried out by consortia on the basis of a design-build approach. For the first consortium (Housing Association 4), the housing association had drawn up performance-based requirements relating to matters such as budget, planning and energy-performance levels. The consortium that met these requirements most closely and proposed the most attractive project was selected for partnership. For the second consortium (Housing association 6), the consortium was selected on the basis of its vision of what the project would look like after the refurbishment work. The housing association involved in that project had only provided a few details, such as the location and number of units. It had challenged consortia of architects and general contractors to provide a plan and an indication of the estimated costs.

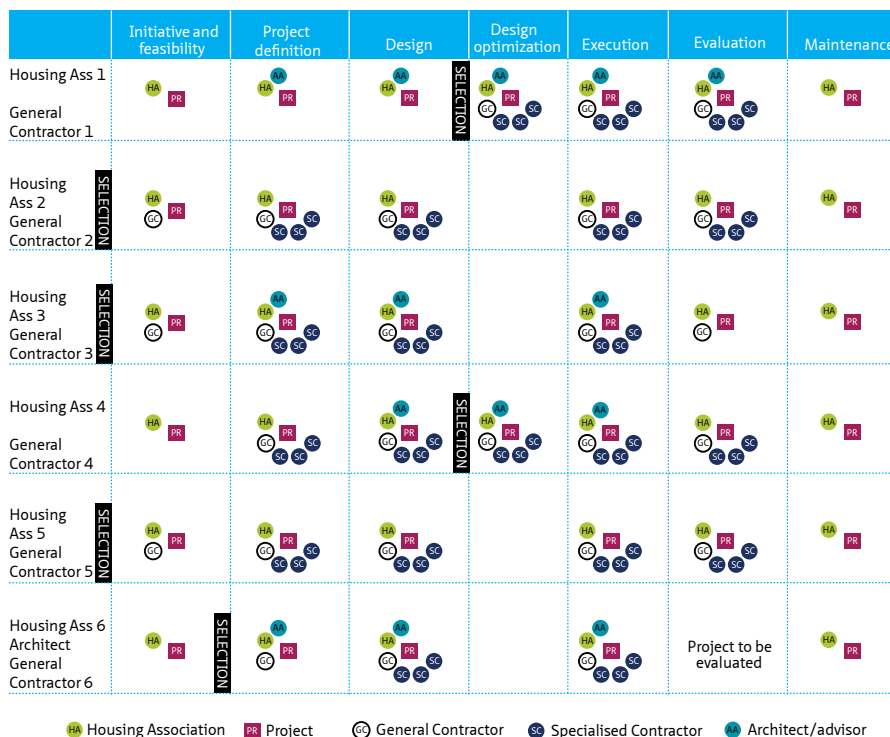


FIGURE 5.1 Schematic overview of construction processes and partners involved

§ 5.4 Mind-set

As stated in the introduction, several governmental documents have called for greater transparency and innovation in the construction sector. Although these subjects were mentioned by the interviewees, they did not seem to accord them the highest priority. According to their responses to the notion of partnering (see Table 5.1), this has more to do with either process-related topics, which are coded as 'Collaboration' (8x), 'Partner quality' (7x) and 'Effective use of knowledge of partners' (7x), or with output related topics, coded as 'Efficiency of building process' (7x). Interestingly, 'Trust' was not mentioned often, although it is generally acknowledged to be a crucial success factor in partnering.

TOPIC	NUMBER OF TIMES MENTIONED		
	Total	HAs (n=6)	GCS (n=6)
Collaboration	8	4	4
Efficiency of building process	7	4	3
Partner quality	7	3	4
Effective use of knowledge of partners	7	2	5
Transparency	6	2	4
Positive feeling about partnering	6	4	2
Product quality	5	4	1
Attitudes of team members	4	2	2
Goal setting	4	3	1
Trust	3	3	0
Innovation	1	1	0

TABLE 5.1 Concepts mentioned in relation to the notion of 'partnering', Total per Housing Association (HA) and General Contractor (GC)

§ 5.5 Success factors

§ 5.5.1 Trust

A central theme in many definitions of partnering is trust. Some of these are shown in Table 5.2. Trust has also been identified by authors such as Kim et al. (2010) as one of the factors that is essential for successful partnering (see also, for example, Akintoye et

al. 2000 and Wong et al. 2005). A rather metaphoric description of the importance of trust in partnering was given by Wong et al. (2005): “Trust is regarded not only as the glue that holds partners together, but also the lubricant that aids project completion”. Wong et al. (2005) have drawn up a list of 14 attributes of trust in construction partnering. They conclude that “to cultivate trust among the contracting partners, the critical factors are to perform competently and communicate openly and effectively”.

Trust can relate to the selection of the construction company by the housing association. It is important to note that public procurement rules do not apply to Dutch housing associations because they are private entities in the eyes of the EU. Although most of the housing associations have the same objectives for choosing supply chain partnering, such as efficiency and cost reduction (Chao-Duivis and Wamelink, 2013), the supply chains are brought together in three different ways: firstly, as a direct relationship, secondly through a ‘consortium approach’ and thirdly through a traditional ‘lowest-bid tendering approach’.

SOURCE	DEFINITION
Kim et al. 2010, p. 188	A supply chain partnership is a strategic alliance to achieve business advantage and exclusive goals by paying attention to critical success factors such as organizational commitment, co-ordination, leadership, trust, communication, conflict resolution, techniques and resources.
CII, 1991 in Hong-Minh et al., 2001, p. 50	Partnering is a long-term commitment by two or more organizations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant’s resources. This requires changing traditional relationships to a shared culture without regard to organization boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each other’s individual expectations and values. Expected benefits include improved efficiency and cost-effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services.
Lambert et al., 2004, in Kim et al., 2010, p. 188	A supply chain partnership is a tailored business relationship based on mutual trust, openness, shared risk, and rewards to create business performance.
NAEC, 2004 (Denmark)	Partnering is a type of collaboration in a construction project based on dialogue, trust, openness and with early participation from all actors. The project is carried out under a mutual agreement expressed by mutual activities and based on mutual economic interests.

TABLE 5.2 table 5.2 Definitions of partnering containing the success factor ‘trust’

The direct relationship was used in three projects. This approach is associated with a high level of trust (Lau and Rowlinson, 2009), because a comparative selection between two or more companies has not taken place. In these cases, trust between the partners of the dyad has generally been established during earlier projects. The second approach; that of a consortium, encourages trust primarily on the contractor’s side of the chain. Under this approach, which has been used in two projects, the work is

contracted to a group of partner firms that have collaborated to develop a joint solution that meets the project requirements set by a housing association. These groups are referred to as 'consortia' in line with the definition of Gruneberg and Hughes (2006: 10): "A consortium is defined as an arrangement between several firms, in which each firm contributes an equity stake in the form of risk capital or payment in kind in order to qualify as a member. Remuneration of consortium members may be calculated as a share of the net profits of the consortium."

The consortia were selected on the basis of pre-established selection criteria, such as their experience in that particular type of project, their attitude towards supply chain integration and the clarity of their vision for the project. In one of the projects, the selection of the partner was based on the lowest bid, and consequently, trust was deemed to have been relatively low at the start of that project.

The amount of information about the project that was known prior to the selection of the partner can be considered as another indicator of trust between partners. The less information that is available, the more trust partners need to have in each other's abilities before committing themselves. In the three projects with a direct relationship between client and contractor, no information was known at all, and even the construction project was chosen afterwards. In both the situations involving the selection of a consortium, the housing associations had provided project information in the form of a programme of requirements that the consortia would need to fulfil. The programme of requirements included the characteristics of the dwelling that had to be renovated and the year of refurbishment.

§ 5.5.2 Leadership

In a partnering process, the involvement of leaders or managers at the senior level of an organisation is very important. According to Kim et al. (2010) "Leadership influences performance by allocating resources; further, leadership involvement symbolises a company commitment that encourages trust among partners". And "to enhance firm partnerships, leaders modify organizational goals, policies, and cultures. It helps to change employee skepticism".

'Leadership' is used widely by the project participants. In all the housing associations and general contractors, senior management supported the partnering approach. These leaders expressed their support in various ways in the different organisations. In every construction company, the directors were involved directly in the partnering project. The senior management of the housing associations remained removed from the process, but approved this method of working based on official and informative

reports by the project leaders involved. In two of the projects, the project structure was defined in such a way that the hierarchical setting of the company (director vs. project leader) was visible, meaning that a steering group and a working group were created. The steering group had to ensure that the success factors were addressed by the working group and they also took the framework decisions relating to budget limits, timeframe and project activities; the working group, meanwhile, was responsible for actually developing the success factors and for planning and carrying out the project within the boundaries set. In the other four projects there was no steering group – work group structure.

§ 5.5.3 Partner capabilities

“Partner capabilities are regarded as a fundamental component for maintaining partnerships. To maintain partnerships, participants should ensure that they deliver their specialised roles, an excellent innovation capability, and sociability. (...) Partner resources and capabilities should be included in a set of selection criteria” (Kim *et al.*, 2010). Here, ‘partner capabilities’ refers to all the partners involved in the construction supply chain: subcontractors and consultants. Manufacturers of building components and installations had no role as a partner in the supply chain. The assessment of partner capabilities is handled differently in every project. The subcontractors and consultants are able to join the supply chain if their capabilities correspond to the selection criteria laid down by the dyad. The use of these selection criteria increases the probability that the construction process will progress without any relational issues in the supply chain caused by uncertainty about partners (Lau and Rowlinson, 2009). The sub-contractors involved were carefully selected by five of the dyads. The subcontractors were known by at least one of the parties and the housing association had the final decision on whether subcontractor would be accepted. The housing association that used a lowest-bid approach at the start of the partnership stated that it did not pay particular attention to the selection of subcontractors by the construction company.

Moreover, in order to start the collaboration on the right foot, most of the partners, both housing associations (4 out of 6) and general contractors (4 out of 6) specifically selected the individual team members that were thought to be capable of working in an integrated supply chain approach. The competences that were found to be important for this were primarily social skills, being among others: collaborative, open-minded and service-oriented.

§ 5.5.4 Commitment

“Commitment is described as the partner’s willingness to continue the partnership. Effective partnerships depend on strong commitment to realise complementary, but unique goals. Commitment helps to avoid potential conflicts among partners. Long-term commitment enables partners to improve their confidence in the investment and the mutual advantages of SCP” (Kim *et al.*, 2010).

Commitment is clearly present in the dyads studied, because it is already implicit in the continuation of an established relationship. Commitment can also be shown by expressing an intention to continue the relationship. In the interviews, such intentions were indeed expressed by the interviewees; however, no concrete arrangements had been made yet. “High levels of commitment are expressed through different types of financial investments, the number of limited partners, or the number of projects. There is a strong positive relationship between the commitment and performance of SCP” (Kim *et al.*, 2010). The commitment of three dyads consisted of time invested in training employees in, for example, lean planning. One dyad planned extra meetings for team-building purposes. Moreover, in three projects, including the consortium-based projects, the building partners had invested time in developing a sound approach to the project prior to signing a formal contract. This means that they were working at their own risk, because the final plans had yet to be approved by the supervisory board. In these cases, the creative power of the consortia was used to convince the board of the quality of the work.

All partnering arrangements focus only on one project, the project at hand, and no agreements that were unrelated to the project were made. This could be partly due to the fact that for many housing associations, this was their first explicit attempt at supply chain partnering in a housing refurbishment project. Nevertheless, some respondents specifically stated that supply chain partnering should not necessarily imply automatic collaboration over a series of projects, partly in order to maintain the opportunities for competition during the selection phase of projects. Others, by contrast, were inclined to state that the full benefits of supply chain partnering can only be achieved if a partnership is built up over several projects. Furthermore, in two projects housing associations have made known their intention to commission the general contractor with the relevant maintenance work too, and in one of those projects a maintenance company played an advisory role in the consortium, thus extending the scope of the partnership beyond solely the refurbishment process.

§ 5.5.5 Conflict resolution

“Conflict resolution techniques are important in partnerships because the distinct companies in a partnership maintain their own characteristics and some conflict is likely to occur. Some researchers explored traditional approaches, such as coercion, domination, and hierarchies (Maheshwari *et al.*, 2006). Others suggested alternative approaches, such as joint problem solving and mutual adjustment programs (Mohr and Spekman, 1994). Many studies agreed that the alternative approaches are better than the traditional approaches because the traditional approaches resulted in negative impacts, such as a decreased level of trust and communication” (Kim *et al.*, 2010).

When asked directly whether they had agreed on any conflict resolution techniques, none of the dyads was able to name any. However, all the dyads stated that they were working with contracts. These were based on the conventional situation in which the housing association has a contractual relationship with the general contractor. Subcontractors then have a contractual relationship with the general contractor, rather than with the housing association. In one of the consortium projects, the housing association was looking for a different contracting formula, but they had not succeeded yet in finding one. As such, all the dyads were working in a hierarchical context, which is generally seen as a traditional approach to conflict resolution (Kim *et al.*, 2010). In this context, the housing association (the party that is paying for the work) has the last word. However, all the dyads stated that they held meetings with all project members every 2-3 weeks. These frequent meetings help to identify and resolve problems at an early stage, preventing potential problems in the relationship (Kadefors, 2004). In one project, the hierarchy was strengthened by the housing association’s stated position that it would only begin paying for work in the plan development phase after the project was given the green light by the supervisory board of the housing association. This implied that the general contractor would have to bear a considerable share of the risks in the plan development and design phases of the project.

§ 5.5.6 Coordination

“Coordination refers to a range of tasks that a partner expects the other to perform. Coordination requires organisational efforts to change processes, culture, and systems. Successful partnerships must share compatible values because unmatched culture, systems, and business objectives could be obstacles to success. Identifying clear goals and tasks helps participants not only to concentrate on their own responsibility, but also to be more actively involved in the partnership” (Kim *et al.*, 2010). The interviewees were asked whether they had shared their expectations concerning

the project in the early phases of the design process. As Lau and Rowlinson (2009) pointed out: "Expectation is one of the components of trust relations". Transparency in expectations makes it possible to identify shared interests and by enhancing these, the parties can work more efficiently, because they will not waste time bridging the expectations gap with their partners. Although establishing and reinforcing shared expectations can improve the effectiveness of the design process, this subject was not discussed during the early phase of most of the projects. In only one project did both the housing association and the general contractor state that expectations had been discussed, agreed on and incorporated into a description of four main goals of the project. These four descriptions had become so familiar that the members of the consortium knew them by heart. There were two projects in which both partners claimed that expectations would be agreed in due course. In one other project, the partners both stated that no common expectations had been formulated.

The partnering relationship can also be influenced through documents that describe the project requirements. In all the projects, the housing associations demonstrated trust in the general contractors and drew on their capacities by involving them in establishing project requirements. These were all performance-based and took the form of a programme of requirements. In no project did the housing association require the construction companies to work to a rigid technical description of the work in material terms. In order to establish a stable partnership, the coordination of internal processes cannot be overlooked. Almost all respondents had experienced this necessity in some way or another, because many Dutch housing associations have established a tendering policy in order to work transparently. In many cases, this has resulted in a statement that they will put construction work out to public tender. Those housing associations that already had a direct relationship with a particular contractor were obliged to convince the supervisory board that they wanted to work together with that contractor because this would have particular benefits.

One housing association mentioned difficulties when additional information was needed from a department other than the project department. Normally, the project department would request information, but now it was an 'outsider' - the construction company - that was requesting the information. One construction company stated that it had completely restructured its organisation, no longer taking the traditional approach but focusing on collaboration and transparency. Every employee had been assessed on partnering-related competences, and these competences had become part of the employee development cycle.

§ 5.5.7 Communication

“Communication is an essential component in successful partnerships, since it can assist participants in establishing the requirements of performance, adapt to changes in partner expectations, avoid potential conflicts, and reduce the level of uncertainty. An environment for opening communication can be created by installing an information system, adjusting cultural differences, and providing a feedback process” (Kim *et al.*, 2010). In three projects, a start-up meeting was held. These meetings help the partners to agree on how they should work together in the best possible way (Kadefors, 2004). The sessions were independent of the project and two of them had a mainly educational character, for example how to set up lean planning. Only one of the three start-up sessions focused specifically on the social aspect of team building, in addition to addressing educational and project-related matters. This session was held at a location outside the participant’s offices, which promotes a focus on team-building without any distractions from the participants’ daily work (Harback *et al.*, 1994). The meeting included an evening meal and some time for socialising, which proved a valuable way of adding to the team-building process.

Collaboration in the projects was further enhanced through agreements on how to communicate within the project team, because communication is one of the elements that sustains a good relationship (Lau and Rowlinson, 2009). All the dyads stated that they held regular meetings every two or three weeks at which the progress of the project was discussed. Four dyads made use of ICT applications for better communication, such as a shared e-mail account to which a copy of all correspondence between the partners was sent, or a web-based platform where all project-related information and correspondence was recorded.

§ 5.6 Discussion

The projects described involve dwellings with diverse characteristics, as well as a diverse range of refurbishment activities, partners and starting points. This made it impossible to make an assessment of which partnering approach suits each type of project best.

What is clear is that ensuring all the success factors are handled satisfactorily requires intrusive paradigm shifts. This requires an emphasis on management support. Together with one consortium project where the selection procedure was initiated by the director, the two projects in which the leaders were involved in the partnering

process via steering groups appear to be more ambitious and innovation-oriented than the other three projects. One could conceive of these as the more successful partnering projects.

Because the projects and partnering approaches are different, so are the pricing and budgeting arrangements. Price is, of course, one of the most important points to be agreed on. All housing associations were transparent about their budget and clearly stated that they expected their partners to carry out the project within the financial boundaries that had been set. This lent stability to the partnerships, because it defined the outline of the project and expressed trust in the sense that the housing association trusted the partners to look carefully for a solution within the budget, rather than claiming extra costs for the changes (Kadefors, 2004). The general contractors in turn were, when asked, willing to ensure openness in the tenders they received from their subcontractors to prove to the housing associations that the price offered in the overall tender was the best offer. This open book strategy creates “perceptions of relative equity” (Kadefors, 2004), improving the sense of trust between the partners. The way in which the dyads arrived at a final project price differed widely. One dyad worked with a ‘price book’ in which standard prices were defined for all the activities that had to be carried out. It was not yet clear how they would deal with unforeseen costs. Another dyad agreed on a final price that had been established through close cooperation between the housing association, the general contractor and three other major project partners. In order to cover unforeseen costs, a ‘risk pot’ was set up out of which these costs could be paid. The money in the pot was contributed by all partners, including the housing association. If at the end of the project there was still money in the pot, this would be returned to the partners. A third dyad was in discussion about whether such a risk pot would be of benefit. In this case, the housing association in particular was sceptical, because the work was commissioned by a consortium that was fully responsible for the design and execution of the project. The housing association therefore felt that the consortium should also bear a share of the risk of unforeseen expenses. Yet another option for determining the final price of the project was for the housing association to make clear that the contractor’s profit was fixed, no matter what might happen during the course of the project. Any unforeseen costs would have to be covered by money-saving alterations in the project. Since these pricing arrangements were discussed extensively and agreed on prior to the execution phase, price was not a subject for discussion during the execution phase. Consequently, meetings during the execution phase focused on more important matters: progress on the project. This is a topic that is of interest to the workmen, unlike financial disputes. As a result of this, their work satisfaction increased.

It is worth noting that during the interviews, statements relating to the positive working environment were heard frequently. These remarks revealed the state of mind of those involved in the construction process and the seven success factors described in this paper as derived from Kim et al. (2010): trust, leadership, partner capabilities,

commitment, conflict resolution, coordination and communication. Although trust is presented as a success factor in its own right, at this point, the conclusion of Bresnen and Marshall (2002) seems more appropriate. They state: “Rather than being simply a case of applying certain tools and techniques, developing an effective partnering approach results from a complex and dynamic process in which informal processes are just as important as formal mechanisms”. Having analysed the approaches of all six dyads, it becomes clear that trust, as an informal mechanism, should indeed be considered more as an overarching phenomenon which is indispensable in any partnering process. Theoretically the six ‘instrumental’ success factors can be identified in the way that they are discussed in the literature, but without trust between the partners (the seventh factor), the partnership will be doomed. In other words, if partners trust each other, it is much more likely that a partnership will successfully incorporate all the other success factors to some extent.

§ 5.7 Conclusions

Although supply chain partnering in construction has been encouraged by government and sector organisations, it remains at an early stage of adoption for the purposes of housing refurbishment projects in the Netherlands. The six dyads of housing associations and contractors involved in this study can thus be considered frontrunners. And it is exactly at this early stage of development that parties can learn from one another’s experiences. The focus of this research was on whether and how housing associations and their contractors have actively managed the factors that are considered important for successful partnering. The wide range of approaches has provided insight into how the success factors for partnering in construction can be developed and managed in practice. However, not all factors have been addressed and neither are they always addressed in the most effective way, so improvement is needed. Factors that demonstrate a high level of compatibility with recommendations from literature are as follows: leadership, all projects enjoy the support of senior management; communication, all projects hold frequent meetings and in three projects ICT tools are also used to improve communication; and partner capabilities, five of the six dyads stated that they have looked specifically at the quality of partners by selecting known parties or by applying selection criteria. One factor that seems in need of improvement is coordination. Not every dyad has clearly expressed goals, which is an important part of establishing a shared understanding. On the other hand, working together in the plan development phase and ensuring openness regarding budgets and subcontracting gives a good impression of the intentions and capabilities of the partners. Another factor that deserves attention is commitment. In three of the six projects, there is evidence of commitment in the sense that the partnerships

have grown from an existing relationship. However, few agreements have been made concerning the maintenance phase and all the partnerships are restricted to the current project. Of course, this situation could change as the projects develop and trust is built up. Conflict resolution techniques also remain underdeveloped. The fact that conflict resolution techniques and coordination require further attention may be a reflection of the still experimental nature of these dyads or indeed of the level of trust within the dyads, but it does imply some risk for the further development of the partnering process, should conflicts arise in the future. It has become apparent that the dyads are constantly dealing with trust issues, with these being an inevitable theme in the establishment of any partnership, whether at a conscious or a subconscious level.

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6 Innovation in housing refurbishment through adopting a partnering approach

The research in Chapter 6 was carried out as part of the same knowledge exchange project that was reported on in Chapter 5, but one year later. In the intervening period, one more dyad had joined the project, bringing the total number of dyads to seven.

Table 6.2, in which a large number of governance tools are rated, includes fewer tools than presented in Chapter 2. The remaining tools could not be evaluated because the interviews had already taken place.

Some of the information in this paper was presented in a separate report: Straub, A., & Roders, M. (2011). *Verslag innovatie bij ketenintegratie*, OTB research for the Built Environment, Delft University of Technology. Client: SEV Rotterdam.

Other parts were published in a popular journal: Straub, A., Roders, M., & Gruis, V. (2012). Ketenintegratie bij woningrenovatie: alleen proces- of ook productinnovatie? *Building Business*, 14(6), 38-41.

Abstract

Housing associations own 32 % of housing stock in the Netherlands, making them major actors in maintaining and improving the quality of life in the urban environment. The building stock requires effective innovation to keep pace with the needs of today's tenants. Moreover, the current financial circumstances and political environment have pushed housing associations to innovate in their (re)construction processes, for example by adopting a partnering approach. Several studies indicate that the implementation of innovations could benefit from partnering approaches in the construction supply chain.

An evaluation of refurbishment projects that have been carried out using a partnering approach, however, indicates that the innovation process itself was seen as the major innovation and may (initially) even hamper innovations that aim to upgrade the dwelling to current standards. This effect should be taken into account when developing innovations in dwellings.

Keywords: process innovation, product innovation, partnering, social housing

§ 6.1 Introduction

In the Netherlands, housing associations are major contributors to quality of life in local urban environments and dwellings because they own and maintain 32% of the total Dutch housing stock and are responsible for taking measures to upgrade the quality of these dwellings.

To keep the dwellings up-to-date with contemporary quality requirements, housing associations need to adapt the technical specifications of their dwellings - by installing new heating and ventilation equipment, a new kitchen or energy-saving double glazing or insulation, for example.

Such upgrades, the aim of which is to improve the material, technical and functional quality of the dwelling, are perceived as product innovations, the dwelling being regarded as a 'product' or asset belonging to the housing association. This perception is in line with, for example, Ling's (2003) definition of innovation as "a new idea that is implemented in a construction project with the intention of deriving additional benefits although there might have been associated risks and uncertainties. The new idea may refer to new design, technology, material component or construction method deployed in a project" (Ling, 2003, p. 635; see also Slaughter, 1998; Rogers, 2003; Sexton and Barrett, 2005).

Apart from these product innovations, housing associations are also innovating the processes that they use, forced by the ongoing push for greater efficiency and political pressure to focus on their core task: the provision of decent homes for those on lower incomes (Nieboer en Gruis, 2014). These process innovations focus on the way in which the associations carry out their maintenance and refurbishment work, aiming to achieve better collaboration with the construction sector (Georgius and Rienhart, 2013; Roders *et al.*, 2013; Vrijhoef, 2011).

Given the importance for housing associations of keeping their housing up-to-date (MinIKR, 2005) and for the construction industry of staying competitive (Blayse and Manley, 2004), several tools exist that support the wider distribution of innovative methods and approaches (Rogers, 2003). Firstly, it is important that innovative approaches and methods are communicated to the actors that are in a position to implement them. Based on the information and knowledge that they receive, these actors can then decide to adopt or reject these innovative methods. Additionally, there are governance tools that seek to influence attitudes towards innovation. These tools focus on incentives and regulations. Financial incentives, for example, can reduce financial barriers (Murphy *et al.*, 2012) which may be hampering the adoption of innovations; alternatively, regulations may oblige housing associations to adopt certain innovations. However, as drivers for innovation, regulatory tools have had a mixed

reception in the literature. On the one hand, stricter rules do lead to change, but using coercion to 'force' innovation usually only leads to incremental changes, simply in order to meet the new standards (Beerepoot and Beerepoot, 2007).

Although companies in the construction sector need to innovate in order to stay competitive, it is not always easy to get an innovation process off the ground. According to Nam and Tatum (1992), the construction sector has small profit margins and this acts as a brake on innovation. Small margins are inherent to the traditional construction process, and are the result of price competition. The level of innovation depends on the risks that a construction company is willing to take in order to implement innovation. The risks are covered by a certain margin in their bid for a project. The stronger the competition on price, the smaller the margin, and the smaller the degree of innovation that can be accommodated. On the other hand, construction clients, too, tend to be averse to substantial risks. As a consequence they specify exactly what they want to do to eliminate as much uncertainty as possible. These specifications form the basis for the tendering procedure. The construction companies only provide what has been prescribed, in their drive to save as much as possible and putting in the lowest bid. Detailed specifications not only hamper innovations because they result in limited profit margins, but they also leave limited room for flexibility in choosing the right products or construction methods in order to achieve the performance required (Sexton and Barrett, 2005). To promote innovation, the procurement of work needs to move to a performance-based set-up, which means that clients describe the performance they need or want but leaves the construction sector to determine the best way to achieve that performance (Egan, 1998; Nam and Tatum, 1992; Sexton and Barrett 2005).

Performance-based construction is facilitated by a construction process based on an integrated approach, in which firms collaborate without company boundaries to obstruct the free flow of knowledge and experience (Dulaimi et al. 2002; Blayse and Manley, 2004). A partnering approach is one form of collaboration (Hughes et al., 2012) in order to carry out a construction project that embraces the focus on integrated projects. Throughout this paper, the definition of partnering as developed by the Construction Industry Institute (CII, 1991) will be used: "A long-term commitment by two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organization boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each other's individual expectations and values. Expected benefits include improved efficiency and cost-effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services."

Looking at the innovation process in more detail, effort should be made to diffuse innovations more widely (Rogers, 2003). At the firm level, this occurs best in a network environment (Barrett et al., 2005), such as a partnering approach. Within a project,

the team members should also be fully committed, and should not adopt an 'arm's length approach' (Ling, 2003). They should be inspired by 'champions and visionaries' (Ling, 2003) or by change agents, who act to bring about changes in behaviour (Rogers, 2003).

The aim of this study is to reveal how housing associations, together with construction companies, deal with the implementation of product innovations to improve the technical and functional quality of the dwellings in refurbishment projects using partnering approaches. The focus is primarily on how the innovations have been implemented. The participants were also questioned about which tools may increase the implementation of innovations.

The following sections will elaborate on the method used in this study. The research question was: "What are the conditions for implementing product innovations in housing refurbishment projects using a partnering approach?" After presenting the findings relating to this 'instrumental' question, these will be discussed from the viewpoint of both implementers and policymakers, so that these groups can gain an understanding of the feasibility of the innovation that is being required of housing associations.

§ 6.2 Methodology

The study used a case-study approach. General contractors and housing associations participated in a knowledge exchange project on partnering for the purpose of housing refurbishment. In the Netherlands, they belonged to a small group of forward-looking parties that are experimenting with partnering in housing refurbishment projects. The knowledge exchange project took place in 2011-2012 and was carried out in collaboration with seven dyads, each formed by a housing association and a general contractor. To participate in the knowledge exchange project, the participants had to carry out a pilot project in housing refurbishment that used a partnering approach.

The knowledge exchange project was initiated with the aim of enabling housing associations and general contractors to gain experience of partnering in the context of housing refurbishment projects. The authors of this paper also participated in the project for scientific support and evaluation. Initially, a total of 20 housing associations and 19 general contractors were individually invited to participate in the project. Not all of the invited housing associations and contractors were willing or able to participate, so the knowledge exchange project was carried out with its seven dyads.

The participants shared their experiences in plenary sessions every 4-6 months. Every session had a central theme - namely: the expectations and approaches of participants, examples from outside the project, contracts, innovation, organisational change and general experiences with the pilot projects (Roders *et al.*, 2013). This paper elaborates on the results of the third aspect: innovation.

The data collection began with a survey in October 2011, followed by a plenary meeting on 30 November 2011, where the results of the survey were discussed. The survey focused on the innovations that were achieved in projects, as well as the conditions necessary for (stimulating) innovation. In the survey, 50% of the data was collected by phone interviews and 50% through surveys sent to the participants by e-mail. Due to limited resources, not all data could be collected through interviews. The results were validated in the plenary session. The questions in the phone interviews and e-mail surveys were identical and consisted of a series of open questions. When processing the responses, no differentiation was made between the data gathered by phone or e-mail. The interview and survey results were presented to the participants in the project at the plenary session, so that the participants could reflect on these. A total of 22 persons responded to the interviews and surveys. The plenary session was attended by 21 persons, as well as three experts in construction processes and innovation who were not otherwise involved in the knowledge exchange project (see Table 6.1).

The data were collected by means of structured interviews based on open questions. These were derived from literature on innovation in construction and focused mainly on the organisational changes necessary to introduce innovations. However, to obtain a clear picture of these innovations, the participants were first questioned about the type of innovation. Subsequently, questions were asked about who initiated innovation, which types of project delivery method were adopted and which individuals were involved in implementation. Finally, the participants were questioned about tools to encourage innovations. These tools were derived from a previous study by the researchers on governance tools (Chapter 2 of this thesis).

PROJECT	FIRM	FUNCTION	PLENARY	INTERVIEW
A	Specialised contractor (HVAC)	Division manager	yes	yes
A	General contractor	Director	yes	yes
A	Housing association	Manager Real Estate	yes	
A	Specialised contractor (Façades)	Director	yes	yes
A	General contractor	Planner		yes
A	Housing association	Project leader		yes
B	Housing association	Policy consultant	yes	
B	Housing association	Project leader	yes	yes
B	General contractor	Division manager	yes	yes
C	General contractor	Director	yes	yes
C	Housing association	Division manager	yes	
D	Architect	Designer/Project leader	yes	yes
D	General contractor	Project leader	yes	yes
D	Housing association	Project leader	yes	yes
E	General contractor	Calculator/Planner	yes	yes
E	Consultancy	Consultant		yes
E	Specialised contractor (HVAC)	Project leader	yes	yes
E	Specialised contractor (HVAC)	Division manager	yes	
E	Housing association	Director	yes	
E	Housing association	Manager Real Estate	yes	
E	Consultancy	Project leader		yes
E	Consultancy	Consultant		yes
E	Architect	Designer/Project leader		yes
E	Housing association	Program manager		yes
F	Housing association	Manager Maintenance	yes	
F	General contractor	Project leader	yes	yes
F	Housing association	Project leader		yes
F	General contractor	Director		yes
G	General contractor	Director	yes	yes
X	General contractor	Director	yes	
X	Knowledge platform	Innovation specialist	yes	
X	Knowledge platform	Innovation specialist	yes	
X	Knowledge platform	Innovation specialist	yes	

TABLE 6.1 Participants in plenary session and interviews

§ 6.3 Results

Although the aim of the research was to reveal the potential of partnering as an approach to implementing product innovations, the first question in the survey was whether the participants had in fact implemented any kind of innovation in a recent project that had involved partnering. It was decided to broaden this question to capture as much information as possible on how the innovation process is carried out. It was then possible to narrow this information down further to the subject of product innovation at a later stage. In total, 19 of the 22 participants stated that they had been involved with innovation. The following sections elaborate on the answers given by these 19 participants.

§ 6.3.1 Type of innovation

When asked about the type of innovation, most participants responded that the innovation primarily involved process improvements: a better collective preparation phase that involved all specialist contractors. The adoption of a partnering approach was perceived as an innovation in itself. Subjects such as 'collaborative development' or 'integrated design' were mentioned. Collaboration was mentioned, but also the instruments that can lead to a better collaboration, such as 'implementing Building Information Modelling (BIM)' and 'lean planning'.

The development and implementation of new products was mentioned less frequently. At the plenary meeting, it was remarked that carrying out the work using a partnering approach was so time-consuming and expensive that it was not feasible to consider product innovation too.

§ 6.3.2 Who initiates innovation?

The respondents were also asked which party initiates innovation. Housing associations were mentioned the most frequently, followed by shared initiatives undertaken by the general contractor and the housing association. The roles of other partners, such as architects, specialist contractors and manufacturers were minor, according to the respondents. At the plenary discussion, the suggestion was made that the manufacturers should play a central role in implementing product innovations, but for the use of their products they depend on either the housing association or the

general contractor. It was also suggested that to encourage innovation, both firms and clients need to be prepared to take risks. Construction companies by nature tend to display a high degree of entrepreneurship, which makes them familiar with handling risk. However, those companies have small profit margins, leaving little room for investment in innovation. Many general and specialist contractors are reluctant to develop innovative construction concepts because this involves the risk of becoming more expensive than their competitors. Another perceived risk is that clients see them as insufficiently flexible vis-à-vis the client's needs.

§ 6.3.3 Project delivery method

On the question of which project delivery method creates the best conditions for innovation, the general opinion was that the process itself is not the decisive factor. What is more important is that housing associations abandon their control role and trust their partners' ability to innovate. The general and specialist contractors commented that, in their experience, housing associations – particularly larger ones – often tend to retain their controlling role, which leads to a hierarchical approach. It was stated that the focus on competition in one-off projects limits the possibilities of repetition, and that the greatest benefit can be realised where there is a continuous flow of projects. This is because there is more experience with the type of project and better communication between employees of all partners. Moreover, errors made in previous projects can be corrected.

Two project delivery methods were used by the participants. Under the first method, the client and firm collaborate at an early stage on the basis of a previously established relationship. In these projects, the performance indicators were defined jointly. Under the other project delivery method, the housing association draws up the performance requirements in advance via a tendering procedure. The consortium with the project that corresponds most closely to the performance indicators wins the tender. The current study did not determine which of these two strategies produced more innovation.

The supply chains in the knowledge exchange project were all set up as if for a one-off project, even those occurring within an already established relationship.

§ 6.3.4 Who was involved?

One of the questions in the survey focused more specifically on the individuals that were involved in the innovation and the factors that helped or hindered the adoption of innovation by those working in the partnerships. Project leaders were mentioned the mostly frequently as being involved in implementing innovations, but others included general management, planners, calculators and sales employees. What is important for all those involved is that they are results-driven and are able to work and interact well with others. The participants believed it is important for people to share the same 'mind-set'. Additionally, clear guidance by general management and/or project management was also very important. The need for one individual to take on the role of process coach or innovation stimulator was also highlighted. Some participants mentioned that focusing on success stories within their own organisation was a very important means of ensuring commitment.

The factors that were cited as decisive for successful implementation of innovation were: selecting the right partners, trust, transparency, collaborative goal-setting and focusing on the employees who need to implement the innovation. The participants in the plenary session shared the opinion that there is a reasonable risk that board members of housing associations may start asking for different partners after a few projects have been carried out by the same firms, which is the case with a partnering approach. The board is under pressure to be seen as an independent institution that is careful about using its tenants' money to maintain its building stock by, for example, creating competition between its supply chain partners. A possible solution to this problem was suggested: maintaining the collaboration between client and firm, but increasing the desired level of performance in each successive project.

Some employees (of clients) were said to find it difficult to change their routines. They tend to fall back into their 'old habits'. On the other hand, it was recognised that it is difficult for project leaders who are carrying out multiple refurbishment projects, both in a traditional and in a partnering setting, to switch between different types of project and modify their behaviour accordingly. In traditional projects, defensive behaviour is required, while cooperative and proactive behaviour is required in partnering projects.

§ 6.4 How to encourage innovation?

Table 6.2 shows a number of tools that policymakers can employ to encourage and stimulate innovation in the construction sector.

Government regulation can lead to innovation. For instance, if government regulations forbid products from being used or approaches from being applied, other (innovative) products or approaches must be developed. However, the interviewees did not view regulation in the form of laws, certificates and permits as a necessary stimulus to innovation. The participants rated the necessity of regulation as 'neutral'. This was confirmed in the plenary session, when people stated that in business 'you are too late if you wait for regulations to be enacted'. Some even took the view that once something is included in legislation, it is no longer innovative.

Incentives may help to encourage innovative behaviour. The measures in this group were generally found to be necessary, but the financial incentives such as tax measures or subsidies were evaluated more neutrally than measures concentrating on social corporate responsibility and covenants. Some even found these financial incentives to be unnecessary because of the associated administrative burden. They believed that intrinsic motivation is necessary to innovate and that the innovation should ultimately 'pay for itself'. Others referred to the subsidy policy as being unstable, implying that subsidies may stop at any time, so that long-term investment would turn out to be too risky. The focus of the participants is more oriented on establishing a good reputation with stakeholders, judging by the importance accorded to corporate social responsibility and covenants.

The most important means of stimulating innovation mentioned by the participants was for partners to take a proactive approach and work together on solutions. In addition, the involvement of motivators, such as change agents or coaches within the partnership was found to be very important.

The information tools were, to a large extent, evaluated as neutral, with a somewhat negative evaluation for TV programmes, and a positive evaluation for demonstration projects.

	N	VERY NECESSARY	NECESSARY	NEUTRAL	REDUNDANT	VERY REDUNDANT
Regulation tools						
Building code	21**	1	4	12	4	0
Certification	21**	1	5	11	4	0
Permits	21**	1	4	12	4	0
Incentives						
Subsidies	23*	5	8	8	2	0
Special loans (e.g. green mortgage)	22	3	10	7	2	0
Tax reduction on innovative products	22	4	11	6	1	0
Tax deduction on innovative products	22	4	9	8	1	0
Competition	22	4	6	8	2	2
Corporate Social Responsibility	23*	7	11	5	0	0
Covenants	23*	5	13	3	2	0
Performance label (e.g. BREEAM)	22	4	7	9	2	0
Pro-active project partners	22	18	3	1	0	0
'Intelligent' supply chain (knowledge with all parties in the supply chain)	22	15	5	1	1	0
Motivator within the supply chain	22	16	5	0	1	0
Motivator outside the supply chain	22	7	9	6	0	0
Information tools						
Online tools and information	22	8	9	5	0	0
Television campaigns	22	0	5	9	7	1
Tailored advice (consultant)	22	4	11	4	3	0
Road shows (demonstration in the office)	22	3	6	8	4	1
Demonstration project (demonstration on site)	22	10	6	4	2	0
Communities of practice (knowledge exchange project)	22	9	11	2	0	0
Discussion platforms	22	5	14	1	2	0
Education programmes	22	8	11	3	0	0

TABLE 6.2 Tools for encouraging of innovation

*1 participant gave 2 answers; **1 participant did not answer.

§ 6.5 Discussion

The composition of the partnerships was determined by the housing associations and/or the construction companies involved. What was notable was the hesitation of many housing associations to take part in such a project, since it would involve forming a partnership with a general contractor and/or suppliers. This happened in previous studies too (Briscoe and Dainty, 2005; Humphreys *et al.*, 2003). The participants were not a random sample from the whole construction sector, but they made a conscious decision to take part in the project to share their experiences of partnering. This meant that all partners were involved in an innovation process and almost all participants (19 out of 22) said that they had also dealt with some kind of innovation in construction processes previously.

While the literature on innovation in construction suggests that an integrated approach should be considered for the implementation of innovations, the current study indicates that this approach does not automatically lead to more product innovation. Since the dyads all had limited experience of the partnering approach, they worked very hard on the construction process itself, which they considered as the major innovation. They stated that the process innovation took so much time that they had no time left for product innovation. In other words, the product innovations were pushed out by the focus on partnering.

Although the housing associations were mostly considered as the initiators of the innovation, it became clear that implementing innovation is not a 'one-man show'. Within all companies in the partnership, including the housing associations, people from both the strategic level and the operational level need to be motivated to work together to implement innovations. To stimulate innovation, the participants are sensitive to measures that appeal to their own curiosity and knowledge development, or their strategic position within their actor network. Furthermore, they consider demonstration projects to be necessary and believe that corporate social responsibility and covenants are important drivers of innovation. Financial incentives and regulation were found to be less important, although not unimportant.

§ 6.6 Conclusion

This article has brought together the experiences of a number of housing associations and contractors in implementing innovations in the refurbishment of the housing stock. Innovation is perceived as a vital prerequisite for achieving general policy objectives relating to major societal concerns such as the need for climate change adaptations. Several studies have already indicated that innovation can benefit from an integrated construction process that is based on collaborative rather than adversarial relationships. However, evidence suggests that partnering itself does not automatically lead to product innovations and most of the respondents see partnering itself as an innovation in its own right. Process innovation required a great deal of attention, while less emphasis was placed on opportunities for product innovations.

Policy-makers need to take these findings into account when imposing requirements for product innovations to achieve objectives related to contemporary societal objectives such as climate change adaptation projects. Furthermore, it may even be counterproductive to focus solely on product innovation since companies may first have to start adapting their processes. Translating this into the governance of climate change adaptations, two strategies for further investigation are suggested. The first is not only to focus on implementing climate change adaptations in dwellings (product innovations), but also on improving the construction process itself (process innovations). The second is to focus on the pioneers in integrated construction processes: they already have an innovative process in place, so they are able to focus genuinely on the product innovations that are required.

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7 Implementation strategies for climate change adaptation measures in Dutch social housing

After two parallel research lines - one on housing associations and their knowledge and awareness of climate change and the other on partnering in construction - Chapter 7 brings both these lines together. In this chapter three conceptual approaches are developed that aim to provide a solution to barriers to the implementation of climate change adaptation measures by housing associations, as outlined in Chapters 3 and 4. Two of the three conceptual approaches are derived from the principles of partnering in construction that were the subject of Chapters 5 and 6.

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Abstract

Housing managers are constantly confronted with the changing demands and requirements that their building stock must meet. One aspect of this is the changing climate, which is caused primarily by greenhouse gases produced by human activities. Even if the emissions of all these gases could now somehow be put on hold, the process of climate change could not be, and the effects of climate change would most probably continue to be felt for many more years. In urban areas, these effects include drought, flooding caused by extreme precipitation and heat stress caused by the urban heat island effect. In addition to threatening the building stock, climate change is also threatening the quality of life of people in urban environments. In the Netherlands, housing associations are responsible for managing the social housing stock and maintaining the quality of life of those that live there. However, research has shown that they are not yet sufficiently aware of the challenge that lies ahead in adapting their dwellings to a changing climate. In view of the focus on the physical adaptations of the building stock, it was chosen to discuss in this paper the effectiveness of three types of conceptual approaches for governance that housing associations could apply directly in their maintenance processes. The conceptual approaches are hypothesised based on the results of earlier research on the implementation of climate change adaptations in

social housing. The conceptual approaches are: CA1) incorporate climate adaptation into the policy that guides the overall management of their stock; CA2) involve actors that traditionally do not play a role in the construction process, such as insurance companies and water boards; CA3) emphasise performance-based procurement to encourage the execution of projects using a partnering approach. The effectiveness of these conceptual approaches was tested using a SWOT analysis for each approach, which was discussed with practitioners. The results are five implementation strategies, based on the combinations of conceptual approaches that are potentially feasible for the implementation of climate change adaptation measures in the Dutch social housing stock. One crucial factor in these implementation strategies is collaboration, because these days no housing association is financially able to assume responsibility for climate-proofing its housing stock on its own.

Keywords: Adaptation, Climate Change, Construction Process, Policy Development, Social Housing

§ 7.1 Introduction

There is clear evidence that the world's climate is changing (Füssel, 2009; Smith *et al.*, 2009). Phenomena such as urban heat islands (Salcedo Rahola, 2009) and flooding, caused by more intense precipitation and increased river run-off, are expected to become more frequent (Bessembinder, 2008), posing a threat to quality of life in cities. As we gain more knowledge about the effects of climate change, both behavioural and physical adaptation measures have been developed to address these effects, resulting in guidelines for citizens on how to behave during heat waves (see for example: MinHWS, 2007; Oakman *et al.*, 2010; Department of Health, 2012), as well as design recommendations for the urban environment such as green roofs for temporary water retention (see for example: GLA, 2005).

In 2012, the Delta Programme New Urban Developments and Restructuring published a 'measure matrix' for the Netherlands that listed 155 adaptation measures for the built environment (MWH, 2012). Housing associations are significant actors when it comes to applying adaptation measures in housing. A relatively small number of organisations (381) own and maintain approximately one third (2.4 million) of the total housing stock of the Netherlands (www.cfv.nl), so, if these associations were to decide to adapt their dwellings, a large part of the country's stock could be made more resilient to the effects of climate change. However, a recent study of documents published by housing associations showed that they have only a limited awareness of how to apply climate change adaptation measures (Chapter 3 of this thesis). What is

more, policy-makers at housing associations have shown in interviews that even when they are aware of adaption measures, implementation is unlikely because of financial constraints, the absence of a policy, or the measures being viewed as too complex to implement (Chapter 4 of this thesis). This implies that housing associations are not planning structural alterations that could mitigate the harmful effects of climate change. There are various reasons why they should start to adapt their dwellings, however. First of all, housing associations can be considered 'social entrepreneurs', deploying their resources and profits to achieve the societal aims that they pursue (Van Overmeeren, 2014). Secondly, housing associations have a legal obligation to provide good quality housing for their tenants both now and in the future according to the Social Rented Sector Management Order (MinIKR, 2005). The societal and legal framework within which housing associations operate implies that they can be expected to commit themselves to adapting their dwellings to changing circumstances that may threaten the quality of life of those living there. Climate change is one of those threats. Thirdly, the failure to implement adaptation measures could jeopardise the future value of their stock, because in the Netherlands dwellings in areas with a risk of flooding have a lower average value than dwellings in a non-risk area (Bosker *et al.*, 2013).

The aim of this paper is to identify approaches to increase the implementation of climate change adaptations, in order to end up with a climate-resilient dwelling. The study looks at housing associations, as major property owners, as the main actor in this process, and the underlying question is how to implement these measures effectively. As such, the study is not focusing on governance schemes initiated by the government which instruct, encourage or oblige housing associations to take action, in hierarchic, market or network settings (Chapter 2 of this thesis), since these schemes are still under development. In addition, if the government forces the housing associations to take action, the disadvantage is that these housing associations would have to develop internal governance schemes to begin adapting dwellings and to request adaptations to the construction sector. This implies governance measures at three levels, the first from the government to housing associations; the second from the policy department to the project planning department and the third from the planning department to the construction sector to carry out the works. The focus directly on the governance level of the construction sector is expected to lead to a more effective implementation of measures. Moreover, knowledge gaps can be identified on which the government should focus its national governance strategies. To do this, a closer look at the maintenance and improvement cycle for existing dwellings is needed to find opportunities for the implementation of measures.

In the following sections, the methodology will be described that has been used to carry out this research. Then, the results will be presented and discussed, and finally conclusions will be drawn and with some remarks and recommendations for further study will be given.

§ 7.2 Methodology

Potentially successful conceptual approaches were hypothesised based on and inspired by the results and experiences of previous studies (Chapters 3 and 4 of this thesis), conference visits and research project meetings attended by the researchers. The basis for these conceptual approaches was that a governance intervention at several phases in the maintenance and construction cycle of a dwelling should lead to the implementation of measures. The first conceptual approach (CA1) was hypothesised as follows: housing associations should incorporate climate change adaptation as an internal policy, meaning that they should allocate resources to this area and include adaptations in their projects. In earlier interviews (Chapter 4 of this thesis), employees of housing associations stated that the lack of policy is one of the reasons why they do not implement measures. The hypothesis underlying the second conceptual approach (CA2) was as follows: housing associations should seek collaboration with actors who might also benefit from the adoption of climate adaptation measures, such as municipalities and insurance companies. In cases where housing associations implement water-retention or infiltration measures, under the terms of the cooperation agreement, the municipalities in question may spend less on adapting the sewage system. The third conceptual approach (CA3) was hypothesised as follows: housing associations should aim for a partnering approach with construction companies to carry out construction work. Partnering promises to be a more cost-effective way of working (CII, 1991), which would create the scope for investing in adaptation measures.

The strengths, weaknesses, opportunities and threats (SWOTs) of these conceptual approaches were discussed and verified in face-to-face interviews with practitioners in each strategic field. The practitioners that were consulted are listed in Table 7.1. The results of the SWOT analysis were used to develop strategies on the effective implementation of climate change adaptation measures.

PRACTITIONER FUNCTION	STRATEGY	ORGANISATION
Senior advisor, property management	S1. Policy development	Housing association (56,000 dwellings)
Director, property management	S1. Policy development	Housing association (77,000 dwellings)
Director, property management	S1. Policy development	Housing association (30,000 dwellings)
Director	S2. External actor involvement	Centre of expertise sewer management and urban drainage
Strategic advisor	S2. External actor involvement	Water company
Senior advisor, water systems	S2. External actor involvement	Water board
Strategic advisor, long-term policy	S2. External actor involvement	Federation for health insurers
Senior advisor, risk management and reinsurance	S2. External actor involvement	Insurance company
Policy advisor	S2. External actor involvement	Insurance company
Employee Development and Maintenance Sewage systems	S2. External actor involvement	Municipality
Director	S3. Partnering approach	Construction company (300 employees)
Director	S3. Partnering approach	Construction company (45 employees)

TABLE 7.1 Interviewed practitioners

§ 7.3 Effectiveness on climate change adaptation

CA1. Policy Development. In earlier research carried out by the current authors, it was concluded that awareness of the need for climate change adaptation was lacking in policy documents published by Dutch housing associations (Chapter 3 of this thesis). As a consequence, there is no policy that guides the implementation of climate-change adaptation measures. According to the definition of ‘policy-making’ used by several scholars (see Dankert, 2011), which states that under a policy strategy goals are established and the resources needed to reach those goals are allocated, the absence of a policy strategy implies that no financial resources have been allocated for climate-change adaptation measures. However, even if housing associations are aware of the need for climate change adaptations and developing policy strategies for their implementation, little money is currently available (Nieboer and Gruis, 2014). So if the government were to put in place governance arrangements in the fields of regulation and information in order to oblige the housing associations to implement such measures, the housing associations would have to reallocate resources from other policy fields in order to implement any such adaptation policy. This could lead to lower

quality in other areas, which is not desirable. Further funding from government is not possible either, due to a lack of resources. Nevertheless, the potential for developing a policy to allocate resources to the field of climate-change adaptation and the associated decision framework for action is a strategy worth investigating.

CA2. Involving external actors in the construction process. A second arrangement is reforming the plan development process to generate funding for climate-change adaptation measures. This arrangement would focus on actors that could benefit financially from such initiatives. Given that a water-resilient dwelling, for example, is less likely to suffer damage due to flooding, insurance companies would incur lower risks. They would save money, which may mean that they would be willing to invest in adaptation measures. The money could be paid directly to the owner of the dwelling, or the insurance premium could be reduced so that the homeowner could use that money for adaptations. (McEvoy, 2010; CEA, 2007). Other beneficiaries of flooding adaptation measures would be municipalities, because there would be less need to adapt their sewage systems and water authorities, since they would not need to change their drainage systems, water cleaning plants and pumping stations. The water volume that they deal with now would remain the same: the increase caused by climate change would be cancelled out by adaptation measures in the urban environment.

CA3. Adopting a partnering approach for projects. Under the third type of arrangement, the focus is on removing the financial barriers that impede the implementation of measures. The solutions can be found in increasing the effectiveness of current 'traditional' construction processes. Increasing effectiveness implies lower costs for the same product, creating financial scope for investing in adaptation measures. In this thesis, the definition of partnering is used as developed by the Construction Industry Institute (CII, 1991): "A long-term commitment by two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organization boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each other's individual expectations and values. Expected benefits include improved efficiency and cost-effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services". According to this definition, partnering can be considered a method of making the construction process more efficient.

§ 7.4 SWOT Analysis

In this section, the results of the SWOT analysis with the practitioners will be presented for each of the three conceptual approaches: policy development; the involvement of external actors; and carrying out the projects by using a partnering approach.

CA1. Policy Development

This conceptual approach was explored using the following question: what are the strengths, weaknesses, opportunities and threats of incorporating climate-change adaptation measures as a specific subject in (any kind of) policy documents? The arguments given by the respondents are summarised below.

Strengths: Adaptation needs to be officially incorporated into policy in order for it to be included in plan developments. A policy plan legitimises investment and sets project boundaries, indicating what should be done. A policy plan identifies a destination for the medium to long term and describes how to reach this destination, guiding decision-making at the product and process levels.

Weaknesses: A policy strategy can be perceived as a restraining, top-down management instrument. Climate change adaptation has low priority and little has been done to raise awareness among the employees and tenants of housing associations. Currently, insufficient resources are available to develop a stand-alone strategy for the implementation of adaptation measures - these must be combined with other projects.

Opportunities: Housing association policy strategies can be matched with the municipal policy strategy, thereby creating a basis for collaboration. With regard to heating, guidelines for a higher comfort level for the dwellings can be specified through policy. Policy in areas such as adaptation, mitigation, and sustainability may reveal opportunities for combining measures to achieve synergies.

Threats: Even if housing associations incorporated adaptation in their policy strategy, support for the tenants would be necessary to implement the measures. Including measures in policy documents does not necessarily mean immediate implementation because risk management and ad hoc measures to address other more pressing or unexpected issues may take a higher priority. The dwelling or plot level may not be the right level for taking measures, since it may be more effective to provide one large-scale measure in the public space.

CA2. External Actors

This conceptual approach was explored using the following question: what are the strengths, weaknesses, opportunities and threats of involving external actors in the plan developments? The arguments, as stated by the interviewees, are summarised below.

Strengths: Collaboration with external actors such as municipalities and water boards may lead to greater efficiency in the development process, because these actors could notify the housing association at an early stage if a project does not meet legal requirements. Housing associations and municipalities would both benefit from a healthy living environment as a result of the adaptation measures. Housing associations and insurance companies would both benefit from the prevention of damage as a result of the adaptation measures.

Weaknesses: If a housing association collaborates with a water board, the housing association would become partially responsible for water-related issues that do not fall within its area of expertise. There is no market for rain insurance for housing associations, because they do not feel it necessary to cover the risk of damage to the structure of the dwelling (they do insure against fire and storm damage). There would be no urgent need for health insurers to become involved with the implementation of climate change adaptations since their main focus is on providing good care after a person becomes ill, not on preventing illness. Moreover, it is difficult to prove a direct relationship between applying measures to dwellings that may help to prevent illness, when other measures, such as ensuring that elderly people drink enough, could prove much more effective.

Opportunities: Implementing adaptation measures that reduce the impact on the sewage system could result in lower sewer taxes. Adaptation measures could be mainstreamed at a neighbourhood level through initiatives such as the circular economy and the implementation of mitigation measures, thereby involving more stakeholders in the project and generating more support among local residents. The different actors would have to collaborate to share tasks and responsibilities because the measures at the building and neighbourhood level would have to be matched.

Threats: Many measures would certainly cost extra money, while in many cases revenues are uncertain. Water boards and municipalities only have public money, which they could not freely spend on the private property of housing associations. Municipalities cannot fully apply their knowledge in housing association projects since they feel they are perceived more as controlling authorities than as partners. Insurance contracts with housing associations are relatively short (1-3 years), which for insurance companies implies the risk that they would not stand to gain from their contribution to adaptation measures if the housing association decided to switch insurance company.

CA3. Partnering Approach

This conceptual approach was explored using the following question: what are the strengths, weaknesses, opportunities and threats of adopting a partnering approach? The following arguments were given by the interviewees.

Strengths: Practical knowledge about technology can be applied early in the development of the plans. The housing association allocates construction risks to its partners in the supply chain during the implementation of the project. Repeating processes with the same partners could reduce costs and also improve quality.

Weaknesses: The 'ultimate' market test, selecting from competitive alternatives with respect to price and/or quality, is not possible. It is uncertain whether the best solution offered by the partnering consortium is also the best solution overall. Current partnering models focus on relationships between housing associations and construction companies, while most of the potential for innovation lies with manufacturers. The strategies and processes of housing associations are a blind spot for construction companies, because they are accustomed to working in a solution-driven environment.

Opportunities: Sub-optimal solutions could be prevented by aligning the goals of the partners and parties from outside the partnership. Within the supply chain, knowledge would be freely available for all parties. Partnering could prevent the waste of public money, because partners would take a longer-term view, while in market-driven environments the short-term solution will often prevail.

Threats: In a partnering setting, the spread of risks is lower because much of the work is done by one consortium. Reliance on the partnering consortium can become too great and control by the housing association may decrease. Once they have been awarded a long-term contract, the partners in the consortium may become less motivated to continuously improve their service.

§ 7.5 Discussion

The next step in this study was to develop feasible strategies for the implementation of climate change adaptation measures to dwellings. The researchers evaluated the feasibility of the implementation strategies by asking whether they were likely to lead to the implementation of measures, in light of the results of the SWOT analyses.

One strategy was based on the conceptual approach of policy development (CA1): *The housing association incorporates the implementation of adaptation measures into its policy, allocates resources for adaptation and prescribes exactly what has to be done by the construction company.*

The positive argument for this strategy is the fact that a change in policy takes place, bringing into play the strengths and opportunities of policy-making as outlined above. However, certain weaknesses and threats cannot be avoided – financing the measures in particular. This could be done by teaming up with external actors, for example, who may be willing to contribute financially to the measures because they would profit from the measures as well. The financial barriers could also be removed by adopting a partnering approach and challenging the supply chain to deliver adaptation measures at a lower price, making the most of the benefits of a more efficient planning process. However, since this strategy only deals with policy-making and neither external actors nor other partners would necessarily be involved, the weaknesses are too significant to consider the strategy feasible. Likewise, the strategies based solely on involving new actors (S2) and on a partnering approach (S3) are not feasible, because the weaknesses would be too great or insufficiently avoidable.

Potentially more feasible are the implementation strategies based on combining two conceptual approaches:

Implementation strategy A (CA1+CA2): The housing association incorporates the implementation of adaptation measures into its policy, allocates money to carry out these measures and seeks to collaborate with an external actor (e.g. municipality, water authority, insurance company) to develop and realise the project together with that actor with the aim of pursuing shared goals.

Implementation strategy B (CA1+CA3): The housing association incorporates the implementation of adaptation measures into its policy, allocates money to carry out these measures and forms a partnership with one or more construction supply chains for all the renovation work on its building stock. The delivery of climate-change resilient dwellings is set as the performance indicator. The supply chains develop specialist knowledge of adaptation measures and apply this knowledge in the design of the project.

Implementation strategy C (CA2+CA3): A construction company works with an external actor (e.g. municipality, water authority, insurance company) and proactively incorporates adaptation measures into a project for a housing association, without the housing association having requested any adaptation measures. Together with supply chain partners and external actors, the construction company looks for solutions that fit into the project boundaries that are defined by the housing association.

Combining two conceptual approaches makes the implementation strategies more feasible. For example, in implementation strategy A, the financing weakness of policy making by the housing association remains, but in the scenario the strengths regarding collaboration with municipalities and insurance companies counteract this weakness because money can be saved on sewage tax, resulting in more investment capacity. In addition, the weakness of policy being perceived as a top-down imposition would be less important, since there would also be pressure from external actors to work on adaptation. In other words, the weaknesses are no longer decisive. The same type of benefits can be distinguished for implementation strategies B and C.

What is even more feasible is combining all three conceptual approaches:

Implementation strategy D (CA1+CA2+CA3): The housing association incorporates the adaptation measures into its policy, allocates money for implementing these measures and seeks to collaborate with an external actor (e.g. municipality, water authority, insurance company) to develop and realise the project together on the basis of shared goals. The project is handed over to a consortium with which the housing association has a partnering agreement. The delivery of climate-change resilient dwellings is set as a performance indicator.

Under this implementation strategy, the challenge of implementing climate change adaptation measures is taken up from three sides, and there is more flexibility to work around the weaknesses and threats. However, since both the second and third conceptual approaches imply the involvement of extra parties, the risk of developing a project with both external actors and a partnering consortium may lead to difficulties (Provan and Kenis, 2007) due to the large number of parties involved, persistent communication problems, the need to reconcile numerous divergent goals, etc. In the SWOT interviews with the practitioners from the housing associations, an argument was raised that did not really belong to any of the strategies outlined at the start of this study. The interviewees stated that tenants are the most important stakeholders that a housing association works for, and it is the societal task of the housing association to meet their needs in the best possible way. Accordingly, housing associations are sensitive to tenant requests. If tenants really feel the need for a measure, it is likely that they would accept a slight increase in rent to cover the cost of investing in the adaptation measure. A fifth implementation strategy was developed, putting the occupants of the dwelling in a central position.

Implementation strategy E: The housing association and/or an external actor (e.g. municipality, water authority, insurance company) inform(s) tenants to make them aware of the benefits (more comfort, lower insurance risk) of an adapted dwelling. The tenants ask the housing association to take action, as a result of which the housing association incorporates climate-change adaptation measures into its policy.

§ 7.6 Conclusion

In this paper, three conceptual approaches for improving the implementation of climate-change adaptation measures in social housing were elaborated. The three conceptual approaches involve policy development, collaboration with external actors and using a partnering approach in the construction process. The feasibility of the conceptual approaches was verified with practitioners by means of a SWOT analysis.

The results made clear that single-pronged conceptual approaches are unlikely to be successful. This means that housing associations are currently not in the position to adapt their building stock by acting alone. It has become clear that a combination of conceptual approaches is much more feasible. A closer look at these feasible implementation strategies shows that collaboration plays an important role, as every implementation strategy includes an element of collaboration. Implementation strategy A, C and D involve collaboration with the external actors, and implementation strategy B and D involve enhancing collaboration among the partners responsible for the execution of the works. When further developing the implementation strategies, the literature on network governance will be a valuable source of reference.

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8 Assessment of the likelihood of implementation strategies for climate change adaptation measures in Dutch social housing

Chapter 8 concludes the empirical section of this thesis. It follows up on the results of the SWOT analysis in Chapter 7 by testing the five implementation strategies that were developed.

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Abstract

Housing providers have to keep adapting their building stock to keep pace with the dynamic changes in the urban environment. One of the main drivers of adaptation is climate change, caused primarily by man-made greenhouse gases. Climate change is impacting on urban areas largely through drought, flooding from extreme precipitation, and heat stress. Climate change not only threatens the building stock, but also the quality of life of people living and working in urban environments. In the Netherlands, housing associations have strong interests in and responsibilities for managing the social housing stock and maintaining quality of life, but they seem scarcely aware of the challenge that lies ahead in terms of adapting their stock to the impacts of climate change. This paper focuses on physical adaptations to the housing stock and discusses the likelihood of the adoption of five implementation strategies for climate adaptation measures as assessed by decision-makers in Dutch housing associations in an online survey. The strategies combine conceptual approaches in policymaking, involvement of external players, and the execution of construction projects in a partnering approach, with the addition of one extra strategy that assigns a central position to the tenants. There was no strategy that stood out clearly as the one most likely to guide the implementation of measures. Many housing associations do, however, see opportunities in this area and might be persuaded to take action if they were provided with a wide palette of implementation strategies from which they could select the most suitable combination.

Keywords: Adaptation; Climate change; Governance partnering; Policy development; Social housing

§ 8.1 Introduction

There is clear evidence that the climate is changing globally (Füssel, 2009; Smith *et al.*, 2009). Rising temperatures (Salcedo Rahola *et al.*, 2009; Kleerekoper *et al.*, 2012) higher levels of precipitation, and increasing river run-off are expected to worsen (Bessembinder, 2008) and will pose a mounting threat to the quality of life in cities. The ongoing accumulation and development of knowledge about the impacts of climate change have led to behavioural and physical adaptations, resulting respectively in citizen guidelines on what to do, for example, during heat waves (MinHWS, 2007; Oakman *et al.*, 2007; Department of Health, 2012), and in design recommendations for the urban environment (GLA, 2005). Since 2010, research on climate change in the Netherlands has been bundled in the Knowledge for Climate research programme (Albers *et al.*, 2015). The 'Delta Programme New Urban Developments and Restructuring', which focuses on the development or redevelopment of urban areas and on making them climate-resilient has been running concurrently (MinIandE, 2011). Our study is part of the Knowledge for Climate programme, but it focuses on the 155 adaptation measures for the built environment in the 'Measure Matrix' of the Delta Programme (MWH, 2012), all of which are designed to make dwellings less vulnerable to the adverse effects of climate change and relate, for example, to the prevention of overheating by applying shading, or by using materials with high solar reflection capacities. Other measures that can prevent overheating are based on making better use of natural ventilation by installing windows that can be opened, or air vents. Meshed screens could also be fitted on windows to allow natural ventilation to take place without infiltration by insects. Another category relates to the prevention of damage by water ingress. Damage can be directly prevented by measures based on the 'dry-proofing' method, which stops water from entering a dwelling by placing watertight barriers in front of windows and doors; and indirectly prevented by the 'wet-proofing' method, which allows water to enter, but uses materials that are not affected by it, such as interior brick walls and floor tiles. Damage can also be prevented indirectly by infiltration crates, water tanks or green roofs, which store water temporarily during bouts of heavy rainfall, thus taking the pressure off the sewage system and lowering the risk of inundation (MWH, 2012).

In the Netherlands, housing associations can play an important role in implementing these measures in the housing stock. Approximately one third (2.4 million) of the total housing stock in the Netherlands is owned and maintained by a relatively small number of organizations (381) (www.cfv.nl). It goes without saying, therefore, that if these organizations adapt their dwellings, a large part of the Dutch stock will be climate-resilient. There are several reasons why a sharper awareness of the possibilities of purposefully implementing climate change adaptation measures could be important to housing associations. First, it would contribute to their social remit. Housing associations are regarded as societal entrepreneurs and are expected

to use their resources and commercial profits to achieve societal aims closely linked to the common interest (Van Overmeeren, 2014). Hence, it would be reasonable to expect them to commit themselves to making timely adaptations in order to prevent changing climatic conditions from threatening the quality of their dwellings. Secondly, the application of climate change adaptation measures could be interpreted as a legal obligation, since housing associations are required under the Social Rented Sector Management Order to provide their tenants with quality housing now and in the future (MinIKR, 2005). Thirdly, if they do not apply adaptation measures, they may be jeopardizing the future value of their dwellings, as the price of property in flood-risk areas is statistically lower than in non-flood-risk areas (Bosker *et al.*, 2013). Thus, adaptation measures can increase the value of their housing stock in flood-risk areas besides improving the quality of life of their tenants. Fourth, on a more economic level, the impacts of climate change are expected to become a serious threat to a country's creditworthiness (Kraemer and Negrila, 2014). And last but not least, housing associations own and maintain many dwellings that were built in the past when no-one gave a second thought to the impacts of climate change. As Jones *et al.* (2013) point out, the design standards to make new dwellings more resilient may not be feasible for the existing housing stock, so the impacts of climate change not only threaten the quality of the indoor environment with damp and mould, they can also accelerate the degradation of the finishes and push up the maintenance costs for many years to come (Hertin *et al.*, 2003).

That said, climate change is fraught with uncertainties (Lindley *et al.*, 2007) – which further complicates adaptation planning. Moreover, there are no government schemes as yet to incentivize adaptations. As climate change adaptation is still in an early stage of conceptual development compared to, for example, mitigation (Biesbroek *et al.*, 2010), policymaking is not yet in place.

The IPCC definitions for climate change mitigation and adaptation which are used in this paper are respectively: “A human intervention to reduce the sources or enhance the sinks of greenhouse gases” and “The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities” (IPCC, 2014). In the case of mitigation, the intensive research efforts have resulted in many governance strategies, which, if not equally successful (www.climateactiontracker.org), have proven able to raise broad awareness of climate change mitigation among policymakers and stakeholders at all levels. The Kyoto Protocol is a prime example of a governance strategy on a worldwide scale, the European ‘Energy Performance of Buildings Directive’ (EP, 2002) is an example at supranational level, and the ‘Energy Performance Coefficient’, which is part of the building code in the Netherlands, is an example at national level.

When it comes to climate change adaptation, however, the situation is different. Both the research field and the governance framework are still evolving. In 2009, in a White Paper on adaptation to climate change, the European Union proposed the establishment of a European Adaptation Strategy (CEC, 2009) and gave Member States until 2013 to prepare themselves. Although many of the 2009 recommendations have been implemented and several national adaptation strategies have been developed, hardly any of these contain concrete implementation plans or monitoring and evaluation programmes. The Member States have now been given until 2017 to prepare their National Adaptation Strategies (EC, 2013). This date is also the cut-off point for the Dutch national strategy (CCPC, 2013).

In the interests of clarity it should be noted that climate change adaptation strategies have already been developed for designated vulnerable areas throughout Europe (Biesbroek *et al.*, 2010; Bulkeley, 2010; MIT, 2014; Carter, 2011), but under the auspices of local programmes, which are driven mainly by internal interests in local aspects and are not guided or supported by an overall framework (Anguelovski and Carmin, 2011). Also, despite the absence of adaptation policy on a large scale, adaptation measures in the urban environment such as more public green space and more open water have been introduced in the Netherlands, Germany, the UK and elsewhere (Runhaar *et al.*, 2012). The same goes for green roofs installed by housing associations, which were not specifically designated as climate change adaptation measures either (Chapter 3 of this thesis). So, although the application of measures appears feasible, examples are largely incidental. For the large-scale application of adaptation measures a policy framework is necessary (Enserink *et al.*, 2010). Accordingly, since there is no policy, it is unlikely that climate change adaptation measures will be purposefully applied in either the urban environment or dwellings. In addition, many climate change adaptation measures may require extra investment by the property owners – which includes housing associations – especially in existing situations (Chapter 4 of this thesis). The housing associations, labouring under financial difficulties (Nieboer and Gruis, 2014), have been cutting their budgets and delivering projects to the minimum required standards for some time now. As climate change adaptation measures are not included in these standards, they are all too easily neglected.

It might be fruitful to combine certain instruments in the search for policy strategies that can increase the implementation of climate change adaptation measures. After all, it has already been noted that there is no single ‘perfect’ strategy that will solve all the problems at once (CEC, 2009; Murphy *et al.*, 2012). This paper evaluates five theoretical implementation strategies for climate change adaptation measures in the social rented housing stock. The research question is: Which strategies do housing association employees regard as most likely to lead to the implementation of climate change adaptation measures? As government schemes to inform, stimulate or force housing associations to take action are still under development, the focus is on the maintenance

and improvement of the housing stock. It is within this context that decisions are taken to implement physical adaptations. Adaptation can be 'mainstreamed' (Klein *et al.*, 2005) by finding synergies between adaptation policy and, for example, the policy on mitigation. In the next section we describe the research methodology and report the results. The paper ends with concluding remarks and recommendations for further studies.

§ 8.2 Methodology

This study contributes to a broader aim: the implementation of climate change adaptation measures in urban environments. All data supporting this study were collected and analysed using qualitative methods.

In brief, this study elaborates on five strategies for the implementation of climate change adaptation measures in the social rented housing stock. These strategies are a combination of several policy strategies (for easier reading, referred to as "conceptual approaches" in the rest of this paper) that should themselves be capable of assuring the implementation of climate change adaptation measures. The conceptual approaches were derived from the outcomes and experiences of earlier studies (Chapters 3 and 4 of this thesis), conference visits, and workshops attended by the researchers, and were underpinned by literature, theoretically confirming their feasibility and respective conditions. Thereafter, the strengths, weaknesses, opportunities and threats (SWOTs) of the conceptual approaches were verified in face-to-face interviews with practitioners such as real estate directors of housing associations, strategy and policy advisors of water boards, and directors of construction companies. After investigating the SWOTs, it became clear that individual conceptual approaches would not lead to the implementation of climate change adaptation measures; what was needed were implementation strategies consisting of several conceptual approaches (Chapter 7 of this thesis). The immediate aim of this study was to assess whether these implementation strategies were likely to be effective. As the wider objective was to generate implementation strategies for housing associations in the Netherlands, it was important to maximize the sample. Thus, the study addressed the entire population of 389 housing associations, 379 of which were contacted. No contact details could be retrieved for the other ten, which were duly omitted from the sample. Data were collected with questionnaires, sent out by e-mail. One strong argument against the effectiveness of questionnaires, 'Problems of motivating respondents' (Gillham, 2000), was avoided by sending personal invitations to people who were considered capable of assessing the implementation strategies. In addition, the questionnaire was designed to be answered within ten minutes. This approach delivered 102 useful responses, equating to a rate of 27%.

The introduction to the questionnaire stated clearly that the questions dealt with adaptation measures aimed at preventing problems caused by heat and extreme precipitation. Therewith it was intended to avoid confusion between adaptation and mitigation, as previous interviewees had displayed a tendency to refer to energy-saving measures (Chapter 4 of this thesis), when they were actually being questioned on adaptation measures. Some examples were even provided: sunscreens for shading, green roofs for water retention, trees for evaporative cooling, and water-infiltration crates in the ground.

The questionnaire consisted of three sections. The first included general questions on the respondent's position, field of work, and the size of the housing association in question. In the second section, the respondents were asked to assess the likelihood that adaptation measures would be implemented if a certain strategy were applied. A total of five implementation strategies (numbered A to E) were assessed on a 5-point Likert scale, ranging from 'very unlikely' to 'very likely'. There was always a 'don't know'/'no opinion' option. Respondents could not proceed to the next question until they had selected one of the answer categories. After assessing the likelihood of a strategy, respondents had the opportunity to explain their answers in an open text box. This was not mandatory before proceeding with the rest of the questionnaire. Seventy-four respondents (73%) did explain their choices in one or more implementation strategies. These statements were post-coded to provide more generic explanations for the assessments. The last section provided an option for remarks and space for an e-mail address if the respondent wanted to be notified of the results at a later date.

The individuals contacted were involved in policymaking on technical measures, and their working field encompassed the building stock of the housing association. Most of them held positions as managers or team leaders, project managers or policy advisors (see Table 8.1). The vast majority (80%) dealt with technical issues on a daily basis (Table 8.2).

Given the size of the housing associations represented by the respondents, it is clear that the larger associations are slightly overrepresented compared to the distribution of the total population. Figure 8.1 shows that 84% of the total population of housing associations have no more than 10,000 dwellings, as opposed to 72% of the housing associations that responded to the surveys (Figure 8.2).

POSITION OF THE RESPONDENTS	
45%	Director
44%	Manager/team leader
24%	Project manager
23%	Policy advisor
6%	Other

TABLE 8.1 Position of the respondent

WORKING FIELD OF THE RESPONDENTS	
80%	Technical
25%	Financial/General
18%	Other

TABLE 8.2 Working field of the respondents

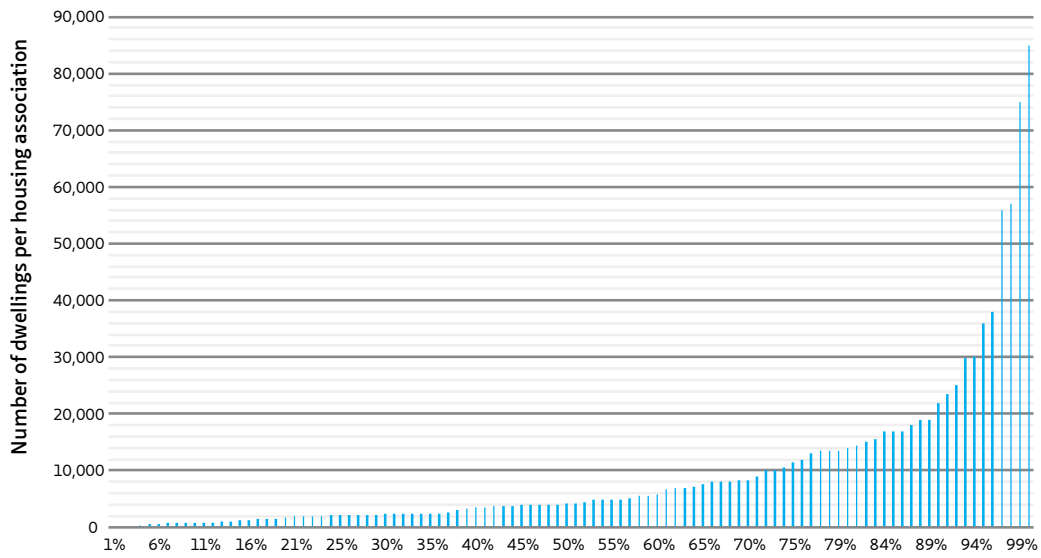


FIGURE 8.1 Distribution of total population of housing associations

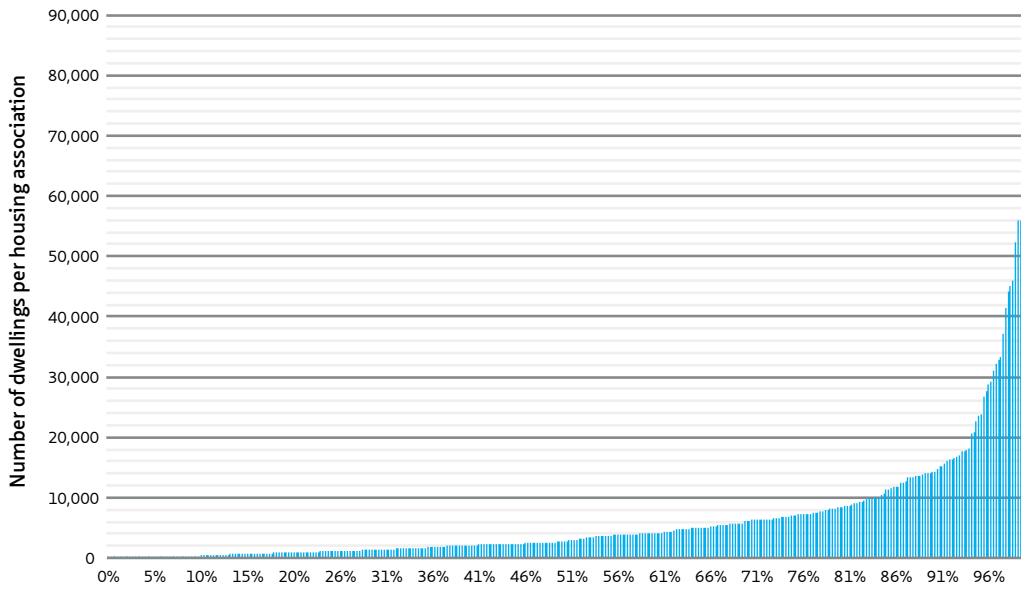


FIGURE 8.2 Distribution of responding housing associations

§ 8.3 Conceptual approaches

Previous studies concluded that climate change adaptation measures would not be implemented in the social housing stock because the housing associations lacked any policy guidelines. A second reason, directly stemming from the absence of policy guidelines, was that there were no resources to finance such measures (Chapter 4 of this thesis).

Three conceptual approaches were hypothesized to overcome the lack of policy guidelines and the financial barrier, and to facilitate implementation:

- 1 **Policy development:** simply stated, if there are no policy guidelines for the implementation of climate change adaptation measures, housing associations should start developing some.
- 2 **Involve external players:** see climate change adaptation as an opportunity. There are many players that stand to benefit financially and otherwise from adaptations to dwellings. For instance, water-resilient dwellings are less exposed to the risk of flood damage and place less of a strain on insurance companies. The housing association could use the money saved by insurance companies to negotiate lower insurance premiums.
- 3 **Carry out projects in a partnering approach:** take advantage of the current trend towards greater collaboration in construction processes in order to improve efficiency and then invest the savings in climate change adaptation measures. Involving the construction sector will also remove the complexity barrier, as this sector has the capacity to find technical solutions for complexity issues.

The SWOT analyses of the conceptual approaches assessed by practitioners (Chapter 7 of this thesis) showed that, for various reasons, these approaches were not feasible for the implementation of climate change adaptation measures in social housing. For example, even if the housing associations did manage to develop policy guidelines for implementing climate change adaptation measures, they would still lack the financial means to do the job alone. On the other hand, if they were working efficiently in partnership with a construction firm, policy guidelines on climate change adaptation measures would be needed to guide the implementation. It was argued that combining the conceptual approaches would considerably enhance feasibility (Chapter 7 of this thesis).

The combination of conceptual approaches led to four implementation strategies. The relationship between them is shown in Table 8.3. In the SWOT interviews with practitioners from the housing associations, one argument was raised that did not really match any of the approaches. Some interviewees pointed out that tenants are the most important stakeholders and that it is the societal task of the housing association to fulfil their needs in the best possible way. Accordingly, housing associations are sensitive to tenants' requests; in other words, if a tenant asks for action, the housing association is more likely to explore the available options. Moreover, if tenants are really

in need of adaptation measures, they will be more willing to contribute financially. A fifth implementation strategy was therefore developed, assigning a central position to the occupants of the dwelling.

		IMPLEMENTATION STRATEGY				
		A	B	C	D	E
Conceptual approach	1: Policy development	X	X		X	
	2: Involvement of external players	X		X	X	
	3: Partnering approach		X	X	X	

TABLE 8.3 Relationship between conceptual approaches and implementation strategies

The implementation strategies were described as follows:

Implementation strategy A: The housing association incorporates the implementation of adaptation measures in its policy, allocates funds for realizing them, and looks for collaboration with an external player (e.g., municipality/water board/insurance company) to co-develop and realize the project on the basis of unified goals. This Implementation Strategy is crucially dependent on an awareness on the part of the housing association that adaptation to climate change is necessary. Moreover, adaptation needs to be incorporated in the policy documents, since these form the basis for investment decisions. If the housing association decides to initiate a refurbishment project, and plans adaptation measures such as the placement of infiltration crates and rainwater tanks (see section 8.1), it can request a discount on sewage taxes, because the municipality – which is responsible for the sewage system – has less water to drain.

Implementation strategy B: The housing association incorporates the implementation of adaptation measures in its policy, allocates funds for realizing them, and sets up a partnership with one or more construction supply chains for all the renovation work in its housing stock. The delivery of climate-resilient dwellings is set as a performance indicator. The supply chains will have to develop knowledge about adaptation measures and apply it in the design of the project.

As in Implementation Strategy A, an awareness of the need for climate change adaptation and the recognition of the topic in policy documents are essential for investment decisions and approval of the design presented by the supply chain. In this Strategy, the housing association relies on the development of knowledge and the learning capacity of the construction supply chain with regard to the adaptation of dwellings to climate change. In a refurbishment project the housing association sets the performance requirements that the dwelling needs to fulfil after an intervention in the form of dry-proofing, for example (see Section 8.1). It is then down to the construction supply chain to come up with solutions to make the dwelling dry-proof.

Implementation strategy C: A construction company collaborates with an external player (e.g., municipality/water board/insurance company) and proactively

incorporates adaptation measures in a housing association project, without being requested to do so by the housing association. Together with supply chain partners and external players the construction company looks for solutions that fit into the project boundaries set by the housing association.

In Implementation Strategy C, if the housing association has not, for example, developed a policy on climate change, it will play a less proactive role. Although the likelihood of this situation arising has been pretty low to date, it is perfectly conceivable that a construction supply chain that is involved in a tender procedure would develop a design solution that involves, say, windows with shading devices, even though shading devices had not been specifically requested by the housing association. Suppose the construction company had received information from the municipality or other external players that shading devices increase the internal comfort of dwellings, and this were to become a unique selling point in the tender procedure, the construction company's chance of winning the tender would increase, especially if the design had been developed so efficiently that the shading devices did not add to the final costs.

Implementation strategy D: The housing association incorporates the implementation of adaptation measures in its policy, allocates funds for realizing them, and seeks opportunities for collaboration with external players (e.g., municipality/water board/insurance company) to co-develop and realize the project on the basis of unified goals. The project is handed over to a consortium with which the housing association has a partnering agreement. The delivery of a climate-resilient dwelling is set as a performance indicator.

This Implementation Strategy aims to bring together as many stakeholders as possible with a view to enhancing the feasibility of the implementation of adaptation measures. The decision framework for the housing association is in place because it incorporates policy arrangements which give the representatives a firm basis for negotiating with other players; collaboration with external players will take place on the basis of shared benefits and the construction supply chain will be challenged to mobilize its expertise and come up with efficient solutions to make the dwellings climate-proof.

Implementation strategy E: The housing association and/or an external player (e.g., municipality/water board/insurance company) informs the tenants and makes them aware of the benefits (more comfort, less risk of nuisance) of an adapted dwelling. The tenants ask the housing association to take action. The housing association then formulates policy on the implementation of climate change adaptation measures.

Implementation Strategy E puts the tenant in a central position. In this strategy it is crucial for the tenant to be aware of climate change and the benefits of adaptation. This bottom-up approach can be initiated by informing tenants via local or national media, or brochures or meetings organized by their own housing association. The housing association has to be prepared to respond adequately to the tenant's requests to implement the measures.

§ 8.4 Results

The implementation strategies explained above are considered feasible for the effective implementation of climate change adaptation measures because they combine the conceptual approaches while mutually compensating for their weak points. Whereas the individual conceptual approaches were assessed by relatively few practitioners, this study sheds light on what a larger population of housing association decision-makers thinks of the implementation chances of the five strategies (see Table 8.4).

Likelihood of implementation strategies

ANSWER CATEGORY		IMPLEMENTATION STRATEGY				
		A	B	C	D	E
Very likely	5	8%	8%	7%	12%	8%
Likely	4	15%	20%	13%	16%	23%
Not likely, not unlikely	3	24%	21%	25%	20%	23%
Unlikely	2	29%	28%	26%	27%	25%
Very unlikely	1	19%	20%	23%	21%	17%
Do not know/blank	0	6%	4%	7%	5%	6%
Overall assessment		2.6	2.7	2.5	2.7	2.8

TABLE 8.4 Likelihood of the implementation strategies

Assessment of implementation strategy A (policy development + external players)

Overall, the strategy was assessed with a mean value between unlikely and neutral (2.6). The housing associations that assessed it as very unlikely or unlikely responded mainly to the issue of policy development. In many cases it was stated that policy for the implementation of climate change adaptation measures would not be developed, either because adaptation has no priority at all, as opposed to mitigation, or because there are no resources for applying adaptation measures in dwellings. Some of those who assessed the implementation strategy as likely or very likely did so under the condition that the measures could be financed. In that case they agreed that collaboration with an external player could offer a solution.

Assessment of implementation strategy B (policy development + partnering approach)

This strategy was assessed with a mean value between unlikely and neutral (2.7). The answers were slightly less pessimistic than for strategy A, given that a score of 3 (not likely, not unlikely) had positive connotations in some of the explanations, for example: “We are not yet actively working on the subject, but I think there is a chance that we will do more in the future” (Respondent 40). The arguments for a low assessment in this strategy were that housing associations are not willing to develop policy because of other priorities and lack of resources.

The reluctance to enter partnerships and the absence of planned rehabilitation projects were also put forward as reasons for assessing this strategy as unlikely or even very unlikely. However, housing associations that evaluated the strategy neutrally believed that the scenario is likely in the future. The respondents who awarded a positive score (likely and very likely) did take a positive view of the strategy in general: “It should be a general thought, for all housing associations” (Respondent 36), and because of the partnerships in particular: “The knowledge of the construction companies is used in this case. This can cut costs and stimulate innovation” (Respondent 57).

Assessment of implementation strategy C (external players + partnering approach)

This strategy was assessed the lowest of the five, but the mean value was still between unlikely and neutral (2.5). The housing associations that assessed the strategy negatively did so because they expected to lose control of the construction and renovation process. Those who assessed it positively did so on condition that it would not cost extra money.

Assessment of implementation strategy D (policy development + external players + partnering approach)

The respondents assessed this strategy as unlikely to neutral (2.7). The reasons varied, from lack of resources to the desire to maintain control of the maintenance and construction process. Some stated that they did not regard the strategy as likely in the current situation, but could still see opportunities in the future. The respondents who answered positively said several times that it was a good strategy in general, without offering further information: “This is how I see it” (Respondent 119). Remarkably, several respondents stated that they could not imagine such a strategy. These arguments were put forward with both positive and negative assessments.

Assessment of implementation strategy E (tenant involvement)

Implementation strategy E was assessed as the most feasible of the five. However, in general terms, the assessment was still unlikely to neutral (2.8).

The housing associations felt that it was important to involve tenants, who – in their view – should take the initiative for any action. Two important arguments can hamper implementation. One is that climate change is not enough of an issue among tenants to prompt them to request measures. The other argument, which was cited many times, is that the measures would have to be paid for by a rent increase – which significantly reduces the chance that they will actually be applied. For example, one respondent clearly stated: “If tenants – or their support groups – stand behind it, I think the chance of implementing adaptation measures is high. But, because it will probably lead to higher rents, the chance of realization will be reduced to zero” (Respondent 34).

Elaboration of implementation strategies A, B and C

Several additional questions were asked in order to gain a better understanding of the opinions of the housing associations in relation to their assessments of the implementation strategies.

For strategy A, the respondents were asked if they regarded external players such as municipalities, water boards and insurance companies as partners who proactively looked for solutions, or as parties with a controlling or advisory role. The outcome was 3.4 on a scale of 5, indicating that the respondents generally saw external players more as controllers or advisors than as potential allies.

For strategy B the respondents were asked how they would award tenders for work that includes adaptation measures, given that the housing association had set performance indicators for adaptation instead of a detailed description. Would they award the work to a specific construction supply chain in a direct relationship, or would they invite tenders from several competing consortia? There was no clear preference for either strategy, since the answer was 2.9 on a scale of 1–5, in which 1 meant working only with specific supply chains and 5 meant working only with competing consortia.

For strategy C the respondents were asked to assess the probability of their housing association buying ready-made renovation concepts for their dwellings. Apparently they were undecided, since the answer was 3.0 on a scale of 1-5.

§ 8.5 Discussion

Mainstreaming adaptation

This paper addresses the issue of adapting to climate change in an isolated situation and takes no account of mitigation or other measures. This perspective enabled the current status of policymaking on the adaptation of the social housing stock to be highlighted. Working out the details of the five implementation strategies showed clearly that adaptation has a low priority as a separate policy field. The likelihoods for all strategies were assessed as being less than the neutral position, edging towards unlikely. The difficult financial situation housing associations find themselves in at the moment (Nieboer and Gruis, 2014) is an important explanatory factor for this result. In addition, climate change adaptation is a relatively new topic for policymakers, so they may be hesitant about believing that measures are likely to be implemented. Moreover, there are many other risks that may have higher priority, such as asbestos in dwellings, carbon monoxide from open heating systems, or the affordability of dwellings.

Nevertheless, maintaining climate change adaptation measures as a separate policy field enables housing associations to learn from the experience gained from the application of previous adaptations and to monitor them (Wilson and Termeer, 2011). It also allows them to keep track of new or unknown impacts and to consider the most effective strategies for adapting the housing stock to these new circumstances. A policy plan for adaptation legitimizes investments, sets project boundaries, and provides guidance about what has to be done (Chapter 7).

However, in contrast to the adaptation policy, the measures resulting from these policy guidelines could be easily mainstreamed as a result of the potential synergistic effects involved. For example, the use of thermal mass in the ground to heat dwellings in winter and cool them in summer is considered energy-efficient and can, therefore, be regarded as a mitigation measure. However, as cooling is also provided in the summer, it is an adaptation measure as well. Similarly, insulating the roof and façade of a dwelling is an energy-efficient way of keeping it warm in winter and, as such, is a good mitigation measure, but it can also prevent dwellings from heating up, which makes it an adaptation measure. The same reasoning holds for green roofs and façades, for keeping the environment cool, and storing water (adaptation), and for increasing air quality (health). From that perspective, climate change could be perceived as one of many issues that housing associations are already dealing with in their general maintenance and improvement programmes, rather than as a completely new challenge (Hertin *et al.*, 2003; Berkhout *et al.*, 2006). It is important to note though, that although mainstreaming can generate many benefits, combining measures with different purposes can lead to suboptimal results (Pinkse and Kolk, 2012).

It can even be argued that the framing and definition of the topics of mitigation and adaptation as two different themes are generating more misunderstandings and negative connotations than necessary. For example, a measure such as insulation which was framed as an adaptation measure would prove a cost-effective way of adapting a dwelling (LCCP, 2014), because it saves energy (mitigation) and thus money!

Policy development

In the survey, the respondents were free to identify what they felt to be the most suitable level of policymaking to develop. Policymaking in housing associations usually takes place at three levels: portfolio management, which deals with the size, composition and location of the housing stock; asset management, which deals with strategies for maintenance interventions (minor/major) and/or whether dwellings will be sold; and property management, which deals with preventive or corrective maintenance interventions, rent collection and tenant contact (Nieboer, 2009).

The most promising option is to embed adaptation policy at asset-management level. This is the level where decisions are made on whether to renovate existing dwellings and whether to keep dwellings or sell them (Nieboer, 2009).

Involvement of external players

Asset management guides decisions not only at building level but also at neighbourhood level (Nieboer, 2009). Housing associations are important players along with municipalities and water boards, amongst others (Termeer *et al.*, 2011), that can help to fill the gap in the development of policy for climate change adaptation measures at neighbourhood level (Wilson and Termeer, 2011; Williams *et al.*, 2012; Uittenborek *et al.*, 2013). This paper has shown that there is room for improvement when it comes to making use of the power at this governance level, since housing associations see these parties more as controllers or advisors than as partners. The interests of housing associations are very much in line with the interests of municipalities, particularly with regard to the quality of life in neighbourhoods.

Partnering approach

The partnering approach, ideally a long-term commitment (CII, 1991) between the construction company and the housing association, could prove promising, not only because of the financial benefits conferred by increased efficiency but also because of risk-sharing. In renovation projects, the design decisions are made at an early stage, but they have a strong influence on the future quality and vulnerability of the dwelling.

The players involved at an early stage in the supply chain, such as designers and construction firms, therefore exert a strong influence on the comfort and vulnerability of the players who are active later in the supply chain, the tenants and housing associations. The partnering approach makes the players at the beginning of the supply chain partly responsible for the comfort and vulnerability of the players at the end and may result in more resilient design decisions (Hertin *et al.*, 2003). Especially if the construction company is engaged to carry out the renovation and the maintenance for the rest of the service life of the dwellings, it can focus on design solutions aimed at resilient dwellings, even if the impacts of climate change increase.

Tenant involvement

Putting the tenant in a central position as suggested in implementation strategy E may seem promising, as this strategy emerged with the highest assessment score. However, housing associations that go down this route could be putting their long-term strategies at risk, since the current occupant decides on measures that may have an influence on the future quality, vulnerability and value of the dwelling. The measure may seem to have a lot going for it in the short term if the tenant contributes financially, but in the long term it may lead to financial losses if the tenant does not (or cannot) collaborate. Moreover, even if the tenant is willing to accept a rent increase, it is sometimes impossible to implement one, because the social rental housing system in the Netherlands sets maximum rents for household groups who are eligible for housing allowance. If a rent is already close to the maximum, it cannot be increased sufficiently to cover the expenses (Hoppe, 2012). Nevertheless, the housing associations can apply measures rejected by the current tenant at a later stage if, for example, the tenancy changes hands. If there are no rent limitations, the costs of the adaptation measures can be easily absorbed in the rent for the new tenant. Lastly, if a tenant specifically requests an adaptation, the housing association would be in a win-win situation, given the prospect of a financial contribution and lower vulnerability in the future. Policy should be in place that allows housing associations to recognize the value of these requests from tenants who are willing to contribute to the realization of a resilient dwelling.

§ 8.6 Conclusion

Five strategies to enhance the implementation of climate change adaptation measures in social housing were assessed via a survey among housing association policymakers. In general, the respondents assessed the feasibility of all strategies as unlikely to neutral. The reasons they gave for their assessments indicate that the uptake of measures in the near future is being obstructed by the current financial situation of housing associations and the low priority of adaptation on the policy agenda. There was no strategy that clearly stood out as most feasible, thus confirming that there is no silver bullet in policymaking that will enhance the uptake of climate change adaptation measures. However, a considerable number of housing associations assessed one or more implementation strategies positively and saw opportunities for implementation of measures. These associations are the ones to focus on in the next step towards making the social housing stock climate-proof. Moreover, the results encourage the development of a wide-ranging palette of policy strategies that recognize the importance of framing adaptation measures, since previous research has shown that the implementation of measures, as such, is feasible, albeit in a different frame, such as mitigation or increased comfort.

At the moment, policymakers at housing associations are not focussing on the projected impact of climate change, which is expected to increase in the coming decades. Of course, it is possible to wait for the right moment to think about implementing climate change adaptation measures. May be then, policymaking on adaptation alone will be able to generate the conditions for implementing adaptation measures, and housing associations will not need other partners. However, the proposed implementation strategies focus on efficiency, which will not only prove beneficial for climate change adaptation measures, but all kinds of other measures that housing associations may want to apply to their dwellings as well. A more efficient construction process would allow housing associations to do more with the same amount of money. Moreover, since the renovation cycles in which the majority of adaptations could be incorporated are expected to last 25–40 years (Chapter 4), the next opportunity to apply measures lies far in the future, meaning that tenants will have to live in vulnerable dwellings for a very long time.

To date, research in this field of knowledge has had to deal with the future expectations of policymakers rather than with their experience of past events. For this reason a qualitative approach was adopted. In future, it is recommended that the policies developed are tested and underpinned through research that makes use of more quantitative data analysis methods.

The study reported in this paper and the studies it builds on (Chapters 3 and 4) share several similarities with research conducted in the UK at sectorial or corporate levels of policymaking (Jones *et al.*, 2013; Hertin *et al.*, 2003; Berkhout, 2004), which relates to the knowledge of the consequences and threats of a changing climate among employees. These employees had a general idea about climate change (obtained from media coverage) but had no specific knowledge of the impacts of climate change or the opportunities to adapt to them in their daily work. Moreover, climate change mitigation had been more successful than adaptation in gaining their attention. The similarities in the state of awareness and state of knowledge among firms in the house building sector make the findings reported in this paper valuable not only for the Netherlands, but also for other countries in Europe or elsewhere in the world where there are large-scale property owners.

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9 Conclusions

§ 9.1 Introduction

Climate change can no longer be ignored. It is globally recognised that the evidence for climate change is unequivocal and that it is influenced by human activities (IPCC, 2014). Global temperatures are rising, and over the past decade, several years have ranked among the warmest since measurements started. The same pattern is visible in the Netherlands. Climate change has many effects, but this thesis focuses on the increased temperatures and more extreme rainfall that are threatening urban areas. Because of the high degree of urbanisation all around the world, many people will be affected and a great deal of economic damage will be inflicted by the negative effects of climate change. Action is needed to adapt our cities to these effects. Adaptation to climate change is defined as: “The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities” (IPCC, 2014).

As the owners of large numbers of homes in urban areas in the Netherlands, Dutch housing associations play a major role in maintaining the quality of life in the urban environment and their decisions will affect many citizens. Because housing associations are regarded as societal entrepreneurs, they are expected to use their resources and commercial profits to achieve societal aims closely linked to the common interest. Implementing timely adaptations to prevent changing climatic conditions from threatening the quality of their dwellings would be one of these societal aims.

This research perceives the choice of partnering as a project delivery method as a governance tool to increase the implementation of climate change adaptation measures in social housing. The involvement of the construction sector is promising, since construction companies are the ones who carry out the work. Early commitment on the part of contractors reduces the risks of miscommunication and failure costs, and enhances opportunities for innovative solutions.

This chapter presents and reflects on the findings of the research, and discusses the wider significance of the research results.

§ 9.2 Elaboration of the research questions

This thesis is based on seven research questions, which will be detailed in turn in this section.

§ 9.2.1 Partnering as governance tool

The first research question focused on the tools that have already been developed to increase the implementation of certain adaptation measures in dwellings - not specifically climate change adaptation measures. This thesis also explored the ongoing trend of partnering in construction, which started a few years ago, and defined this for the purpose of this thesis.

***RQ1.** Which types and tools of governance could increase the implementation of climate change adaptation measures by housing associations?*

To formulate an answer to the first research question, three types of governance were described: hierarchic governance, market governance, and network governance. Many tools have been developed on the basis of these types of governance. However, in order to increase the implementation of climate change adaptation measures in social housing, not all tools were equally successful from a theoretical point of view. For example, the effectiveness of information tools is not always clear or measurable. Many incentives require financial investment, which is more difficult during difficult economic times such as those experienced recently. Moreover, financial incentives such as subsidies may stimulate action, but it is not certain whether this action is sustainable, or if it is simply a means of securing extra funding, meaning that the desired behaviour would cease as soon as the subsidy was withheld. Regulatory tools are less favoured because of the ongoing struggle for deregulation. To increase the implementation of measures, tools could be combined to create a more solid impetus for action, and there is scope for additional governance tools to widen the palette of tools that can be used.

***RQ 2.** How can partnering in construction become a valuable tool of governance with which to increase the implementation of climate change adaptation measures by housing associations?*

By viewing partnering in construction as a combined market and network type of tool, it is clear that it can serve as a valuable governance tool. The market aspect refers to the knowledge of climate change adaptation that is gained by the participating construction companies, which implies a competitive advantage for them. The network aspect is closely linked to collaboration within a partnering approach. Networks are

an effective type of governance for dealing with climate change issues because of their ability to deal with uncertainties. The participation of many different actors provides a good basis for innovative solutions, because problems are viewed from a range of standpoints.

The partnering approach may help to address fragmentation in the construction sector and the barriers that this creates. It provides for a more efficient construction process and allows an easier flow of knowledge on climate change adaptation.

§ 9.2.2 Adaptation planning by housing associations

Before assessing the feasibility of partnering as a governance tool in construction, the current state of knowledge among housing associations was assessed regarding climate change in general and climate change adaptation measures for the housing stock in particular. This enabled the development of governance tools to increase the implementation of climate change adaptation measures by housing associations.

RQ3. What is the level of awareness of climate change among housing associations?

A content analysis of the annual reports and policy plans of housing associations was carried out to reveal their awareness of climate change. The housing associations were then classified according to four levels of awareness, based on the inclusion of themes relating to climate change in their policy plans and annual reports. The building stock of housing associations with the lowest level of awareness (unaware, not adapted) is the most vulnerable to the effects of climate change, because the dwellings are not adapted and the housing association demonstrates no awareness of the effects of climate change. The dwellings of housing associations at the two middle levels (aware, not adapted and unaware, adapted) have a medium level of vulnerability because either the housing association is aware of the effects of climate change but has not (yet) taken action, or adaptation measures have already been implemented without the association being aware of it. The dwellings of housing associations in the highest group (aware, adapted) are the least vulnerable. The houses have been adapted for the currently known effects of climate change and the housing association is aware of changing circumstances which may pose new threats that require further action in the future.

The majority of the housing associations studied demonstrated no awareness of climate change adaptation in their policy documents. They were placed in the two 'unaware' categories. However, this does not mean that their building stock is not adapted to climate change, because in the annual reports they state that they have applied climate change adaptation measures without naming them explicitly. This also implies that adaptation measures are neither impossible nor unrealistic, provided they are applied not solely for climate change adaptation purposes but for other reasons as well, such as improved energy-efficiency.

RQ4. *How do policymakers from housing associations assess the feasibility of climate change adaptation measures?*

Since not all the knowledge available in an organisation will always end up in a policy document, individual policy-makers were interviewed to answer the fourth research question.

In comparison to their own corporate policy documents, the individual employees demonstrated relatively good awareness of climate change in general and were able to name a number of the associated effects and risks. However, in relation to climate change adaptation measures in the daily work of the staff members and policymakers, awareness is low, especially in relation to the threats posed by climate change. This means that planned adaptation is currently not taking place, even though the social remit of housing associations mean that they might be expected to take action or at least be aware of the possibilities of adaptation measures. The employees were fairly well capable of assessing the measures once they had been made aware of the need for such measures. However, the interviewees believed that the implementation of measures would be unfeasible in most cases. The main reason for this was that the housing associations have no policy guidelines in place regarding adaptation measures. Moreover, in many cases there are financial obstacles and/or technical barriers to the application of certain measures that would need to be removed first.

One important argument for implementing climate change adaptation measures, which would contribute positively to the social mission of housing associations, is the expected increase in comfort in the dwellings. There was a consensus of support among employees for all measures concerning their positive effects on comfort during use.

§ 9.2.3 Partnering in housing refurbishments

In parallel with the assessment of the state of knowledge of the housing associations regarding climate change adaptation and the adoption of measures in their dwellings, the possibility of using the partnering approach as a governance tool was explored.

RQ5. *How do housing associations and construction companies carry out refurbishment projects using a partnering approach?*

Although partnering in construction has been encouraged by both government and sector organisations, its adoption is still at an early stage in Dutch housing refurbishments. To answer the fifth research question, seven success factors for partnering in construction were assessed in seven projects carried out by dyads of housing associations and construction companies. The success factors examined were: leadership, communication, partner capabilities, coordination, commitment, conflict resolution and trust. In all the projects, senior management supported the partnering approach. Moreover, communication was arranged as recommended in the literature,

by means of frequent meetings and in some projects shared ICT tools. For most projects, the capability of partners was assured by the housing associations by selecting known parties or applying selection criteria. Coordination was a factor that seemed to need improvement. Most dyads worked together during the plan development phase and were open regarding their budget. This gives a good impression of the intentions of the partners. But not every dyad had clearly expressed goals, which is important for common understanding. Few agreements have been made about the maintenance phase and all partnerships are restricted to the current project, reflecting a low level of commitment. Conflict resolution techniques have been relatively poorly developed. The success factor of 'trust' showed that this is something the dyads are dealing with constantly, and it is an inevitable theme in the establishment of partnerships. This study shows that Dutch housing associations and construction companies are indeed capable of carrying out housing refurbishment projects using a partnering approach. Although they do not implement all the success factors equally, they will be able to benefit from this approach, which is expected to be more efficient, leaving scope to invest in adaptation measures.

Additionally, it allows for the selection of the construction process to be used as a governance tool to increase the implementation of climate change adaptation measures. To do this, these adaptation measures should be considered as innovations, which is a valid assumption following Ling's definition: "[An innovation is] a new idea that is implemented in a construction project with the intention of deriving additional benefits although there might have been associated risks and uncertainties. The new idea may refer to new design, technology, material component or construction method deployed in a project" (Ling, 2003, p. 635). Subsequently, the participants in the knowledge exchange project were asked how they would handle the implementation of innovations.

RQ6. *How can product innovations be implemented in housing refurbishment when a partnering approach is used?*

Innovation is seen as the main requirement for achieving policy objectives that relate to major societal concerns, such as the need for climate change adaptation measures. As several scholars have concluded, a construction process that focuses on closer integration between the construction firms and clients, such as a partnering approach, is needed to increase product innovations.

These innovations can be implemented by ensuring that the housing associations or construction companies know what they have to do. In an approach that favours good communication (one of the critical success factors), an open discussion on the implementation of these measures, including the financial consequences, becomes possible. Under these circumstances, it does not matter which side the proposed innovation comes from. What is important, however, is that if the housing association decides to apply the adaptation measures, this goal is shared by all the other partners. The motivation for prioritising the adaptations may come either from the housing association or from the construction company. Especially when it comes from the

construction companies, trust is indispensable in the partnership because the housing association has to be confident that the construction company really will focus on delivering a more resilient dwelling rather than maximising their profits. For policymakers the partnering approach offers many opportunities to inform parties. There is a wide range of parties to focus on - not only housing associations, but all kinds of companies across the whole construction sector too. As long as one of the partners in the partnership sees the benefits of adaptation, there is a high chance that it will end up being applied in the dwelling. Nevertheless, the innovation of the new construction process itself will still require a great deal of effort, and the study shows that an integrated construction process does not automatically lead to product innovations. Policymakers should take this into account when requesting product innovations to achieve objectives related to contemporary societal objectives such as climate change adaptations.

§ 9.2.4 Implementation strategies

RQ7. Which strategies could be effective in removing the barriers to the implementation of climate change adaptation measures?

For this research question, three conceptual approaches were developed, concerning policy development, collaboration with external actors and the use of a partnering approach in the construction process, respectively. The feasibility of these conceptual approaches was verified with practitioners using a SWOT analysis. The results show that single-pronged conceptual approaches are unlikely to be successful because they imply serious weaknesses or threats. A combination of the conceptual approaches has much more potential to remove barriers to the implementation of adaptation measures, because the various conceptual approaches can reinforce one another.

RQ8. How do housing associations assess the likelihood that theoretical strategies for removing barriers to implementation actually increase the implementation of adaptation measures?

Five strategies for enhancing the implementation of climate change adaptation measures in social housing were assessed through a survey of policymakers at housing associations. In general, the respondents assessed the feasibility of all strategies as 'unlikely' to 'neutral'.

The reasons they gave for their assessments indicate that the adoption of measures in the near future is being impeded by the current financial situation of housing associations and the low priority for such adaptation projects on the policy agenda. There was no strategy that clearly stood out as being the most feasible, confirming that there is no 'silver bullet' in policy making that could increase the implementation of climate change adaptation measures. However, a considerable number of housing

associations assessed one or more implementation strategies positively and saw opportunities for the implementation of measures. Moreover, the results suggest that it would be beneficial to develop a wide range of policy strategies that recognise the importance of framing adaptation measures in the right way, because previous research has shown that the implementation of measures is more feasible within a different frame, such as energy saving or increased comfort.

§ 9.3 Discussion of the main research question

The main research question of this thesis is:

How can partnering in construction increase the implementation of climate change adaptation measures in dwellings owned by Dutch housing associations?

The study on governance (Chapter 2) confirms the need for more governance strategies to increase the implementation of adaptation measures. The studies in Chapters 3 and 4 showed that the challenges encountered by the housing associations in implementing such measures are lack of awareness, lack of policy, lack of resources and technical constraints. Partnering in construction can help the implementation of adaptation measures in so far as it can help to overcome these challenges, and the studies in Chapters 5 and 6 show that housing associations and construction companies are indeed able to carry out projects using a partnering approach. However, the novelty of partnering involves considerable effort and the housing associations and construction companies may not have the capacity to concentrate fully on implementing climate change adaptation measures. What is more, the choice of partnering as a project delivery method and a governance tool is unlikely to resolve issues regarding policy development, which remains a barrier to the implementation of measures. In addition, other parties may become involved to help provide funding for the measures. The selection of a partnering approach in the construction process is therefore not the only possible governance tool. More options were therefore added to the solutions palette, which were assessed on their future applicability in the final two studies of the thesis (Chapters 7 and 8).

On the basis of the above, the answer to the main research question is: Partnering in construction can increase the implementation of climate change adaptation measures in dwellings owned by housing associations, when it is understood as a catalyst for information-sharing and increased efficiency in the construction process.

The working hypothesis: “Carrying out refurbishment projects in a partnering approach increases the implementation of climate change adaptation measures” cannot be fully

supported by the evidence generated. By aligning the interests of housing associations and the construction sector, the likelihood of adaptation measures being implemented will increase. However, if other stakeholders also become involved and housing associations embed climate change adaptation in their policy guidelines, the likelihood will increase still further. Although none of the implementation strategies clearly stood out as the best strategy, a considerable number of housing associations assessed various measures positively.

If the construction process becomes more network-based, which would be the case under a partnering approach, many more parties would become involved who could contribute to the implementations of climate change adaptation measures. In such a situation, it no longer matters who introduces the subject during the plan development and construction process, as long as it ends up there and action is taken. The framing of the measures is important, however, because climate change adaptation does not generate much support in its own right. For example, insulation to prevent overheating in the summer is seen as a supplementary measure, the utility or necessity of which is still doubtful. However, if the same measure is framed as an energy-saving measure, it also saves money and acceptance therefore increases.

§ 9.4 Scientific implications and further research

With its focus on housing associations, this thesis fills a gap in recent research on policy making in the area of climate change adaptations in the Netherlands, which tends to focus either on the municipal level (e.g. Mees, 2014; Uittenbroek, 2014; Root, forthcoming) or on the level of individuals (Boonstra, forthcoming).

Although the scientific evidence is ever clearer about the necessity of adaptation measures (IPCC 2014), the awareness of climate change among housing associations is surprisingly low, particularly in light of their societal duties and the potentially adverse effect on the capital value of their dwellings (Chapter 3). This low level of awareness would indicate that the development of more governance tools is needed that can be used to implement climate change adaptation measures, especially since the majority of these measures would also benefit the comfort and quality of the dwellings (Chapter 4).

This thesis has made a start in the development of such governance tools by focusing on the building level, whereas currently adaptations strategies predominantly are targeted at the national (EC, 2013) or local levels of the built environment (Biesbroek *et al.*, 2013). Moreover, this thesis demonstrates the utility of adopting partnering

as a project delivery method as a governance tool (Chapters 2, 7, 8), bridging the theoretical fields of network governance (Jones *et al.*, 1997; Provan and Kenis, 2007; Meuleman, 2008) and integrated construction and maintenance processes (Egan, 1998; Lahdenperä, 2012, Hughes *et al.*, 2012), and more specifically partnering in construction (Bygballe, 2010; CII, 1991). It thus expands the palette of governance tools that has traditionally consisted of information tools (e.g. Murphy *et al.*, 2012; SEV, 2011), tools regarding division of property rights (e.g. Gerber *et al.*, 2011; Zijlstra, 2011), incentives (e.g. Murphy *et al.*, 2012; Bressers *et al.*, 2009), and regulatory tools (e.g. MinIKR, 2014). It has been proven that housing associations can successfully adopt partnering approaches, with several possible approaches to collaboration (Chapter 5). As such, partnering is a feasible approach for the implementation of innovative measures, such as climate change adaptation measures.

The projects studied were one-off projects because they were considered pilots (Chapters 5, 6). This meant that there was less benefit from the expected benefits of partnering in terms of learning and repetition (Egan, 1998). But even though long-term relationships are beneficial to the performance of the partnership (Gruis *et al.*, 2011), housing associations continuously have to prove to their stakeholders that they have selected the best (or cheapest) partners to carry out renovation projects. If they work with only one supply chain, this cannot be demonstrated. Future studies should therefore focus on how to create competition or transparency in the partnering approach, while maintaining its apparent benefits.

Moreover, the study on the adoption of innovations (Chapter 6) and the SWOT analysis on the conceptual approaches (Chapter 7) show that partnering alone will not bring the change that is sought. The evaluation of the implementation strategies, by which the partnering approach was combined with policy making and the involvement of players from outside the construction sector, have proved that none of the strategies was clearly better than the others (Chapter 8).

§ 9.5 Practical implications

The assessment of the five implementation strategies showed that adaptation takes a low priority as a separate policy field. It is a relatively new topic for policymakers, and they may be reluctant to believe that measures are likely to be implemented. Moreover, there are many other areas that may have a higher priority for them, such as improving energy-efficiency and thereby also the affordability of dwellings, or converting the dwellings for use with an ageing population.

In the literature on climate change adaptation (e.g. Berrang-Ford *et al.*, 2011), the idea of mainstreaming adaptation is suggested, which implies linking the adaptation policy to policy frameworks that already exist. This makes policymakers aware of the subject of adaptation so that they can look for synergies between adaptation measures and measures that are needed in relation to those other topics. Insulating dwellings is an adaptation measure, but when it is undertaken only for climate change adaptation reasons, it is perceived as costly. However, when it is framed as a cost-reduction or energy-saving measure, the feasibility of implementation increases.

The refurbishment and maintenance process of housing associations provides opportunities to mainstream adaptation measures. Housing associations are facing an ageing housing stock that needs to be improved gradually if it is to continue to meet the ever higher basic requirements of tenants and the increasing demand for energy-efficiency. Since climate change is a gradual process, the building stock can also be adapted gradually, in step with the renovation and maintenance cycles of housing associations. For the type of refurbishment works that would allow climate change adaptation measures to be mainstreamed, the cycle is 25-40 years. In this case, it is very important that the housing associations are aware of the impacts of climate change and the possibilities of adaptation so that they can take these measures into account.

The involvement of external players, especially municipalities and water boards, requires a search for shared interests, which could be at the financial level in the form of greater efficiency, but it could also be reinforced by asking parties to commit to covenants. The interests of housing associations are very much in line with the interests of municipalities, particularly with regard to the quality of life in neighbourhoods. In such a covenant, they could agree on a range of activities regarding adaptation – and many other relevant topics – and on how support would be provided.

Bringing the construction partners together requires governance tools that inform them of the benefits of partnering. It is likely that the partnering approach could contribute to a broader awareness of climate change since the partners with knowledge and experience in the field of climate change adaptation would be able to transfer this knowledge to others with the aim of providing better dwellings.

Especially in situations where the construction company is responsible for the renovation project as well as maintenance for the rest of the service life of the dwellings, it can implement design solutions that aim to create resilient dwellings and materials that are better able to withstand the effects of climate change.

The role of tenants in applying climate change adaptations to dwellings is primarily that they may push for action from their housing association. To do this, they need to have information about the effects of climate change that refer specifically to their

own home or neighbourhood, so that they can identify with the issues. However, even if tenants are aware of the effects of climate change and requesting adaptation measures, the final decision on implementation still lies with the housing association. Moreover, putting the users in a central position may seem promising, because they are unlikely to object to the application of the measures to their dwellings and they even may be willing to contribute financially; however, given the risk that users may object, in the long term the housing associations may be putting their strategies at risk, since the current occupant decides on measures that may have an influence on the future quality, vulnerability and value of the dwelling.

§ 9.6 Discussion

The challenge of developing governance strategies to increase the implementation of adaptation measures is combined with partnering in construction, an approach that seeks to increase the efficiency of the construction process and the quality of the dwellings. Making a dwelling climate-resilient can enhance its quality and so it is an obvious aspect to consider.

In this section, the results of the research will be placed in a wider perspective and the consequences will be discussed.

Governance

One might ask whether it is in fact a good choice to reject a regulatory approach to climate change adaptation and leave the matter to the housing associations themselves, with the support of other partners in their network, or relying on market parties from the construction sector. Certainly, less regulation means less enforcement and this reduces costs for the government, and it is also true that the drive for innovation is significantly enhanced by a competitive environment. However, as long as there is no awareness and there is no necessity for immediate change, nothing will happen. This also raises the question of the feasibility of the current trend towards deregulation, which may turn out to be counterproductive in the long run.

But in support of the approach that focuses on the governance of networks and markets, when looking at energy-efficiency, housing associations have accepted their share of responsibility by carrying out renovation projects to improve the energy performance of their dwellings. Such activities were motivated by a collective sense of corporate social responsibility to reduce the energy bills of the tenants.

This was further enhanced by the signing of a covenant between the sector and the national government entitled 'Covenant for saving energy in the social rented sector' (MinIKR *et al.*, 2012). This proves that the combination of a network and market approach may work.

Partnering

It is not only housing associations, but also other property owners that depend on third parties to carry out physical adaptation measures on their buildings and in the built environment generally. The creation of a (long-term) partnership between the construction sector and private owners or institutions that own or maintain a large number of dwellings could function in the same way as it does with housing associations. However, creating partnerships with parties that own a small number of buildings may be less feasible, because it is not possible to create benefits of scale.

Nevertheless, it is possible that different firms from the construction sector may set up a partnership to develop a concept for a climate-resilient building or building element and bring that to the market. If this were to happen, the partnership could approach the whole sector of private owners, generating benefits of scale that would result in a more competitive price or higher profit margins to provide a return on the investment made in innovation. In the Netherlands, such an approach is gaining momentum in the field of climate change mitigation. Real shops are being established that sell energy-efficiency 'products', such as wall insulation. The customer pays a fixed price that covers the material and its installation in the dwelling. To be able to deliver products and installation for one guaranteed price, the shop has established production chains that come into action once a product is bought. Owners can also establish economies of scale by collectively purchasing adaptation measures. In this case, building owners create a 'market pull' for innovative ideas.

Parallel to the improvements to the current refurbishment process achieved by using a partnering approach, it may be worth studying more far-reaching measures, where the construction sector has a more prominent role in maintaining and operating dwellings. For example, to ensure high performance in the building after the refurbishment, a construction company may provide a 20 to 40-year performance guarantee. In this way, the construction company is encouraged to use high-quality materials and ensure that the construction details are carefully designed. A long-term maintenance contract is provided with the delivery of the project to ensure that the maintenance of a dwelling is carried out to a high standard to prevent the degradation of the building components prior to their technical life span. As such, the refurbishment costs are calculated on the basis of Whole-Life-Costing, not only taking into account the purchase of new materials but also including maintenance costs and the residual value of the building components.

Construction companies could even become (part) owner of a dwelling, sharing the risk of damage caused by the effects of climate change or vacancies because tenants find the dwellings uncomfortable. Presumably, they will take action more quickly since they have the tools, knowledge and resources to improve the dwellings.

§ 9.7 Limitations

Because of its positioning in the framework of the larger research consortium, Climate Proof Cities, the focus of this thesis has been on implementing physical adaptation measures at the building level. The research began at the same time as the research that focused on the development of these measures. This meant that an implementation method was to be developed without knowing exactly what to implement. A generalised approach was thus the most appropriate, targeting all housing associations in the Netherlands, from large to small, located from north to south. What these housing associations all have in common are their societal aims and the fact that they have a physical building stock to maintain, supported by the construction sector which carries out this maintenance work.

This generalisation hampered the development of a scientifically underpinned guideline for the implementation of climate change adaptations, because the range of measures was too wide, and the size and location of the housing associations were too varied. With current knowledge on partnering and especially the availability of tools that can simulate effects of climate change in a certain area, more specific solutions can be developed.

When it comes to making cities 'climate-proof', the building level may not seem the most obvious starting point for the implementation of climate change adaptation measures. For example, an open infiltration area in a neighbourhood or near a street may relieve the local sewage system in the same way as water retention and/or infiltration measures at the building level, such as green roofs or infiltration options in gardens. The former option may certainly be more favourable if it would cause less disruption for the people whose dwellings or gardens need to be modified. When looking at the vulnerability of the occupants of the dwellings, other building owners may accord a higher priority to climate change adaptation because of health concerns (elderly homes or schools), productivity (office buildings, industrial buildings) or commercial interests (shopping streets).

Nevertheless, housing associations were the main focus of this research because of the impact that could be generated with this thesis. Housing associations own and

maintain a substantial portion of the total housing stock and there are relatively few organisations to approach. This means that with a relatively small effort, significant momentum could be gained. Housing associations have a long track record of maintaining and improving large numbers of dwellings and, as such, are experienced clients in the construction process. This makes them qualified as stakeholders to assess the involvement of the construction sector in developing and implementing climate change adaptation measures for dwellings.

Dutch housing associations represent a promising case in terms of research on climate change, because the Netherlands has a long history of adapting effectively to adverse climatic circumstances, and more specifically of 'living with water'. This applies not only to large-scale coastal and river defences, but also to smaller-scale interventions to keep the urban environment safe from inundations. This experience was gained over time by engineers, scientists and policymakers all over the country. This knowledge base, supplemented by current knowledge on climate change regarding increased precipitation as well as higher temperatures, provides fertile ground for the development of knowledge and solutions to mitigate the negative consequences of climate change. These solutions are not only important for the Netherlands, but also for many other countries in the world that experience similar climate change threats.

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Curriculum Vitae

Martin Roders was born in Apeldoorn on 5 October 1978. He obtained his Gymnasium-B diploma in 1997. In the same year he began his academic training at Eindhoven University of Technology, where he obtained an MSc degree in Building Technology in 2003. His graduation thesis focused on developing a consumer-oriented decision support system, to help potential customers to design a house according to their personal preferences.

Martin began his professional career in 2004 as an assistant project manager in a construction management company in Eindhoven. His field of work ranged from feasibility studies to quality control, mainly during the construction phase. In 2006, he moved into a more policy-oriented job and started working at a social housing organisation (SHO) in Tilburg. He was a specialist on energy and sustainability issues, for example acting as the SHO representative at the 3rd Energy Covenant attended by the municipality of Tilburg and three other SHOs in Tilburg. His operational responsibilities included the coordination and planning of maintenance, renovation and new-build projects, as well as budgeting and writing management reports. From 2010 to 2014, Martin focused on his PhD research at TU Delft concerning the assessment of the potential of the partnering approach in maintenance and refurbishment projects to increase the implementation of climate change adaptation measures in Dutch social housing. The research was carried out as part of the Dutch programme “Knowledge for Climate”, in the consortium “Climate Proof Cities”. While conducting his PhD research, Martin carried out several activities that broadened his academic formation.

In 2011-2012 he specialised in partnering in construction as a researcher on the knowledge exchange project: ‘Supply Chain Integration in Housing Renovation’, hosted by HU University of Applied Sciences Utrecht. In addition to his research activities, he coordinated the meetings and was the main contact person for the participants. He was also the lead author of the book ‘Even Anders’, which presented and discussed the results of the knowledge exchange project.

In 2012, Martin became one of the co-founders of the PhD Council of the Faculty of Architecture and the Built Environment of TU Delft, which aims to create the best environment for PhD candidates, both socially and in terms of education and research. He was the secretary of the council from 2012 to 2013.

In 2013 he became a visiting PhD researcher at Queensland University of Technology in Brisbane, Australia, where he worked at the Construction and Project Management Department.

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