Master's Thesis

Community Resilience to Climate Change Disasters:

Comparing how Rotterdam and New York City approach community resilience in policy

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Abstract

Community resilience is the ability of communities to withstand and recover from stressors as well as to learn from past stressors to strengthen future response and recovery efforts (Vivian et al., 2015). A resilient community is able to act as competent first responders in an emergency, they are able to communicate to vulnerable citizens that may be out of the municipality's reach, and they can pass on valuable local knowledge to the municipality. Community resilience as a concept concentrates on enhancing the day-to-day learnings and wellbeing of communities to reduce the negative impacts of disasters.

This research will focus on community resilience to climate change disasters, specifically to dangers imposed by flooding and excess precipitation. Addressing these climate change disasters calls for an approach that combines knowledge about preparing for disasters with knowledge about actions that strengthen communities every day. Many of the current efforts to increase resilience remain focused on the physical built environment, however just as crucial as resilient development is the creation of a resilient community. This research explores the dynamics of resilience with a focus on how local governments can influence their communities' level of resilience.

> **Research Question:** What components should the municipalities of Rotterdam (NL) and New York City (USA) include in policy, in order to build community resilience to climate change disasters?

The first step in this research was to develop a framework driving from literature and consisting of critical components of municipal policy which aim to build climate change resilient communities. The resulting framework components were: (1) Communication; (2) Education and Training; (3) Governance; (4) Resources; (5) Public Awareness; (6) Urban Identity; and (7) Participation. These components were then tested in the context of two case studies, New York City (USA) and Rotterdam (the Netherlands), both which are frontrunners in climate change and resilience networks. For both case studies the seven components were mapped on a scale relating to the efforts made by the municipality, those being: marginal; in progress; or established. The results of the case study analysis revealed the following new components: Community Leaders, which are crucial to enabling communication between municipality and citizens; and Governance sub component Strategy, which relates to the municipality's focus as well as disaster influence. In addition, several areas were highlighted as vulnerabilities for both cities: social cohesion; participation; and government accountability.

Rotterdam and New York City remain frontrunners in the area of resilience development, however there is much work yet to be done. Recommendations for these two cities, as well as for municipalities in general to improve community resilience, are largely related to improvements in leadership. Improved leadership within the municipality contributes to greater accountability, more organized communication to the public, and better internal communication and coordination, all of which contribute to greater project success. In addition, the designation of community leaders would improve participation amongst the community, awareness of risks as well as training and education opportunities, social cohesion, and communication amongst citizens and with the municipality.

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Acknowledgements

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1. INTRODUCTION

This section will begin with a brief background of the situation, followed by a description of how the concept of community resilience is applied in this research, including definitions of key terms. Next the significance of studying this topic is presented, and a more detailed description of the problem. Finally, the research objective is presented as well as the resulting research question its sub questions.

1.1 Climate Change Disasters

On December 12, 2015 the Paris Climate Summit (COP21) came to a historic close, with the outcome being a single agreement uniting all the world's nations in an effort to tackle climate change and cut greenhouse gas emissions for the first time in history (BBC News, 2015). In addition, the world's leading body for the assessment of climate change, the Intergovernmental Panel on Climate Change (IPCC), has indicated that the climatic changes the Earth is currently experiencing, and will continue to experience, are due to human activities (2007). "*Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing, observed warming, and understanding of the climate system.*" (IPCC, 2013 pg 15). Finally the world has acknowledged that climate change is happening, but even though global emission reduction and adaptation efforts have been increasing over the last few years a significant amount of human-induced climate change has become inevitable (Swart et al., 2009). Climate change impacts vary depending on geographic location, however on a global scale there will be an increase in temperature and changing rainfall patterns, these changes will lead to a range of impacts such as (IPCC, 2007):

- Increase in storm and flood events
- Sea level rise
- Increase in heat stress events and drought
- Increase in precipitation and subsequent floods
- Increase in tropical cyclone intensity

The wide-ranging impacts of these risks have been documented, and Biesbroek et al. found that there is growing anticipation that nearly all regions will be, and in many cases are already are, negatively affected by some impacts (2010). The consequences of being unprepared for changing weather patterns are enormous, particularly in densely populated economic areas such as large cities which are more vulnerable to extreme weather events (Runhaar et al. 2012). Historically, cities have been and often still are, perceived as places of refuge from disasters and as buffers against environmental change. Today however, they are better described as hotspots of disasters and risk as found by Wamsler et al (2013). The rapid urbanization and growth of these large cities is accompanied by growth of highly vulnerable urban communities which are at high risk from extreme weather events (IPCC, 2014).

There is a wide array of adaptation options available, and some areas have already begun to make changes, however there is a need for more extensive change than is currently occurring to reduce vulnerability to climate change (IPCC, 2007). Closer integration of disaster risk management and climate change adaptation along with the incorporation of both into local, sub-national, national, and international development policies can provide benefits at all scales (IPCC, 2014). Clearly there is need for better disaster risk management in urban areas, especially as climate change disasters continue to worsen. However, what is being concealed behind most disaster headlines are the people; the survivors, family members, and neighbours who are assisting each other, salvaging what is left and counselling each other. The factors that enable people to cope with hardships and survive trauma have always been of interest to scientists, and now more specifically the factors that enable recovery from climate change disasters (IFRC, 2004).

1.2 Resilience to Climate Change Disasters

In order to be more comprehensive, this research will deal with resilience as it relates to climate change disasters with a specific concentration on flooding as it is one of the most critical risks facing both case studies (City of New York, 2013; Solecki, 2012; van Peijpe et al., 2013). Flooding will be defined by the National Severe Storms Laboratory, which includes: river floods; coastal floods; storm surges; inland flooding; and flash floods (excessive rainfall in a short period of time), (2014). The focus of this research is on building community resilience, as this is a critical and often overlooked part of resilience in municipal policy. The importance of this issue and justification of this topic is elaborated on further in section 1.3, significance of this research. In addition, the term community is referred to in the geographic sense as the multiple sub-divisions within a municipality's designation, this is further clarified in later chapters. This section will include a brief explanation of resilience as a concept, followed by specific applications in the community, government, and citizen context, and how those relate to this research.

Resilience Levels

Resilience is a relatively new concept that is growing in popularity as it can be applied to many aspects of life, from resilient companies that recover from bankruptcy, to resilient people that recover from illness. A resilience approach to sustainability focuses on how to build capacity to deal with unexpected change; this approach moves beyond viewing people as external drivers of ecosystem dynamics and rather looks at how we are part of and interact with, the air, water, and land that surrounds the planet and in which all life is found (Simonsen et al., 2014). 'Resilience' is generally seen as a broader concept than 'capacity' because it goes beyond the specific behaviour, strategies, and measures for risk reduction and management that are normally understood as capacities (Twigg, 2009). Resilience, for social-ecological systems, is related to: (i) the magnitude of shock that the system can absorb and remain within a given state; (ii) the degree to which the system is capable of self-organization; and (iii) the degree to which the system can build capacity for learning and adaptation (Desouza & Flanery, 2013; Folke et al., 2004).

The International Federation of Red Cross is a leading NGO in this area, and recognizes that resilience is relevant in all countries because all countries have communities that are vulnerable, and that resilience can be observed and strengthened at multiple levels (2014). This research focuses on how actions at the local government level impact community resilience and thus individuals. These levels are not necessarily comparable, but are presented to reveal their interrelationships.

Local Government Level: Can either strengthen or weaken resilience at the community level as it is responsible for infrastructure development, maintenance, social services, and applying rule of law.

Community Level: A resilient community strengthens the resilience of its constituent individuals and households.

Individual Level: a resilient community is made up of individuals with knowledge, skills, competencies, and mind-set to adapt to new situations and improve her/his life, and those of her/his family, friends, and community.

Defining Community Level Resilience

The term resilience has numerous definitions (Table 1), and when defining the more specific concept of 'community resilience' just as many variations can be seen, however it is further complicated by variations in the meaning of community as seen in the research by Norris et al (2008). The literature on community resilience is a convergence of two strands. The first strand comes from ecology and addresses the resilience of ecosystems, it is strong in biophysical science components but lacks development in the social sciences (Berkes & Ross, 2013; Holling, 1973). The other strand consists of literature originating in the psychology of personal development and mental health, as well as research into factors that allow communities to deal with adversity, such as community development and organization (Berkes & Ross, 2013). The term resilience began to be used in relation to disasters the 1980s and has been further specified into different areas; unfortunately, there is no one agreed upon definition of resilience and several have been developed over time (Table 1).

Table 1: Various definitions of the terms resilience and community resilience over time (Community and Regional Resilience Institute, 2013; Norris et al., 2008)

Author(s)	Definition Category	Definition
Gordon (1978)	Physical Resilience	The ability to store strain energy and deflect elastically under a load without breaking or being deformed
Holling (1995)	Resilience	The buffer capacity or the ability of a system to absorb perturbation, or the magnitude of disturbance that can be absorbed before a system changes its structure.
Adger (2000)	Social Resilience	The ability of communities to withstand external shocks to their social infrastructure
Godschalk (2003)	City Resilience	A sustainable network of physical systems and human communities, capable of managing extreme events; during disaster, both must be able to survive and function under extreme stress
Ganor (2003)	Community Resilience	The ability of individuals and communities to deal with a state of continuous, long term stress; the ability to find unknown inner strengths and resources in order to cope effectively; the measure of adaptation and flexibility
Walker (2004)	Ecological Resilience	The capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks
Allenby (2005)	Community Resilience	The capability of a system to maintain its function and structure in the face of internal and external change and to degrade gracefully when it must
Longstaff et al (2005):	Community Resilience	Community resilience is the ability of a community to absorb a disturbance while retaining its essential functions.

Norris et al (2008)	Community Resilience	A process linking a set of networked adaptive capacities to a positive trajectory of functioning and adaptation in constituent populations after a disturbance
Collins, Carlson, & Petit (2011)	Community Resilience	The ability of a community to absorb, respond/adapt to, and recover from a disturbance while retaining its essential functions.
(Wamsler et al., 2013)	Disaster Resilient City	One that readily withstands or overcomes disasters, including climate and non-climate related, small and large-scale disasters.

The common theme that runs through these definitions is the ability to anticipate risk, limit impacts, and bounce back rapidly in the face of turbulent change. In addition there is general consensus on two points: community resilience is better conceptualized as an ability/process than an outcome; and community resilience is better conceptualized as adaptability than stability (Norris et al., 2008). The definition of community resilience that is used in this study encompasses these themes and is made more applicable to this research:

Community Resilience: The ability of communities to withstand and recover from stressors as well as to learn from past stressors to strengthen future response and recovery efforts (Vivian et al., 2015).

In this research the term 'stressors' will refer to climate change disasters, specifically flooding and excess precipitation.

A related concept in the field of community resilience is disaster vulnerability, another concept with many definitions, but which generally refers to the degree to which communities or societies are "susceptible to the damaging effects of a hazard" (UNISDR, 2009:30). It describes the existing conditions, characteristics and circumstances of an area exposed to one or several hazards, where a highly vulnerable area is understood as being incapable of resisting their impacts (Wamsler et al., 2013). Note that the terms vulnerability and risk are thus different concepts, although in literature they are often used as a synonyms (ibid). Risk is generally discussed in relation to particular population groups, sectors, or places, whereas resilience is discussed in relation to what helps to protect them (ibid). Figure 1 helps describe the difference between disaster risk reduction and community resilience, and how the two fit together (Chandra et al., 2011).

Further Delineation - Individual Level

Community resilience can be further delineated into the resilience levels of each community's individuals. Citizens are important to resilience as they make it possible to circulate resilience knowledge more widely, especially to those who have had no direct contact with the government. Citizens are crucial to resilience building processes because they can internalize the knowledge and activities for resilience building; while laws may be revoked, organisations can cease operating, publications withdraw and laws revoked, the resilient citizen is still there (Malcolm, 2013). For this research the focus will remain on the resilience of the community as a

Traditional Disaster Preparedness Approach Focuses On:	Community Resilience Approach Focuses On:
Individual households and their readiness to respond to emergencies	**Community members working together** to respond to and recover from emergencies
Disaster-specific functions	Merging of other community efforts that build **social, economic, and health well-being**
Government's response in the first few days and weeks after a disaster	**Diverse network of government and nongovernmental organizations** in preparing for, responding to, and recovering from disaster
Emergency plans and supplies only	**Collaboration and engagement** of the whole of community for problem-solving
Self-sufficient **individuals or households**	Self-sufficient community through **neighbor-to-neighbor connections and strong social networks**

Figure 1. Traditional disaster preparedness vs. community resilience approach (Chandra et al., 2011).

whole, emphasizing the ability of individuals to communicate with and assist others.

Resilient Citizen: One who is equipped with the knowledge, leadership capacity, and tools to prevent and quickly recovery from a climate disaster and to assist others in the community to do so as well.

Focus of this research - Influence of Local Government Level

Mitra (2013) states that resilience is determined by two measures of peoples' livelihoods – the assets they possess and the services provided by external infrastructure and institutions, and that both of these measures are greatly influenced by the quality of urban governance and the level of infrastructure and services provided by the government.

Local Government: In this research the local government refers to the municipal government of each case study city.

The success of reducing the impacts of global climate change depends on actions at the local level, since it is the level closest to the people and local governments are in the best position to apply polices with direct influence on individual communities; local governments have the opportunity to apply strategies for adaptation that are best for their specific conditions and impacts (Saavedra & Budd, 2009). Local governance influences the resilience of communities, and the ways in which they can build community resilience is the focus of this research and will be explored in greater depth in following sections.

1.3 The Importance of Researching Community Resilience

As of 2010 half of the world's population dwell in urbanized areas, and of those 3.5 billion people 38% live in large urban mega-cities which represent concentrations of enormous human, financial, and cultural capital (Desouza & Flanery, 2013; IPCC, 2014). Rapid urbanization and growing mega-cities points to a need for smarter and more resilient cities that possess the capacity to withstand the shocks of population growth, world economic crises, rapid demographic shifts in population, and environmental catastrophes (Desouza & Flanery, 2013). Addressing the complexity of communities, the increasing threat of climate change related disasters, and uncertain climate futures calls for an approach that combines what we know about preparing for disasters with what we know about actions that strengthen communities every day. Community resilience in particular is important because a resilient community contains citizens that give back to their community and pass knowledge on through generations to come (Malcolm, 2013). This research has both scientific and societal relevance, as community resilience is a topic that broaches both areas.

At the individual level resilience is a common characteristic of all human beings, yet what is regarded as hardship in one context may be simply a way of life in another. For example, power cuts across Europe and North America during the summer of 2003 created serious disruptions to everyday life. Those who depended on electricity for cooking or cooling had no alternative provisions and found it difficult to adjust (IFRC, 2004). In many other parts of the world, however, searching for the raw materials with which to cook a meal is a daily chore rather than a disaster, this is an example of a lack of resilience in the citizens of Europe and North America. After drastic changes in markets, technology, legislation and resource base, residents of hundreds of small towns in the Canadian province of British Columbia saw their livelihoods disappearing before them. While many people abandoned the town, those that remained formed a 'community resilience project' to assess and strengthen their own capacity to adapt to these changes (IFRC, 2004). These examples point towards a common issue – the importance of understanding the ability of the individuals, communities, and businesses not only to cope with, but also to recover from adverse conditions, and to focus any interventions on building those strengths (IFRC, 2004).

In response to climate change, the majority of the international focus has been on mitigation through reduction of greenhouse gas emissions, however it is now recognized that even the most aggressive mitigation action will not be enough alone to address climate change impacts (Saavedra & Budd, 2009). In order to address these impacts, community resilience has become a key policy issue, which is being embraced at federal, state, and local levels (Chandra et al., 2011). It is increasingly recognized that resilience is considered critical to a community's ability to reduce long recovery periods after an emergency (ibid), as an educated and informed community can act as first responders in an emergency. The growing focus on resilience means putting greater emphasis on what communities can do for themselves and how to strengthen their capacities, rather than concentrating on their vulnerability to disaster or environmental shocks and stresses (Twigg, 2009).

Saavedra and Budd (2009) found that since local communities may not be able to control the occurrence of climate related disasters, they need to create the capacity to deal with the resultant change; building resilience involves understanding these changes and creating the capacity to live with those changes instead of being a victim of them. Community resilience is a relatively new term, but it captures and expands upon many traditional themes in emergency preparedness as well as general community health promotion (Chandra et al., 2011). In the context of today's resource-limited environment where efficiency is critical, communities can identify and leverage the activities that are already in place to further build resilience (ibid).

More work is needed about the values and behaviour that bond communities and cultures with their environments and cross-cultural resilience and there is a need for more community resilience research focused on the less quantifiable aspects (Adger, Barnett, Brown, Marshall, & O'Brien, 2012). Berkes & Ross (2013) state that we know about sense of place, formation of social identity, and stewardship, but we do not know their significance for community resilience, and in addition there is little in the literature about methodologies. This research will address these scientific gaps and contribute to the body of literature surrounding resilience and specifically community resilience, it will inform new research directions and practice toward improving the resilience of human–environment systems at the community level.

1.4 Description of the Problem

The creation of resilient communities is a crucial component of any resilience strategy, however thus far the creation of resilient communities has fallen to a low place on the resilience agenda. Resilience literature at the level of ecosystems is well developed, but the same cannot be said for the community level (Berkes & Ross, 2013). Research and policy is largely focused on the material and quantifiable aspects of climate change, such as costs of decarbonizing economies, costs of impacts to sectors of the economy, and risks to lives (Adger et al., 2012). Due to the complexity of resilience strategies far less attention is given to what affected communities can do for themselves and how best to strengthen them (IFRC, 2004). To date, communities have minimal opportunity to share activities for building or enhancing community resilience and to discuss whether and how government and nongovernmental actors should be involved (Chandra et al., 2011). The concept of a resilient community is very new and there is limited understanding about the components that should be included to enable communities to recover more quickly; the literature to date has identified factors likely to be correlated with achieving resilience for communities, however these domains have been rather broad and lack the specificity required for implementation (Chandra et al., 2011). In addition , whilst planning and planners are generally regarded to be responsible and capable to adapt to disasters and climate risk, (IPCC, 2007) their specific role, the actions to be taken, and the associated responsibilities of city authorities often remain unclear (Wamsler et al., 2013).

> **The problem this paper will address is:** Although the importance of having resilient communities is clearly recognised by governments, the components that contribute to their creation remain unclear and are therefore not being addressed to the extent that they should be in climate resilience policies.

In order to address this current gap in community resilience research, this paper highlights the vulnerability of communities to climate-related risks, and in particular it focuses on the role that local governments play in building climate resilient communities. This paper assesses the actions/inaction taken by the municipalities of two case study cities to develop their community's resilience. This assessment is based on a framework developed as a part of this paper, which considers the components necessary for a municipality to create resilient communities. This report summarizes with main findings from the comparison and recommendations for municipalities to increase their community resilience levels.

1.5 Research Objective

In the previous sections the reasons to study the issue of community resilience to climate change disasters in urban areas were given:

- An increased vulnerability of urban areas to climate change disasters (Wamsler et al., 2013).

- Systematic assessment of what enables people to cope with, recover from and adapt to various risks and adversities – at household and community level – is badly needed (IFRC, 2004)

- There is a need for more community resilience research focused on the less quantifiable aspects (Adger et al., 2012).

- Resilient communities means resilient citizens, and resilient citizens, unlike resilient structures, give back to their community and pass knowledge on through generations to come (Malcolm, 2013).

- Resilient communities internalize the knowledge and activities for resilience building (Malcolm, 2013).

- Resilient communities circulate resilience knowledge more widely, especially to those who have had no direct contact with the government (Malcolm, 2013).

- More work is needed about the values and behaviour that bond communities and cultures with their environments, and cross-cultural resilience (Berkes & Ross, 2013).

- There is a wide array of adaptation options available, and some areas have already begun to make changes, however there is a need for more extensive adaptation than is currently occurring to reduce vulnerability to climate change (IPCC, 2007).

This will be a practice-oriented research project, exploring municipalities and how they approach community resilience in policy. This research will contribute to the understanding of community resilience in practice and specifically how municipalities can better include the topic in policy creation.

> **The research objective is:** to contribute to the development of municipal policies, dealing with the issue of community resilience to climate change disasters, *by* making an assessment of key components of community resilience as they apply to municipalities and their inclusion in resilience policy within two case studies.

The research will also contribute to a larger study at the University of Utrecht on the development of a tool (scoring card/matrix) for evaluating/scanning the municipal adaptation plans of cities on their contribution to enhancing urban resilience. The larger study will help in developing this research through illustrative case-studies using an interview/evaluation metrics score card for assessing a specific focus within the climate adaptation strategies. In doing so this study will make a scientific contribution to the literature on the building of community resilience to climate change disasters. In addition, research into municipal policy is relevant as this is a research master's within the program Sustainable Development – Environmental Governance.

1.6 Central Research Question and Sub Questions

Based on the above research objective, one main research question has been formulated, and three sub questions to guide the study.

Research Question

What components should the municipalities of Rotterdam (NL) and New York City (USA) include in policy in order to build community resilience to climate change disasters?

This question will be answered with an exploratory research approach using both a literature review and a practical case study portion. The justification for use of the specific case studies is explored in the methods section. This way the components will be developed from literature and tested in practice. The knowledge generated will be:

- Descriptive: regarding the methods used by the municipality and the impacts on the community
- Explanatory: regarding the factors that may explain the outcomes of the municipality's efforts to contribute to community resilience
- Prescriptive: regarding the recommendations for further inclusion of community resilience in future policy.

Sub Questions

1. **Creating the Framework:** Based on a review of literature, what components should municipalities address in order to contribute to creating and maintaining a resilient community?

This section involves the creation of a framework that includes the main components that contribute to creating a resilient community and a description of each. This framework was developed through the process of reviewing literature and collecting the factors mentioned by various authors to be key for a resilient community. After this collection these factors were sorted into a general framework, based upon the main categories found. The result is seven main components of a resilient community, supported by various literature.

2. **Testing the Framework:** Using the components developed in sub question 1, what are the focuses and gaps in community resilience policy of Rotterdam and NYC?

This section explores how the components are represented in current policy in two cities presently active on community resilience, this was done by grading each component in order to identify it as a vulnerability or capability. The results of this mapping are a description of what areas of community resilience are being addressed, where the emphasis lays in policy development, and if there are any major gaps.

3. **Main Findings:** What are the main components that Rotterdam (NL) and New York City (USA) should address in order to build community resilience?

This section is a synthesis of the main findings in the comparison between Rotterdam and New York City, in regards to the overarching issues, highlights, and critical components. It also includes recommendations for the improvement of community resilience by the municipality. In addition, if there are any factors being addressed in practice, but not in literature.

2. METHODS

This next chapter includes the methods used to conduct this research. This research was conducted such that the theoretical framework was also a part of the results, thus it will be presented in depth in the next chapter. In addition, limitations to this research are presented in the discussion section.

This research will use a comparative case study method (Verschuren & Doorewaard, 2010) – spatial variation but limited temporal variation, due to the restricted time frame of this research. The case studies will be compared by their current projects (within an approximate five-year range) that address community resilience to climate change risks related to flooding and excess precipitation. Using multiple case studies will allow for a difference in governance structures and policy design due to geographical location, and a comparative design enables the analysis of commonalities and differences. An international comparative approach makes this research relevant for a wide scientific and societal audience. This research includes two main steps, firstly the gathering of assessment components for resilient communities for the creation of a framework, and secondly the mapping of the two different case studies against this framework. By comparing the components to the case studies it is possible to see the extent to which they create more resilient communities, which answers the main research question - **What components should the municipalities of Rotterdam (NL) and New York City (USA) include in policy in order to build community resilience to climate change disasters?**

In order to increase the validity of the research, which is largely qualitative, the triangulation of methods and data was used. This triangulation occurred between desk research (including case related policy document analysis and site visits), interviews, and working sessions. Firstly, the methods to create the theoretical framework will be presented, then those used to analyse the case studies, and finally that which was used to garner the final results.

2.1 Framework Creation

In order to create the theoretical framework for this research, desk research comprised the central literature review in the form of a literature survey. The results of this desk research answered the first sub question. This literature review was specific to community resilience to climate change disasters as approached by the municipality, and resulted in a set of components central to creating a resilient community. The initial literature survey took into account both recent literature and historical, research reports, theoretical literature, and policy reports. Cues in the literature such as "key components/important factors/critical elements" to "building/creating/contributing to" community resilience were used to interpret and synthesize this literature into the resulting framework. This framework is roughly based off of Twigg's (2009) paper "Characteristics of a Disaster-Resilient Community", on the sections Knowledge and Education, and Disaster Risk Reduction. John Twigg's (2009) research was used as the starting point for this framework because it is comprehensive, relevant, relatively recent, and is based on the UN developed Hyogo Framework, which is generally accepted by international agencies, governments and many NGOs, and the only DRR framework agreed on internationally (Recently updated to the Sendai Framework for Disaster Risk Reduction 2015 – 2030). In addition this framework reflects other comprehensive frameworks such as the International Federation of the Red Cross's 'Framework for Community Resilience' (IFRC, 2014). Although the framework developed by Twigg (2009) is comprehensive there are some elements that have been added/changed and reflect elements from the other frameworks mentioned, such as the addition of 'Urban Identity', and the inclusion of 'Research' into 'Coordination and Partnerships'. This was primarily to make the framework more specific to municipalities and how they can address community resilience. Another change made was to sort the components into 'tools' and 'outcomes', again to better see where municipalities can influence community resilience. Tools refers to components that can be used directly by the municipality to influence community resilience, and that the municipality has a more control over. In contrast, outcomes refer to the components that the municipality does not have direct control of, these tend to be more abstract qualitative factors. The resulting framework consists of a set of seven different

components - a summary of factors that municipalities need to be address in order to create a resilient community. The seven components have comprehensive elements as well as sub components, but do not have a detailed operationalization. Operationalization is not the main emphasis of this study, as the outcome of this research is not focused on the ranking of each city, rather it is an exploration of municipal policies and projects and the role they play in creating more resilient communities. The framework was also used in the development of the interview questions. It is important to note that these components are relevant for communities that already have their basic needs met (food, water, shelter) and that they are not a measure of community resilience (a composite measure of the various characteristics that comprise community resilience) but a measure of the municipality's contribution to community resilience (measurement of the incorporation and achievement of specific activities supporting community resilience strengthening). A summary of the resulting framework is as follows:

Figure 2. A concentrated summary of the resulting framework, sorted into tools and outcomes

Tools that the municipality can use to increase community resilience and their sub components:

- Communication
  - ✓ Information Systems
  - ✓ Information Exchange
  - ✓ Local knowledge
- Education and Training
  - ✓ Access of the community to education and training opportunities
  - ✓ Communities as first responders
- Governance
  - ✓ Accountability
  - ✓ Polycentric Institution/Internal Coordination
  - ✓ Partnerships
- Resources
  - ✓ Funding
  - ✓ Economic Opportunities
  - ✓ Research

Outcomes of these tools and their sub components:

- Public Awareness
  - ✓ Awareness of risks and resources
  - ✓ Disaster influence
- Urban Identity
  - ✓ Social cohesion
  - ✓ Place attachment
  - ✓ Intrinsic motivation
- Participation
  - ✓ Levels of participation, voluntarism and accountability
  - ✓ Involving a diversity of stakeholders (vulnerable, less empowered etc.)

2.2 Case Study Exploration

The case study research gives an aspect of depth to the project, as opposed to the breadth given by the central literature review. It allows for a close look into the experiences of policy makers and community members, how concepts are applied in climate change policy, and what the results look like in communities. The methods used for the case studies were qualitative and consisted of: interviews with key policy makers and other stakeholders; review of key documents; participation in working sessions and conferences; as well as site visits (A1- Appendix for comprehensive list). The interviews were structured around the framework developed, but adjusted depending on the background of the interviewee and their responses. The majority of interviews were between 30 – 45 min and most were recorded and transcribed, in total there were 10 interviews conducted. Interviewees were contacted using connections obtained largely through the University of Utrecht and the Municipality of

Rotterdam. These interviews provided very important insights into the perceptions of stakeholders, and into the ongoings of the municipality. The interviews were composed of questions pertaining to municipal projects related to climate change resilience, how they affect the community, and what challenges are being faced. The case studies were supplemented by literary research, also referring to the community impact of these strategies. An outline of these documents and programs for each case study can be found in appendix A4 and A5. In addition, attendance at the Adaptation Futures 2016 conference, as well as the Rotterdam Resilience working session helped bolster the case study research.

In order to analyse this information, being qualitative in nature, the software NVivo version 11 was put into use. This software allows for the entry of multiple source types, such as audio interviews, policy documents, emails, and daily memos. Using NVivo 11 each source of information was coded into different categories that were based off of the theoretical framework presented. There were two main nodes – Vulnerabilities and Capabilities, these were further divided into seven sub-nodes based on the components: (1) Communication; (2) Education and Training; (3) Governance; (4) Resources; (5) Public Awareness; (6) Urban Identity; and (7) Participation.

Case Selection

"*Community resilience research should be comparative, in the sense that researchers should look at similarities and differences across multiple communities. In order to make the search of patterns in similarities and differences possible it is necessary to make the analysis comparable.*" (Brown & Kulig, 1997, p. 46). This research zooms in on, as mentioned in the introduction, the local governance level and its impacts on community level resilience. In particular this research is focused on local governance of large urban cities as cities are generally more unencumbered by the complicated international negotiations and have more funding for these types of projects (Reckien et al., 2014). These large urban areas have a more thorough base of literature written on them, which allows for a more comprehensive investigation of how their current projects contribute to community resilience.

This research is focused on two major cities that have created their own adaptation plans (City of New York, 2015; van Peijpe et al., 2013). The cities were selected based on a minimum number of differences, which allows for greater ease when comparing the various methods for involving the community. These cities are representative of cities that are beginning, or in the process of, addressing climate change and resilience in policy, and thus the findings are applicable on many levels. Both of these cities are located on the coast and are in stable first world countries with relatively strong economies. The two cities are however located in different countries, to provide a contrast in government structure and economies, which is described further in the case study chapters. Rotterdam, the Netherlands, and New York City, USA are the two case studies selected. Having the cities located in both Europe and North America means that they are comparable in the knowledge and understanding of key adaptation issues. Both of these cities are leaders in the area of climate change adaptation/mitigation/resilience, and are members of the 100 Resilient Cities program and Connecting Delta Cities (CDC) network (within the Climate Leadership Group C40), descriptions of these programs can be found in A2 in the Appendix. For this research communities can be thought of as the interacting population of various individuals in a common location, that being the municipality's of New York City and Rotterdam for this research. Spatial dimensions are used to identify communities, such as municipal boundaries, and have been determined specifically for each case study.

2.3 Determining the Main Results

Mapping each case study in NVivo 11 resulted in a description of what areas of community resilience were being addressed, where the emphasis lay in policy development, and if there were any major gaps. In order to further assess the case studies, each of the sub components were graded by the researcher on a simple scale (Table 2) in order to identify them as vulnerabilities or capabilities. The grading took into account all information gathered during the case study exploration, as well as the information that makes up the developed framework. As an example, within the case study Rotterdam the sub component information exchange was pointed out as a vulnerability in both interviews and documentation, and therefore it was given a grade of marginal. Following the grading of each sub component an overall grade was given to each of the seven components, which included a brief description of what areas are being addressed within the component, where the emphasis is in policy creation lay, and where the gaps are. This grading is not exhaustive and is not a representation of the degree of community resilience but rather highlights similarities and differences in the ways municipalities approach community resilience in policy and illustrates where examples of good urban governance indicate a capacity for community resilience, thereby informing the components of a community resilience framework. There is no overall grade for each case study city, because the grading scheme was used solely to view how each city is approaching the seven components from the framework, where the focus and gaps are in policy development, and if there were any lacking elements in the framework.

After the grading it was possible to see the components which Rotterdam and New York City are weakest and strongest in, these were labelled as the highlights in the main results section. In addition, there were certain factors found during the case study exploration that appeared to be critical to implementing community resilience in municipal policy, but were not present in the current framework. These factors were labelled as 'new components' in the main results section.

This research does not attempt to establish direct causality between the independent variable - the degree to which each municipality approaches the components developed in the framework, and the dependent variable - the level of community resilience. To establish direct causality between the two variables would require a much more extensive study than this, as one would have to prove: asymmetry, that municipal resilience policy comes before increases in community resilience; covariance, if municipal resilience policy increases, then community resilience policy always increases; and non-spuriousness, that there is no possible alternative explanation for an increase in community resilience then an increase in municipal resilience policy. Instead this research will assume a positive relationship between the two variables, i.e. that an increase in the degree to which each municipality approaches the components developed in the framework helps increase the level of community resilience.

Table 2 – The grading scale used to compare and investigate the efforts made by municipalities to build community resilience.

Marginal	In Progress	Established
The municipality's efforts in this component are minimal.	The municipality's efforts in the component are new and developing.	The municipality's efforts in the component are comprehensive and well developed.
There is much room for improvement	There is room for improvement, some actions are being taken.	There is not much room for improvement.
Either over all a low effect, or beneficial on only a few aspects – total effect is still clearly low.	There are some positive and some negative effects and the total effect is unclear	It has a positive effect on most aspects, and no negative effects

3. THEORETICAL FRAMEWORK

Sub Questions 1: Based on a review of literature, what are the main components that contribute to creating and maintaining a resilient community?

The following table (Table 3) identifies the components of resilience found in the literature research, beside each component is a list of supporting literature that references that component or a similar idea as key characteristics/factors for community resilience. This supporting literature is not from Twigg's (2009) work, but found through this research. It is important to note that these components are not isolated and do influence each other and overlap. The components were found in the literature by searching for key phrases such as: "Essentials for make a city disaster resilient", or "A disaster resilient city is…", or "The set of actions to enhance community resilience includes…". It is important to remember that these factors are also interconnected, which requires that they be considered and understood holistically, through a multi-disciplinary approach which takes into account how factors influence each other. Their connections and various influences are further described in the section following Table 3, elaboration of components. This section includes a description of each component, some examples, the relationship between components, and how the component relates to community resilience. This section is based off of the literature from the authors mentioned in the previous table. The components developed are not proxies for community resilience, but factors that contribute to its creation. There may be other characteristics that should be considered, particularly in more regional or national contexts, but those detailed below are offered as a general set of characteristics that can be used to compare large urban cities in the first world.

3.1 Theoretical Framework in Depth

Table 3. The first column shows the components of community resilience, sorted into Tools and Outcomes, the second column lists various authors that mention this component in their writing, the second column is a list of the various "key factors for community resilience", or similar topics, as mentioned in that author's research.

Tools

COMPONENT: COMMUNICATION

Supporting Literature	Topic as raised in literature
(Rojas Blanco, 2006)	**Local knowledge**
(Dummett, 2009)	**Using local knowledge**; Linkages and access of external resources (building relationship between agencies); International standards; Training;
(Chandra et al., 2011)	Wellness; Access to Services; **Education and Information**; Engagement; Self-Sufficiency; Government and non-government partnerships; **Quality Data**; Efficiency of Resource Use
(Berkes & Ross, 2013)	People-Place Connections; Values and Beliefs; Knowledge, skills and learning; **Social Networks**; Engaged Governance (involving collaborative institutions); A diverse and innovative economy; Community Infrastructure; Leadership; Readiness to accept change
(Allen, 2006)	**Technical Information Dissemination and Training**; Raising Awareness of Risk and Vulnerability; **Accessing local knowledge and Resources**; Mobilising local people
(Arup, 2015)	City Resilience Driver: **Reliable communication and mobility** (Diverse and affordable multimodal transport networks and systems, ICT and contingency planning)

(United Nations, 2012)	Institutional and Administrative Framework; Financing and Resources; Multi-hazard Risk Assessment; Infrastructure; Vital Facilities; Building Regulations; Training Education and Public Awareness; Environmental Protection of Ecosystems; Preparedness and Response; Recover and Rebuilding Communities; Inclusive, competent and accountable local government; Understanding of Risks; **Local shared information base**; People empowered to participate
(Norris et al., 2008)	Economic development (diversity of resources); Social Capital (support, participation, sense of community, organizational linkages); **Information and Communication**; Community Competence (flexibility, problem solving skills, empowerment, political partnerships)
(Cutter et al., 2008)	Social Resilience – **Communications**, risk awareness, preparedness, disaster plans, insurance, **sharing of information**; Organizational resilience – organizational structure, leadership, training, experience Community – pre/post disaster functioning, sense of community, attachment to place, desire to preserve cultural norms and icons
(Collins, Carlson, & Petit, 2011) – Synthesis of (Norris et al, Steward et al, Longstaff et al, and Cutter et al)	Develop economic resources; **Meaningful engagement with local people**; Develop organizational networks and relationships; Promote naturally occurring social supports; **Build an effective and trusted information/communication network**; Public-Private Partnerships (PPPs); **Adaptive Capacity (Memory, Learning, Connectedness)**
(Desouza & Flanery, 2013)	Planning – **Involvement of citizens**, Flexible, **Information flow**; Designing – Adaptability; Managing – Agility
(Wilkinson, 2012)	Assume change and uncertainty; Nurture conditions for recovery and renewal after disaster; Combine different types of knowledge for learning; Create different types of knowledge for learning; **Create opportunities for self-organization**;
(Bornstein, 2011)	Ability to deploy resources; **Preservation and dispersion of knowledge**; Redundancy and decentralization; Community Spirit; Resilient Individuals; Limited reliance on a single resource; Respect for the environment;
(World Bank, 2008)	**Amount and quality of knowledge and labour available**; Physical and financial capital individuals possess; Social relations; Access to natural resources; Flood control and coastal protection; **Transport and communications**; Access to credit and financial systems; Access to markets; Emergency relief;
(Williams, 2014)	Identify vulnerabilities; Enable residents to be equipped with knowledge; **Engage foundations and charitable groups**; Build disaster preparedness programming into everyday community actions; **Foster local leadership and networks to connect all parties**; Community oriented programs that build the social fabric; **Invest in back-up communications systems**, continuity of operations plans; Develop social capital and preparedness programs in neighborhoods with vulnerable populations;

COMPONENT: EDUCATION AND TRAINING

Supporting Literature	Topic as raised in literature
(Dummett, 2009)	Using local knowledge; linkages and access of external resources (building relationship between agencies); International standards; **Training**;
(Chandra et al., 2011)	Wellness; Access to Services; **Education and Information**; Engagement; Self-Sufficiency; Government and non-government partnerships; Quality Data; Efficiency of Resource Use
(Berkes & Ross, 2013)	Community strengths to assist resilience development: Leadership
(Arup 2014)	Driver of City Resilience: Empower a broad range of stakeholders – **education for all,** access to up-to-date information. **Knowledge to enable people and organizations to take appropriate actions.**
(Saavedra & Budd, 2009)	Learning to live with change and uncertainty; Nurturing diversity for reorganization and renewal; **Combining different types of knowledge for learning**; Creating opportunities for self-organization
(Cutter et al., 2008)	Social Resilience – Communications, risk awareness, preparedness, disaster plans, insurance, sharing of information; Organizational resilience – organizational structure, leadership, **training, experience** Community – pre/post disaster functioning, sense of community, attachment to place, desire to preserve cultural norms and icons
(United Nations, 2012)	Institutional and Administrative Framework; Financing and Resources; Multi-hazard Risk Assessment; Infrastructure; Vital Facilities; Building Regulations; **Training Education and Public Awareness**; Environmental Protection of Ecosystems; Preparedness and Response; Recover and Rebuilding Communities; Inclusive, competent and accountable local government; Understanding of Risks; Local shared information base; People are empowered to participate
(Simonsen et al., 2014)	Diversity and redundancy; Connectivity; Manage slow variables and feedbacks; Foster complex adaptive systems thinking; **Encourage learning**; Broaden participation; Promote polycentric governance (networks);
(Wilkinson, 2012)	Assume change and uncertainty; Nurture conditions for recovery and renewal after disaster; Combine different types of knowledge for learning; **Create different types of knowledge for learning**; Create opportunities for self-organization;
(Williams, 2014)	Identify vulnerabilities; **Enable residents to be equipped with knowledge;** Engage foundations and charitable groups; Build disaster preparedness programming into everyday community actions; Foster local leadership and networks to connect all parties; Community oriented programs that build the social fabric; Invest in back-up communications systems, continuity of operations plans; **Develop social capital and preparedness programs in neighborhoods with vulnerable populations;**

COMPONENT: GOVERNANCE

Supporting Literature	Topic as raised in literature
(Simonsen et al., 2014)	Diversity and redundancy; Connectivity; Manage slow variables and feedbacks; Foster complex adaptive systems thinking; Encourage learning; Broaden participation; **Promote polycentric governance (networks);**
(Chandra et al., 2011)	Wellness; Access to Services; Education and Information; Engagement; Self-Sufficiency; **Government and non-government Partnerships**; Quality Data; Efficiency of Resource Use
(Berkes & Ross, 2013)	**People-Place Connections**; Values and Beliefs; Knowledge, skills and learning; Social Networks; **Engaged Governance (involving collaborative institutions)**; a diverse and innovative economy; Community Infrastructure; Leadership; Readiness to accept change
(United Nations, 2012)	**Institutional and Administrative Framework**; Financing and Resources; Multi-hazard Risk Assessment; Infrastructure; Vital Facilities; Building Regulations; Training Education and Public Awareness; Environmental Protection of Ecosystems; Preparedness and Response; Recover and Rebuilding Communities; Inclusive, competent and accountable local government; Understanding of Risks; Local shared information base; People are empowered to participate
(Dummett, 2009)	Using local knowledge; **linkages and access of external resources (building relationship between agencies)**; International standards; Training;
(IFRC, 2012) and updated	Knowledgeable and healthy; Organized; Access to infrastructure and services; Economic opportunities; Management of Natural assets; **Connections with external actors**
(IFRC, 2014)	Knowledge and health; Social cohesion; Infrastructure and services; Economic opportunities; Natural asset management; **Connectedness**
(Cutter et al., 2008)	Social Resilience – Communications, risk awareness, preparedness, disaster plans, insurance, sharing of information; Organizational resilience – **organizational structure**, leadership, training, experience Community – pre/post disaster functioning, sense of community, attachment to place, desire to preserve cultural norms and icons
(Collins et al., 2011) – Synthesis of (Norris et al, Steward et al, Longstaff et al, and Cutter et al)	Develop economic resources; Meaningful engagement with local people; Develop organizational networks and relationships; Promote naturally occurring social supports; **Build an effective and trusted information/communication network**; **Public-Private Partnerships (PPPs)**; Adaptive Capacity (Memory, Learning, Connectedness)
(Lebel et al., 2006)	Governance and the capacity to manage resilience
(Simonsen et al., 2014)	Diversity and redundancy; Connectivity; Manage slow variables and feedbacks; Foster complex adaptive systems thinking; **Encourage learning**; Broaden participation; Promote polycentric governance (networks);

COMPONENT: RESOURCES

Supporting Literature	Topic as raised in literature
(Chandra et al., 2011)	Wellness; Access to Services; Education and Information; Engagement; Self-Sufficiency; Government and non-government partnerships; Quality Data; **Efficiency of Resource Use**
(Allen, 2006)	Technical Information Dissemination and Training; Raising Awareness of Risk and Vulnerability; **Accessing local knowledge and resources;** Mobilising local people
(United Nations, 2012)	Institutional and Administrative Framework; **Financing and Resources**; Multi-hazard Risk Assessment; Infrastructure; Vital Facilities; Building Regulations; Training Education and Public Awareness; Environmental Protection of Ecosystems; Preparedness and Response; Recover and Rebuilding Communities; **Inclusive, competent and accountable local government**; Understanding of Risks; Local shared information base; People are empowered to participate
(Collins et al., 2011) – Synthesis of (Norris et al, Steward et al, Longstaff et al, and Cutter et al)	**Develop economic resources**; Meaningful engagement with local people; Develop organizational networks and relationships; Promote naturally occurring social supports; Build an effective and trusted information/communication network; Public-Private Partnerships (PPPs); Adaptive Capacity (Memory, Learning, Connectedness)
(IFRC, 2012) and updated (IFRC, 2014)	Knowledgeable and healthy; Organized; Access to infrastructure and services; **Economic opportunities**; Management of Natural assets; Connections with external actors Knowledge and health; Social cohesion; **Infrastructure and services**; **Economic opportunities**; Natural asset management; Connectedness
(Dummett, 2009)	Using local knowledge; **linkages and access of external resources** (building relationship between agencies); International standards; Training;
(Norris et al., 2008)	**Economic development (diversity of resources)**; Social Capital (support, participation, sense of community, organizational linkages); Information and Communication; Community Competence (flexibility, problem solving skills, empowerment, political partnerships)
(Berkes & Ross, 2013)	People-Place Connections; Values and Beliefs; Knowledge, skills and learning; Social Networks; Engaged Governance (involving collaborative institutions); **a diverse and innovative economy**; Community Infrastructure; Leadership; **Readiness to accept change**
(Bornstein, 2011)	**Ability to deploy resources**; Preservation and dispersion of knowledge; Redundancy and decentralization; Community Spirit; Resilient Individuals; **Limited reliance on a single resource**; Respect for the environment;
(World Bank, 2008)	Amount and quality of knowledge and labour available; Physical and financial capital individuals possess; Social relations; **Access to natural resources**; Flood control and coastal protection; Transport and communications; **Access to credit and financial systems; Access to markets; Emergency relief;**

Outcomes

COMPONENT: PUBLIC AWARENESS

Supporting Literature	Topic as raised in literature
(Chandra et al., 2011)	Wellness; Access to Services; **Education and Information**; Engagement; Self-Sufficiency; Government and non-government partnerships; Quality Data; Efficiency of Resource Use
(Allen, 2006)	Technical Information Dissemination and Training; Raising **Awareness of Risk and Vulnerability**; Accessing local knowledge and resources; Mobilising local people
(Berkes & Ross, 2013)	People-Place Connections; Values and Beliefs; **Knowledge, skills and learning**; Social Networks; Engaged Governance (involving collaborative institutions); a diverse and innovative economy; Community Infrastructure; Leadership; Readiness to accept change
(United Nations, 2012)	Institutional and Administrative Framework; Financing and Resources; Multi-hazard Risk Assessment; Infrastructure; Vital Facilities; Building Regulations; **Training Education and Public Awareness**; Environmental Protection of Ecosystems; Preparedness and Response; Recover and Rebuilding Communities; Inclusive, competent and accountable local government; **Understanding of Risks**; Local shared information base; People are empowered to participate
(Collins et al., 2011) – Synthesis of (Norris et al, Steward et al, Longstaff et al, and Cutter et al)	Develop economic resources; Meaningful engagement with local people; Develop organizational networks and relationships; Promote naturally occurring social supports; Build an effective and trusted information/communication network; Public-Private Partnerships (PPPs); **Adaptive Capacity (Memory, Learning, Connectedness)**
(Biesbroek et al., 2010)	Motivation and facilitation of the strategy; Scientific and technical support; **Role of strategy in information, communication and awareness-raising**; Forms of multi-level governance to implement actions; Addressing integration with other policy; Implementation and evaluation;
(Cutter et al., 2008)	Social Resilience – Communications, **risk awareness**, preparedness, disaster plans, insurance, sharing of information; Organizational resilience – organizational structure, leadership, training, experience

Community – pre/post disaster functioning, sense of community, attachment to place, desire to preserve cultural norms and icons |
| (IFRC, 2012) and updated (IFRC, 2014) | **Knowledgeable** and healthy; Organized; Access to infrastructure and services; Economic opportunities; Management of Natural assets; Connections with external actors

Knowledge and health; Social cohesion; Infrastructure and services; Economic opportunities; Natural asset management; Connectedness |
| (Adger & Barnett, 2009) | Diverse values; **knowledge**; perception of risk; valuation of loss of places and cultures |

COMPONENT: URBAN IDENTITY

Supporting Literature	Topic as raised in literature
(Simonsen et al., 2014)	**Diversity and redundancy**; Connectivity; Manage slow variables and feedbacks; Foster complex adaptive systems thinking; Encourage learning; Broaden participation; Promote polycentric governance (networks);
(Maton, 2008)	Empowering Community Settings
(Berkes & Ross, 2013)	People-Place Connections; **Values and Beliefs**; Knowledge, skills and learning; Social Networks; Engaged Governance (involving collaborative institutions); a diverse and innovative economy; Community Infrastructure; Leadership; **Readiness to accept change**
(Norris et al., 2008)	Economic development (diversity of resources); **Social Capital (support, participation, sense of community, organizational linkages);** Information and Communication; Community Competence (flexibility, problem solving skills, **empowerment**, political partnerships)
(Cutter et al., 2008)	Social Resilience – Communications, risk awareness, preparedness, disaster plans, insurance, sharing of information; Organizational resilience – organizational structure, leadership, training, experience Community – **pre/post disaster functioning, sense of community, attachment to place, desire to preserve cultural norms and icons**
(IFRC, 2012) and updated (IFRC, 2014)	Knowledgeable and healthy; Organized; Access to infrastructure and services; Economic opportunities; Management of Natural assets; Connections with external actors Knowledge and health; **Social cohesion**; Infrastructure and services; Economic opportunities; Natural asset management; Connectedness
(Adger & Barnett, 2009)	Diverse values; knowledge; **perception of risk; valuation of loss of places and cultures**
(Bornstein, 2011)	Ability to deploy resources; Preservation and dispersion of knowledge; Redundancy and decentralization; **Community Spirit; Resilient Individuals**; Limited reliance on a single resource; Respect for the environment;
(World Bank, 2008)	Amount and quality of knowledge and labour available; Physical and financial capital individuals possess; **Social relations**; Access to natural resources; Flood control and coastal protection; Transport and communications; Access to credit and financial systems; Access to markets; Emergency relief;
(Williams, 2014)	Identify vulnerabilities; Enable residents to be equipped with knowledge; Engage foundations and charitable groups; **Build disaster preparedness programming into everyday community actions**; Foster local leadership and networks to connect all parties; **Community oriented programs that build the social fabric;** Invest in back-up communications systems, continuity of operations plans; Develop social capital and preparedness programs in neighborhoods with vulnerable populations;

COMPONENT: PARTICIPATION

Supporting Literature	Topic as raised in literature
(Simonsen et al., 2014)	Diversity and redundancy; Connectivity; Manage slow variables and feedbacks; Foster complex adaptive systems thinking; Encourage learning; **Broaden participation**; Promote polycentric governance (networks);
(Chandra et al., 2011)	Wellness; Access to Services; Education and Information; **Engagement**; Self-Sufficiency; Government and non-government Partnerships; Quality Data; Efficiency of Resource Use
(Berkes & Ross, 2013)	People-Place Connections; Values and Beliefs; Knowledge, skills and learning; Social Networks; Engaged Governance (involving collaborative institutions); a diverse and innovative economy; Community Infrastructure; Leadership; Readiness to accept change; **Participatory Projects**
(Allen, 2006)	Technical Information Dissemination and Training; Raising Awareness of Risk and Vulnerability; Accessing local knowledge and Resource; **Mobilising local people**
(Arup, 2014)	A driver of city resilience: Cohesive and Engaged Communities
(United Nations, 2012)	Institutional and Administrative Framework; Financing and Resources; Multi-hazard Risk Assessment; Infrastructure; Vital Facilities; Building Regulations; **Training Education and Public Awareness**; Environmental Protection of Ecosystems; Preparedness and Response; Recover and Rebuilding Communities; Inclusive, competent and accountable local government; Understanding of Risks; Local shared information base; **People are empowered to participate**
(Norris et al., 2008)	Economic development (diversity of resources); **Social Capital (support, participation, sense of community, organizational linkages);** Information and Communication; Community Competence (flexibility, problem solving skills, empowerment, political partnerships)
(Saavedra & Budd, 2009) Components based on Folke et al (2003)	Learning to live with change and uncertainty; Nurturing diversity for reorganization and renewal; Combining different types of knowledge for learning; Creating opportunities for self-organization
(Desouza & Flanery, 2013)	Planning – **Involvement of citizens**, Flexible, Information flow; Designing – Adaptability; Managing – Agility
(IFRC, 2014)	Individual level: a resilient individual is healthy; has the knowledge, skills, competencies and mind-set to adapt to new situations and improve her/his life, and those of her/his family, friends and community. **A resilient person is empowered.**

3.2 Elaboration of the Seven Components

1. Communication

- ✓ Information Systems
- ✓ Information Exchange
- ✓ Local knowledge

Communication with the community is a crucial component to building the awareness levels of the citizens. Citizens can share information through social and mobile networks that alert their peers within the same city and beyond about activities, their personal safety during an emergency, and political views among other purposes.

Traditional top-down decision making processes have become inadequate, due to their inability to create appropriate solutions for local communities (Rojas Blanco, 2006). Effective risk communication, especially related to emergencies, is critical to ensuring ongoing regular information exchange with the public. Risk communication is broadly defined as the interactive process that involves the exchange of information between parties about a sensitive issue, in this case the emphasis lays on the two-way exchange (Chandra et al., 2011). Effective communication of risks is essential as it provides the community with accurate information about dangers and mitigation options. The increased availability of information increases the community's levels of knowledge and therefore their resilience to these risks. In addition, effective risk communication builds trust between the municipality and community which can have important consequences for adherence to government recommendations and social cohesion (Norris et al., 2008).

INFORMATION SYSTEMS

Communication methods used to reach all citizens, and especially the vulnerable populations, must include different forms of technical dissemination such as different written languages, web based applications, and face to face contact. It is important to note that information increases resilience only if it is correct and correctly transmitted (Norris et al., 2008), thus highlighting the importance of information accuracy.

"Practice informs theory as much as theory informs practice" a quote by Folk et al (2003) meaning that building resilience involves the sharing of lesson learning and information with other levels of society (Saavedra & Budd, 2009). Douglas et al (2008) found that one of the main methods of communication by the municipality to the public is through information technology, namely the use of websites and phone applications. Though while researchers expect information technology to have an increasingly important role in information-sharing during emergencies and disasters it is still a slow area to be developed - a recent study found that 42% of local community web sites have no disaster related content and that the 2005 hurricane disasters had little effect on municipal website content (ibid). One example of a best practice in the area of disaster communication is the CDIS (Community Disaster Information System), the local resource database for community non-governmental organizations (NGOs), such as the American Red Cross, and government agencies. One reason this system is successful is because it is managed as a collaboration between community, non-governmental organizations, and municipalities, ensuring maximal information exchange. The participation of the community in its own information supply is very important, in addition to communication from the community to non-governmental organizations, private organizations, and the municipality. Data such as population vulnerabilities can help improve mitigation strategies before a disaster and the social network data can be used to determine which networks are in place and which need to be build, and how these can be used for communication during and after an incident (Chandra et al., 2011).

INFORMATION EXCHANGE

Allen (2006) found that successful implementation of adaption projects requires an understanding of the communities involved, which highlights the importance of information exchange. Information exchange is the link between the information system and local citizen knowledge. In order for a system to be fully functional it needs to allow for two-way information flows. Not only should citizens be informed about disasters from the municipality and other organizations, but they should be able to share their knowledge as well. Developing capacities for network solutions both before, during, and after civic disruptions will ultimately create strong communities of citizens that have the capacity to step in and solve local problems in coordination with other local institutions and governance structures. Carefully considering successful self-organizing operations (e.g., the volunteer boating rescues of stranded neighbors in response to Katrina as well as the Boston Marathon bombing first aid and crowd sourced video responses) reveals potential tactics for enhancing more emergent resilience capacities (Desouza & Flanery, 2013).

Mitigation strategies that ignore social heterogeneity and do not take into account that vulnerable community member's interests are least likely to be represented in the participator process, and are unlikely to be acceptable to the intended beneficiaries (ibid). Communities have the right to be informed, and are also capable of generating solutions likely to work at their level (Rojas Blanco, 2006). In addition building on local knowledge makes a resilience program more likely to be successful and sustainable, as citizens find it easier to improve something that already exists than adopt new practices (Dummett, 2009). Communication between citizens and state is needed to ensure that knowledge is being transferred between stakeholders and cities (Arup, 2014).

LOCAL KNOWLEDGE
Citizens are what makes up a resilient community, and thus largely shape a city's social, economic, environmental, and increasingly governance network dynamics (Desouza & Flanery, 2013). They hold valuable knowledge on the intricacies of their physical environment, as well as the social dynamics in their community. That a municipality accesses their local knowledge is crucial to build upon local coping and adaptive strategies, and to mobilise local resources (Allen, 2006). Scientists have a tendency to disregard local knowledge generated via empirical processes. Thus, important data on traditional practices or in-field experiences may not be taken into account, and their contributions may be lost to policy development processes (Rojas Blanco, 2006).
It is important to access the knowledge and skills of the community, in order to build on local coping and adaptive strategies, instead of creating new ones that may not fit the community. The municipality should work with citizens to develop a shared local information base of disaster losses, hazards and risks, including who is exposed and who is vulnerable (United Nations, 2012). The municipality can make use of concepts such as 'Citizen Science' - A citizen scientist is a volunteer who collects and/or processes data as part of a scientific enquiry (Silvertown, 2009). The use of local knowledge is paramount to the usefulness of climate change actions plans, and in ensuring that people accept these plans.

2. **Education and Training**
   ✓ Access to education and training opportunities
   ✓ Communities as first responders

Education and training of citizens is crucial to their role as first responders, and in addition by educating and training citizens they in turn can educate and train others in their community, taking a large part of the burden off the municipality. The United Nations (2012) found that education and capacity building programmes are also key for mobilizing citizen participation in the city's disaster risk reduction projects as increased participation will improve preparedness and help citizens respond to local early warnings.

ACCESS TO EDUCATION AND TRAINING OPPORTUNITIES
The skills and experience gained through the training in disaster management have a long-term value, which is potentially far greater than physical project outputs, such as construction of flood defences and emergency shelters (Allen, 2006). This component is closely linked to communication, as a key component of resilience is the ability to incorporate lessons learned back into practice, and a large database allows communities to share lessons learned and improve the quality of resilience-building activities (Chandra et al., 2011). A critical method for preparing communities is to promote training and education that identifies and accounts for the specific needs of at-risk populations during an emergency, and that includes at-risk individuals. Involving at-risk individuals in exercises also can increase trust and cooperation during an actual emergency. (Chandra et al., 2011). Important to mention is the diversification of this education and training. Social and economic diversity is increased with education about actions such as local food networks to enhance food security, climate friendly transportation, and use of more efficient water sources (Saavedra & Budd, 2009).

One example of community resilience education found by the United Nation (2012) is in Japan, Saijo City. After record typhoons caused flooding and landslides in urban areas the city began an education program in schools that takes 12 year olds on risk education fieldtrips. The young urban dwellers meet with elderly people to learn about the risks facing Saijo City and to remember the lessons of the 2004 typhoons. They have developed a communication component to this as well, which is a "mountain and town watching" handbook as well as a teacher's association for disaster education and a children's disaster prevention club. This long-time investment undoubtedly saved many lives in the March 2011 Great East Japan earthquake and tsunami (United Nations, 2012).

COMMUNITIES AS FIRST RESPONDERS

As the primary component of cities, people play an important role in mediating the impact of stressors and other system disruptions on a city's governance as well as each other individually by self-organizing to facilitate appropriate action at appropriate scales. Desouza and Flanery (2013) found that if one was to examine the case of the Boston Marathon bombings, runners who were competing in the race came to the aid of victims. This is a demonstration of how it is possible to enhance resilience at the citizen level, to plan and prepare, in the face of unpredictable threats by developing and training broadly diverse members of the population in response protocols.

3. **Governance**
   ✓ Accountability
   ✓ Polycentric Institution/Internal Coordination
   ✓ Partnerships

Governance is the structures and processes by which societies share power, and shape actions, it is not the sole purview of the state through government, but rather emerges from the interactions of many actors, including the private sector and non-governmental organizations (Lebel et al., 2006). Some of the key attributes of 'good' governance are: Participation, representation, deliberation, accountability, transparency, empowerment, social justice, and multilayer/polycentric/decentralization, responsiveness, and effectiveness (Kokx & van Kempen, 2010; Lebel et al., 2006; Tanner, Mitchell, Polack, & Guenther, 2009). This sub-component will focus primarily on the related concepts of accountability, multilayer/polycentric and the related concept of partnerships, as the majority of the other attributes are addressed in other components.

ACCOUNTABILITY

Accountability refers to whether or not authorities are obliged to provide information and explain their decision and actions/inaction, and whether they can be sanctioned when those answers are unsatisfactory (Lebel et al., 2006). Accountability can be both upward to central authorities or the state, downward, and horizontal; for example, the relationship between advisory and state resource management. Climate resilient urban development relies on a municipal system that maintains a relationship of accountability to its citizens, and is open in terms of financial management, information on the use of funds and adherence to legal and administrative policies (Tanner et al., 2009). Accountability helps to enhance the ability of authorities to work at multiple scales and thus benefit from, and not be overwhelmed by cross-scale interactions. Accountable authorities who also pursue social justice by helping to secure the livelihoods of the most vulnerable groups enhance the capacity of society to manage resilience (Lebel et al., 2006). There are definitely barriers to government accountability - government decision makers may not invest in a perceived low-probability event because they assume that the international relief community would come to their rescue in the event of a disaster, or because wealthier groups that have the capacity to invest in resilience projects are not the ones facing serious risk (Tanner et al., 2009).

POLYCENTRIC INSTITUTION/INTERNAL COORDINATION

Tackling climate change is an extensive, costly and time consuming task which cannot be achieved solely through policy implementation and regulation from central governments alone, it is crucial for nation-states to engage in sub-national and local level action in order to commit to and meet international targets for offsetting climate change (Betsill & Bulkeley, 2006). A polycentric institution has multiple layers or authorities which do not have to be neatly hierarchical, they create possibilities for moderating vertical interplay among institutions (Lebel et al., 2006). It is important to note that although polycentric governance increases the ability to adapt, decentralization without corresponding accountability can reduce the capacity to manage resilience (Lebel et al., 2006). When a government is structured with multiple relatively independent centres, it creates opportunities for development to better match the varied social and ecological contexts and dynamics of different locations (Lebel et al., 2006), as well as bolstering the ability and capacity to make decisions and implement them across a range of responsibilities and services (Tanner et al., 2009).

As mentioned previously, local knowledge can inform local actions in ways that a single centralized system cannot. In monitoring, using, and managing natural resource systems, the flexibility provided by polycentric and multilayered systems of governance can create opportunities for learning and decision making in places and scales that match social and ecological contexts much more closely than is possible in monolithic arrangements. (Lebel et al., 2006).

Internal Coordination

"*mainstreaming, coordination, and cooperation across government agencies is vital*" (Bulkeley, 2010). Related to the internal dynamics of municipal governments, and key to the quality of a municipality's partnerships with other organizations, is the level of coordination and organization within the municipality itself. The city administration must be the first line of response and responsibility (United Nations, 2012). Typically, the expertise on climate change remains concentrated in the environmental departments of municipalities, this potentially limits municipal capacity for two reasons. First, environmental departments are often marginalized within municipal (and other) authorities (Bulkeley, 2010). Second, the "cross cutting nature of climate change governance means that environment departments or agencies are frequently not able to implement the policies (for transportation or finance for example) that are required to address the problem (Bulkeley, 2010)

PARTNERSHIPS

To be fully effective '*At the same time, politicians have to be involved through workshops and orientation programs because until the movement is transformed from a greater social movement to a greater local and political movement the NGO- and civil society-led social movement will not succeed*' (CARE-Bangladesh, 2005, p. 3). This component includes partnerships between government, specifically the municipality, and non-government organisations. Non-government organisations can include bottom-up initiatives started by the community, organisations such as the Red Cross, or any other contributing body.

Developing the capacity of a community to prevent, withstand, and mitigate the stress of an incident is a fundamental element of community resilience. Because much of this capacity may currently exist across a loosely associated system of groups, networks, and organizations, the importance of forming robust partnerships within communities and across government is a central concern for building community resilience (Chandra et al., 2011; Tanner et al., 2009). Allen (2006) found that in the past disaster management roles were often the burden of civil society actors as state expenditures were cut back, however in the last 30 years the emphasis of disaster management has shifted to a less autonomous role for civil society organisations working in partnership with government. In order to be effective and contribute to a city's development and safety, managing disaster risk and understanding the potential threats of complex events requires a holistic approach and must include the involvement of local government decision makers, city officials and departments, academia, business and citizens

groups (United Nations, 2012). Partnerships between governments, NGOs and donors play a vital role, not just in providing funding and disaster management knowledge, but also in setting the agenda for vulnerability reduction (Allen, 2006). Greater integration of organizations can increase trust and knowledge among community members and help increase participation levels, contributing to the ability of communities to enhance plans and speed recovery (Chandra et al., 2011).

Involving new partners such as local groups and organizations, creates a more unified effort that can be stronger under distress and result in increased community resilience (Chandra et al., 2011). In addition, connecting organizations that have a greater sense of vulnerable groups, such as at risk populations and their needs, is critical. Overall, the promotion of extensive partnerships throughout the community and government organizations ensures that preparation, response, and recovery activities have a wider reach with stronger ties to the community and increased knowledge and capacity for support services (Chandra et al., 2011). One example of this is the city of San Francisco (California) which uses a "resilience wheel" to show partners, both inside and out of government, how their organisation's mission connects with those of other stakeholders who may work in sectors perceived to be quite different from theirs (United Nations, 2012). To be noted, is that there is always a danger in these partnerships, as in some circumstances the institutionalisation of state–civil society relations may serve as a mechanism by which civil society activity can be regulated and controlled by state institutions or political actors (Allen, 2006). In addition, it can be used as an excuse to shift the burden of the action to others and dilute responsibilities.

4. Resources
- ✓ Funding
- ✓ Economic Opportunities
- ✓ Research

One of the keys to a resilient city is… *an inclusive, competent and accountable local government … that commits the necessary resources to develop capacities to manage and organize itself before, during and after a natural hazard event* (United Nations, 2012, p. 10). A strategic plan and its resources go hand in hand. A strategic plan remains just that – a plan – unless it has dedicated resources to ensure that it can be carried out. In addition, a strategic plan will ensure that projects contribute to defined objectives and can be used to allocate budgets for specific projects (ibid). This section encompasses funding available to communities for climate change resilience related projects, economic opportunities, and research being conducted. Resources other than financial are mentioned in other sections, such as education, and training opportunities. This section is closely related to communication with citizens, as the link between communities and national government disaster management agencies can be typically weak due to lack of resources (people, time and funding) or policy.

FUNDING

The funding of resilience based projects is crucial for these projects to succeed, and although the municipality is the first place that financing should come from, this is a responsibility that must be shared among all those who have a stake (United Nations, 2012). In addition, many cities do not have a large budget for resilience based projects, and cannot provide financial incentives and subsidies for sustainable initiatives. For this reason, this element relates closely to partnerships/coordination, a mutual understanding among the private sector, local and national governments, industry, NGOs and citizens will lead to a city that is better prepared to address risks.

One example of this is an ambitious slum upgrading imitative launched by the government of Thailand (United Nations, 2012). The Baan Mankong (secure housing) programme channels funds in the form of infrastructure subsidies and housing loans directly to community organisations of low-income inhabitants in informal settlements. The funding comes almost entirely from domestic resources—a combination of national government, local

government and community contributions. Under this programme, illegal settlements can obtain legal land tenure through a variety of means such as direct purchase from the landowner (supported by a government loan), negotiating a community lease, agreeing to move to another location provided by the government or agreeing with the landowner to move to part of the site they are occupying in return for tenure of that site (land sharing). (United Nations, 2012).

ECONOMIC OPPORTUNITIES/FOCUS ON THE MOST VULNERABLE

In a review of four recent studies (Norris et al, Steward et al, Longstaff et al, and Cutter et al) done by (Collins et al., 2011) economic resilience clearly has important implications for the ability of a community to "bounce back" from a disturbance. Like opportunities for funding, economic opportunities depend not only on the capacities of the individual's businesses, but on the capacities of all the entities that depend on them and on which they depend. In this sense this sub component is also related to partnerships/coordination. This sub-component is also related to public awareness, because if the resources are available but citizens have no knowledge of them, they will not be utilized.

There is an emerging consensus that resilience and adaptation strategies should target the most vulnerable citizens, therefore a focus on urban governance in the context of climate change necessarily involves a focus on the way that governance systems target the needs and well-being of the poor and marginalized groups of citizens (Tanner et al., 2009). Societies do not allocate environmental risk equally, often the poorest communities are the weakest links in hazard mitigation (Norris et al., 2008). The case for a link between economic resources and post disaster wellness is most evident in research on social class as a buffer of disaster stress, past disaster research has shown that participants of lower socio-economic status (SES) often experience more adverse psychological consequences than do participants of higher SES (Norris et al., 2008). In a study done by the Red Cross (2012) of the economic assets that were identified by communities, the greatest emphasis was placed on the importance of employment and income; communities indicated that they need to be entrepreneurial, be able to take alternative employment and have the capacity to adapt and especially in uncertainty. In many cities the most vulnerable groups of people live in the areas of highest risk for floods. In these areas special attention must be placed on employment and income opportunities when initiating a resilience building project. A municipality can have all the educational programs, and awareness raising opportunities possible, but these will not succeed if the community's primary concern is making enough money to survive day to day life. Ideally, the distribution or mobilization of support follows the "rule of relative needs." Simply put, the most support goes to those who need it the most. Often, however, the distribution of support follows the "rule of relative advantage" because one's embeddedness in the community, political connections, and social class determine the availability and accessibility of resources (Norris et al., 2008).

In addition, the importance of a diversity in economic opportunities is key. Community resilience depends not only on the volume of economic resources but also on their diversity (Norris et al., 2008). For example, Cutter et al. (2006) described one community that was especially devastated by Hurricane Katrina in August 2005 because residents were almost totally reliant on the shrimping industry, on which the storm's impact was tremendous.

RESEARCH

Cities should work with national and local research institutes and hazard monitoring centres, encouraging them to contribute to documenting and assessing past and potential hazards and risk scenarios, these institutions should be part of the coordination mechanism created to deal with disaster risk reduction (United Nations, 2012). The participatory process in research helps to align and harmonize the municipality's goals with those of the national, state and other public and private institutions, in particular those that provide critical services (utilities, health, education, public safety), to ensure proper communication before, during and after a disaster.

One example of this presented by the United Nations (2012) is in Mumbai (India), where the city engages over 100 institutions and organisations to understand its risk and identify solutions. Mumbai worked to address risk reduction issues and prepared an initial study and road map for improving the city's disaster resiliency. By involving a wide range of actors in the development of their Master Plan, stakeholders understand better their relationship to the risks that threaten Mumbai and their role in the city's disaster risk management agenda.

5. Public Awareness

- ✓ Awareness of risks and resources
- ✓ Disaster influence

Awareness can be a very general concept, but for this component it will be roughly thought of as the degree to which people understand the concepts of climate change and are aware of its risks, current impacts, future impacts, and of how they can contribute to the adaptation efforts. This category also includes the knowledge of disaster risks as a component to the awareness of citizens. As mentioned previously, this component is closely related to how well the municipality communicates with citizens, as better communication typically inspires higher awareness levels. In turn higher awareness can bring higher levels of citizen participation and education.

The level of awareness of citizens is crucial to building community resilience, the entire community must know about the hazards and risks to which they are exposed as well as available resources if they are to be better prepared and take measures to cope with potential disasters (United Nations, 2012). For example in a comprehensive study of Red Cross tsunami operations Indonesia, Sri Lankan and Thai communities identified that their increased level of awareness about maintaining good hygiene and sanitation practices as well as their ability to administer first aid when needed, were characteristics that made them more resilient to shocks and stresses (IFRC, 2012). In addition often it is the consequences of climate change that result in increased awareness, for example in Prince George, Canada, warmer temperatures has contributed to the destruction of the pine forest and consequently impacted the forestry industry, contributing to a high awareness of climate change and its impacts amongst local residents (Picketts, Déry, & Curry, 2013).

Allen (2006) found that community members who perceive their lives or livelihoods to be especially vulnerable to hazards, are more likely to cooperate in the relevant disaster preparedness initiatives, than those who don't. In addition, if people understand projects in their community, and why they are useful, the projects are more likely to be successful in the long run. The process of creating climate change action plans can be used as a platform to raise awareness, develop strategies, and encourage action (Picketts et al., 2013). Also the development of a communication tool such as a local database through a collaborative process of constructing, gathering, and maintaining information raises awareness of risk and vulnerability in the community, and assesses local knowledge and resources (Douglas et al., 2008). An example of a communication tool is the CDIS (Community Disaster Information System), a database designed as the local resource to serve community NGOs, such as the American Red Cross, and government agencies (ibid).

One example of an awareness raising campaign is a 'disaster safety commemoration day', in which the anniversaries of disasters are met with educational and fun activities. In Nepal, the 15th January marks the anniversary of the great Nepal earthquake of 1934. In Kathmandu, political leaders and prominent personalities commemorate the event with activities such as street parades, shake table demonstrations, exhibitions on safe construction, street drama, interactive seminars, posters, art and other competitions and presentations for children (United Nations, 2012). Earthquake simulation drills are the highlight of the observance, with wide public participation and media coverage (United Nations, 2012).

DISASTER INFLUENCE

The acceptance and awareness levels in communities is also very dependent on whether or not they have witnessed a disaster in their area, as places that have recently had a major disaster are more likely to be aware of risks and engaged. One example from the IFRC (2012), was in Sri Lanka where the Danish Red Cross (DRC) ran a CBDRR programme in two districts. Communities in Ampara had been affected by the 2004 tsunami, while inland communities in Monaragala had not. The DRC found that it was easier to engage the communities which had been affected by the tsunami, as they had a greater awareness of the risks they faced. This example illustrates the difference between working in pre-disaster and post-disaster situations and how it can have an impact on the level of motivation within a community.

6. Urban Identity

- ✓ Horizontal bonds (Social cohesion)
- ✓ Intrinsic motivation
- ✓ Place attachment

The urban identity of a city is made up of many factors such as, the cultures, attitudes, motivations, and sense of community. Having a 'sense of community' is an attitude of bonding (trust and belonging) with other members of one's group or locale, including mutual concerns and shared values (Norris et al., 2008). This sense is characterized by a high concern for community issues, respect for and service to others, and sense of connection, it is an important dimension of community capacity (ibid).

This component is the most qualitative of all six, and thus is often the last to be addressed in policy formation. However, because this component is closely related to all others, a lack of sense of community can negatively impact participation in community activities and training and will hinder communication between members. In addition adaptation strategies can potentially undermine the resilience of communities and cultures, when they promote private interests at the expense of public goods such as cultural heritage or community cohesion (Adger et al., 2012). The expected impacts of climate change will affect cultures in diverse ways, but the risks are manifest globally and few cultures will escape the influences of climate change in these coming decades, whether in cities in the developed world or in resource- dependent subsistence economies (Adger et al., 2012).

SOCIAL COHESION

Communities are composed of built, natural, social, and economic environments that influence one another in complex ways. The individuals within communities may belong to more than one community, and in fact the more communities they belong to the more resilient they become (IFRC, 2014). Discussions of community resilience often note that "the whole is more than the sum of its parts", which implies that a collection of resilient individuals does not guarantee a resilient community (Norris et al., 2008). Authors Brown and Kulig (1997) noted that people in communities are resilient together, not just resilient in similar ways. It is important to bear this in mind when approaching community resilience; that the key components need not only be applied to the relationship between the municipality and the community, but also to the relationship within the community itself. Higher levels of bonding within the community make it more likely that citizens will help each other during disasters.

PLACE ATTACHMENT

Adger and Barnett (2009) recognize that current climate change discussions frequently focus on physical transformations and their economic implications, but this focus frequently fails to recognise that the experienced worlds of individuals and communities are bound up in local places and that the physical changes will have profound cultural and symbolic impacts. They propose that "*by undervaluing culture and place we are ignoring certain limits to adaptation, which whilst subjective are real for those experiencing them*" (Adger & Barnett, 2009, p. 348). Place attachment is the emotional connection to one's neighborhood, city, or environment, somewhat

apart from connections to the specific people who live there (Norris et al., 2008). As a result of the complex interactions of cultural, political, and ecological processes landscapes assume symbolic meaning and may have profound cultural implications, historical and contextual experience also leads to the development of rules, norms, and forms of governance to manage and interact with the environment (Adger & Barnett, 2009). *"Part of the order and structure of societies is designed to interact with the physical environment and any change in the physical environment will influence these structures as well as the larger social system."* (Adger & Barnett, 2009, p. 348).

Place attachment often underlies citizens' efforts to revitalize a community and thus may be essential for community resilience. A strong sense of place attachment may in fact hinder resilience after a disaster, as citizens would feel a greater sense of loss and may be less likely to make more radical adaptations. For example, there is a widely held idea that relocating populations from island communities in danger will save them from climate change impacts such as morbidity and mortality, but research in Funafuti, Tuvalu shows that some people have such strong cultural, spiritual, familial, and historical ties with the island that relocation would entail unbearable psychosocial losses such that many would say that would refuse to leave (Adger & Barnett, 2009). Before a disaster it is a crucial component to getting people to 'care' about their community and participate in resilience building activities, and in addition it is plausible that after a disaster place attachments promote healing and increase the likelihood that the community as a whole has the will to rebuild instead of leaving (Norris et al., 2008).

The benefits of living in a community characterized by strong place attachments do not accrue only, or even necessarily, to those individuals who feel the attachments most strongly. Rather the attachments create a better environment for all who live in that place (Norris et al., 2008).

INTRINSIC MOTIVATION

For individuals, and the societies they are members of, actions are shaped in part by deeply-embedded (but not static) cultural and societal norms and values. Some characteristics operate at the individual level and include beliefs, preferences, perceptions of self-efficacy and controllability. These, together with perceptions of risk, knowledge, experience, and habitual behaviour, norms and values determine what is perceived to be a limit to change—at both individual and social levels in any particular society—and what is not (Adger & Barnett, 2009)

For the purpose of this research the focus will be placed on intrinsic motivation and self-efficacy. Intrinsic motivation is a very general term, used in this research to define the drive of individuals of a community to participate in community events, interact with others, and their attitude towards their community. The collective efficacy of a community is also a part of the intrinsic motivation, and is a composite of mutual trust and shared willingness to work for the common good of a neighbourhood (Norris et al., 2008). This is highly related to empowerment and participation, as a greater willingness to work results in more participation.

6. **Participation**
    ✓ Levels of participation, voluntarism and accountability
    ✓ Involving a diversity of stakeholders

Participation as a component is the level to which the community is being involved in the resilience projects, the amount to which they are voluntarily participating, and the availability of participation opportunities. One of the overriding aims of community based disaster preparedness, and community resilience, is the empowerment of citizens by supporting them to become increasingly self-reliant (Allen, 2006). The participation of local people in resilience projects is a crucial component to increasing their resilience levels, a resilient city is one where people are empowered to participate, decide and plan their city together with local authorities (Norris et al., 2008; United Nations, 2012). Participation can also be a tool, if a municipality creates many opportunities for

public participation these repeated interactions of stakeholders will build trust and shared understanding, as well as enable social learning (Lebel et al., 2006).

Community engagement reinforces the ability to improve the community and requires processes that encourage civic engagement in planning and decision making (Arup, 2014). One of the qualities of a resilient city as defined by Arup (2014) is its inclusiveness, having 'many seats at a table will create a sense of shared ownership or a joint vision to build city resilience'. In addition participation is critical to ensuring accurate, timely, and resilient situational awareness, and should not just include members of the public, but other stakeholders too (Chandra et al., 2011). Fostering effective public participation is largely dependent on leadership, leaders can give direction, inspire and motivate others into actions in which significant uncertainty could have led to costly inaction (Lebel et al., 2006).

INTERCONNECTIONS

Participation is also closely linked to urban identity, as it is not only participation in policy process and training events, but the extent of social connectedness within a community. The relationships and interconnectivity of individuals and organizations contributes to the resiliency of the community. Social connectedness also increases an individuals' access to real and perceived social support, and communities with many social connections more quickly mobilize resources (Chandra et al., 2011). A resilient community can be characterized by its interconnectivity—that is, the presence of strong horizontal and vertical relationships that exist between community residents (Allenby & Fink, 2005). There is evidence that both the sense of community created by these relationships and the individual characteristics of the relationships (i.e., the characteristics of those involved) help improve disaster preparedness (Chandra et al., 2011). An example of participatory projects are ones that improve a neighbourhood or service, and which community groups select and carry out themselves, as vehicles to empower the group or community through a series of small successes and learning experiences (Berkes & Ross, 2013). Such processes build cohesion and a sense of community while achieving tangible outcomes.

Again it is important to include at-risk individuals in the planning process, when plans are made without involvement from these groups the community may spend additional resources that only decrease resilience or delay recovery (Chandra et al., 2011). It is important to include these groups explicitly, as they are less likely to show up on their own initiative. There is risk of building resilience only for the 'usual suspects', (highly educated wealthy white people), who are already most resilience and least vulnerable. Involving at-risk populations in planning can also decrease the negative psychological impact of disasters by fostering a sense of coping self-efficacy—one's sense of being able to manage the demands of posttraumatic recovery (Benight & Harper, 2002). Ringel et al (2009) found that participation from these groups can bring to the table - new knowledge and insights about their needs, insights into common concerns of individuals with special needs, advice regarding the appropriate content and format of preparedness materials, risk- communication messages, and alerts, and awareness of equipment and supplies needed by responders and shelter providers.

4. ROTTERDAM

4.1 Introducing the City

Rotterdam is a major port city located in the province of South Holland in the Netherlands, with a population of approximately 600 000 (2011). In May of 1940 the majority of Rotterdam was destroyed during a bombing by the German Air Force, and as consequence the centre of Rotterdam was almost completely rebuilt after the Second World War. Situated in a low-lying, highly urbanized delta, Rotterdam is currently home to an industrialized port area as well as a bustling city life (Molenaar, Aerts, & Dircke, 2010). The climate in Rotterdam is generally temperate, however heat waves with temperatures over 30°C do occur and are occurring more frequently due to climate change (van Peijpe et al., 2013). The observed temperature rise in the Netherlands is about twice as high as the global average, and

Figure 3 - Rotterdam, the Netherlands

over the past 20 years there has been no visible decline in this upward trend (Bresser et al., 2005). In addition, rainfall amounts per year have been increasing, and a new record was set in 2006, when 300mm of precipitation fell in one month and there was extensive flooding damage in the city (van Peijpe et al., 2013). Figure 4 in the following sub section shows some of the future climate risks for the Netherlands. Because Rotterdam is a delta city, it is especially vulnerable to the consequences of climate change (Molenaar et al., 2010). Two thirds of Dutch GDP, and the majority of urban development is concentrated in areas below sea level, one of the most vulnerable locations to flood risk in the world, which is why the Dutch continue to invest heavily in flood protection. Currently the protection standards in the Netherlands are the highest in the world, with the average dike height along Rotterdam's coast being more than 10m (Molenaar et al., 2010).

The government of the Netherlands is a constitutional monarchy, the head of state is presently Willem-Alexander, however the sovereign's powers are largely ceremonial. The chief of government is the prime minister, who is usually leader of the majority party in parliament or leader of the largest coalition of parties. Unlike the US, during elections people do not vote for an individual candidate, but for a particular party. The results are proportional, so a party that received 60 percent of the votes would have 60 percent of the seats in the Second Chamber. There was a general election September 2012 in which both the VVD (People's Party for Freedom and Democracy, conservative liberalism, centre-left) and the PvdA (Labour party, social-democracy, centre-left) won considerably, gaining 41 and 38 seats respectively. The two other major opposing parties are the Christian Democrats and Green Party. The current government supports free enterprise capitalism, but also the redistribution of wealth through taxes on the wealthy and middle-class. In addition, Rotterdam is composed of many different governmental organizations that are responsible for protecting different—and often overlapping—regions of the city (Keeton, 2013), these groups include the Waterschap Hollandse Delta, Hoogheemraadschap van Delfland, Veiligheidsregio, Gemeente Rotterdam and Rijkswaterstaat. Although the Netherlands is a decentralized unitary state, Dutch local authorities depend on central government finance; they receive 80 percent of their income through central government grants (Kokx & van Kempen, 2010).

The government is currently in the process of creating an Environment & Planning Act, set to take effect in 2018. The Act will replace 15 existing laws, including the Water Act, the Crisis & Recovery Act and the Spatial Planning Act, will result in fewer regulations, and reduce the burden of conducting studies (Government of the Netherlands, 2016). At the same time, decisions on projects and activities can be made better and more quickly.

For citizens or companies that want to implement a project, they will be able to apply for a (digital) permit at a 'one-stop-shop' (ibid). The municipality or province will then make a decision. This simplifies things for the applicant and speeds up the permit application procedure.

Risks to the Community

The Netherlands is a country that has been dealing with water related issues for centuries, through a method of trial and error the country learned that build-in redundancy is crucial to their system of levees. After a disastrous flood in 1953, the Dutch decided to build their sea and flood protection system to meet the conditions of a 1000-year event – four layers of redundancy (Desouza & Flanery, 2013). The centrepiece of this plan is the Delta Works programme which resulted in the development of the Maeslantkering, a massive storm surge barrier in Rotterdam, allows two massive floating arms to automatically close off access to the North Sea when computers predict a storm surge of more than three meters (Jha, 2016). Although the dike protection system is very safe, a failure in the system could still cause immediate and sever damage. In the face of uncertain consequences of a changing climate it is essential that Rotterdam continues to adapt, doing nothing is not an option. A brief summary of some of the risks includes:

- Water: Annual precipitation in the Netherlands has increased by about 20% in the last century and periods of heavy rainfall have become much more frequent (Bresser et al., 2005). Future scenarios include higher risk of river and water drainage flooding (as a result of intense precipitation) and declining surface water quality (water temperature, algal growth) and biodiversity.

- Structural: Although these large scale defenses are amongst the best in the world, the Netherlands spends €1 billion every year maintaining large-scale flood defenses like these (Jha, 2016). In addition, *"The physical process of closing the Maeslantkering takes half an hour. For the arms to sink, it takes another two hours. And of course all of this depends on the right tide conditions; the barrier can only be closed at rising tide."* (Keeton, 2013).

- Population in high risk areas: The high risk areas in Rotterdam house port facilities, railroads, tunnels and a large portion of the working population in that area, and the number of people living in these areas in only increasing. Rotterdam's port is regarded as safe because it is located several meters above sea level, however it also lies outside the dike protection system and is only protected by a smaller storm barrier, so high water levels can be problematic.

Figure 4 – Future Climate Risks for the Netherlands

- Predisposed to stress: The city of Rotterdam is already under the burden of having to constantly pump water out of the city and keep it out, these problems will only be exacerbated with growing climate extremes.

- Economic Damage: Cost of damage to buildings and infrastructure is very high. Special attention is needed for the cultural heritage in the area, as many historic buildings are prone to future flooding (Bresser et al., 2005).

4.2 Rotterdam's Current Vision and How It Relates to Community Resilience

"The resilience of any city lies in the strength of all of people, businesses and organizations combined. We focus on their strength and their cohesion: the city as a habitat, with future-proof infrastructures and resilient citizens.

Citizens are key!" -Arnoud Molenaar, Chief Resilience Officer of Rotterdam. Rotterdam's vision is to become a resilient world port city, and to make Rotterdam 'climate proof' by 2025 (the City of Rotterdam, 2016). In addition, the city recognizes that it is essential to become climate proof both now and in the future (ibid). Methods to accomplish this are laid out in the newly published document Rotterdam Resilience Strategy 2016. This was not always Rotterdam's focus; the following list shows how this shift came about:

2001	1st Waterplan Rotterdam	Water
2005	Rotterdam Water City	Water + Spatial Planning
2007	2nd Waterplan Rotterdam	Water + Spatial Planning + Climate Change
2008	Rotterdam Climate Proof	Water + Spatial Planning + Climate Change
2010	Connecting Delta Cities	Water + Spatial Planning + Climate Change
2013	Climate Adaptation Strategy	Water + Spatial Planning + Climate Change + General Resilience
2014	100 Resilient Cities	Water + Spatial Planning + Climate Change + General Resilience
2016	Resilient Rotterdam	Water + Spatial Planning + Climate Change + Resilience Focus

ROTTERDAM RESILIENCE STRATEGY 2016

This new strategy is based primarily on the 100 Resilient Cities methodology, a group funded by the Rockefeller Foundation, and in which Rotterdam is a major part. The 100 RC definition of Urban Resilience does include communities: "The capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience".

In the new Resilience Strategy, released May 2016, the vision for 2030 was outlined. This vision touches on community resilience in three points, with three corresponding goals:

- **Vision**: strong citizens respect each other and are continuously developing themselves.
    - Goal: A balanced society - Skilled and healthy citizens and balanced society
- **Vision**: self organization in the city gets enough room and a flexible local government supports if really needed
    - Goal: Rotterdam network – Truly our city - Residents, public and private organizations, businesses and knowledge institutions together determine the resilience of the city
- **Vision**: Resilience is part of our daily thinking and acting.
    - Goal: Anchoring resilience in the city - Truly applying the resilience lens across all aspects of our daily lives and business activities across multiple levels: both at building and district level and at the level of the city and metropolis

The focus areas stated in Rotterdam Resilience strategy that relate to the community resilience components are:

- **Focus Areas:** social cohesion and education
    - Components: (2) Education and Training; (6) Urban Identity; (7) Participation (5) Public Awareness
- **Focus Area:** Changing Governance
    - Components: (4) Resources; (3) Governance (1) Communication

The new resilience program outlines a large number of actions to support these goals, however the majority of these actions are new and have very limited information available about them, and so they are not taken into account in this comparison.

4.3 Definition of the Community

Until 19 March 2014, Rotterdam's fourteen boroughs had the formal status of submunicipalities (*deelgemeenten*) under the Dutch Municipalities Act. The average size of the boroughs is 42 000, representing about 7% of the population each. The sub-municipalities were responsible for many activities that previously had been run by the central city. The idea was to bring the government closer to the people. All sub-municipalities had their own *deelgemeenteraad* ('sub-municipal council'), direct elected by the borough's inhabitants. The district councils enjoyed far-reaching autonomous decision making powers in many policy areas. Only

Figure 5 - The 14 boroughs of Rotterdam

affairs pertaining the whole city such as major infrastructural projects remained within the jurisdiction of by the central municipal council. In 2014, the sub-municipalities were abolished by law, but Rotterdam maintained its boroughs. The district councils were then replaced with smaller *gebiedscommissies* ('area committees'). The area committees no longer have autonomous powers, but instead act primarily as advisory and participatory bodies for the central municipal council. For this research the term community will refer to the citizens residing in each of these 14 boroughs (Figure 5).

4.4 Grading on the Municipal Efforts to Increase Community Resilience

Overall Rotterdam is strongest in the resources component and has good availability of funding, economic opportunities, and research. However, services such as communication systems and education and training opportunities are lacking. One of the main vulnerabilities of Rotterdam is within the component governance, and attributed to lack of accountability and strategy focus. The outcome components were all graded fairly low, but with the municipality's change of focus from international to local there is great potential for higher overall community resilience.

Following is the in depth grading of the municipality of Rotterdam and how it approaches the seven components in its policy, based on the information gathered from interviews with key policy makers and other stakeholders, key documents, participation in working sessions and conferences, as well as site visits (A1- Appendix). Each sub component is given a grade based on the scheme presented in the Methods section, in addition each of the seven components is given an overall grade.

Communication with Citizens

Score: Marginal - Rotterdam scored marginal in this category because the communication efforts are largely being focused on documentation creation and the international image, and not on communicating with the public or amongst the municipality itself. Although there are some efforts being made to communicate to citizens, these are project specific and there is still a lot of improvement to be done.

Sixty years ago, during the flood of 1953 as floodwaters surged across the country, a lack of communication left countless people unaware of the impending flood (Keeton, 2013). During rescue operations, communication challenges between various parties slowed recovery and the flow of information. Although Rotterdam has

greatly improved its flood safety through structural implementations, the area of communication is still lacking (Keeton, 2013). In the Connecting Delta Cities document (Molenaar et al., 2010), it is acknowledged that communication is important and required on different levels in the city and that communication between citizens, local (city council), regional (water boards), and national government bodies is crucial in creating awareness and commitment for funding of research and measures.

Information System and Availability - Some information sharing and gathering systems exist in Rotterdam but are not widely accessible or known to the public. One such information site is the delta cities network knowledge portal (C40, 2016), but this has limited information on Rotterdam's flood risks and emergency plans, in addition this information is directed more at the scientific community. The Rotterdam Climate Initiative (Rotterdam Climate Initiative, 2016) has information on some major projects, and the 'waterloket' (City of Rotterdam, 2016) has more information on what to do in the event of street or basement flooding and includes a general number to call for questions. While these websites are informative the main gap is that there is no platform for multi-way information exchange between the public, private organizations, researchers, and the municipality. Of the information that is available the majority of this is based around promotion of city projects, and there is limited information on actual risks and emergency protocols. In addition, very little of this is tailored for at-risk individuals with consideration to issues of literacy; culture; trusted spokesperson/channels; preferred languages; or preferred formats. Although Rotterdam's population is close to 50% non-Dutch there are almost no municipal documents or websites offered in languages other than Dutch, or English.

Community – Municipality Information Exchange - "*Rotterdam recognizes that at local level, communication with residents in the early stages of urban planning processes is essential for the public acceptance, and a requirement for successful implementation of innovative solutions*" (Molenaar et al., 2010). Rotterdam recognizes the importance of community engagement in it's public documents, and a lesson which was learned in past projects. The original Water Square project was not accepted by the chosen community, which was due in part to a lack of communication with the members of that community about the benefits and details of the Square. Respondent 5 said that "*Sometimes with innovations, and certainly when it comes from top down, there is sort of a, something you just don't see.*" The Water Square that now exists, at Benthemplein, was a success after a large effort to communicate and engage with the community. The new Water Sensitive Movement program is very participatory, as they encourage everyone to be involved and share their ideas, "*So I want all landscape architects and all spatial planners and all engineers who work on these projects all involved, not just in this project but in projects similar to this.*" – Respondent 1. Rotterdam is increasing its communication to the community during its project development, however the level of information exchange outside of projects is minimal.

Local Knowledge - The low scoring in communication is closely linked to the category of awareness, although Rotterdam is known as a leader in climate resilience, especially in the field of water management, the citizens of Rotterdam are not well informed. The local knowledge of community members is not being utilized by the municipality. The emphasis in Rotterdam is very heavily placed on communication to the international world. Respondent 1 stated that "*Abroad there were 67 delegations that came to Rotterdam (referring to an event held at the floating pavilion), but about 99% of the people living here don't know anything about it, and this is the funny thing*".

Education and Training

Score: Marginal - *Rotterdam scored marginal in this component, because there is very little education of citizens of the flood risks, as well as few opportunities for citizens to be trained as first responders. The city is just beginning to recognize this as an area for development and the emphasis is still on structural developments and research.*

Education and Training for Citizens - Although citizens have access to some information about flood risks, there is very little information about flood evacuation plans and opportunities for citizens to improve their skills as first responders. This component is closely related to communication, as there is information about predicted flood consequences and scenarios, but response and emergency planning is weak. In addition, there has not been a flood evacuation drill since the 1953 flood. Although the storm surge barrier and dike system have an extremely high safety standard, people and businesses are still left vulnerable to damages caused by excess precipitation and sewage overflow. If there were a disaster in Rotterdam community members would not be able to act as competent first responders to a situation.

Education importance is recognized - The city is changing however, and the importance of education and training is being recognized. For example, in the Inner Garden Project, there is no aspect of awareness, but they want to introduce an information evening where they can tell people about why these gardens are important and what they can do to help. There is also recognition of the opportunity to introduce resilience education into schools, it just has yet to be done. Also, as mentioned previously, there are new trainees being hired that are very motivated and inspired to help in the various projects.

Governance

Score: In Progress - Rotterdam has a score of in progress in this category. They have partnerships with different governing bodies, as well as private organizations. Where there needs to be improvement is coordination within the municipality itself, between employees, as well as the boundaries between organizations are at times unclear which results in a lack of accountability. Improving accountability would help in project follow through. There is a lack of concrete long term strategies coming from the municipality, although there are many documents being produced there is little ownership for them.

Accountability - When it comes to climate adaptation, an important part of making your city climate proof, is taking responsibilities for your citizens especially when it comes to climate resilience, however the citizens have to have some degree of responsibility for themselves. In this regard the municipality cannot be held completely accountable for its citizens, but it should be held accountable for its projects, which in turn affect citizens. The municipality has a matrix structure, meaning many actors are involved in different areas and not compartmentalized, which is beneficial in the area of information sharing within the municipality. However, redundancy can lead to behaviour and actions that are not efficient or accountable, as the responsibilities are often dispersed. The clarity of responsibilities within the municipality is fairly weak, and limits the accountability.

Having accountability for a project is very important, as it ensures that the project's development does not get overlooked, which seems to be the case in Rotterdam, "*Some say that Rotterdam is a city of projects*" – Respondent 5, and especially pilot projects. One example of a showcase project that had limited follow though is the Rain-Away gardens, which are three large pieces of concrete replaced with water absorbing surfaces (plant or aggregated tile). This action was initially a small 'gorilla' action, with the idea of scaling up and creating a larger garden. When the initial action was completed, the municipality agreed on scaling up, there was a project leader hired, and funding allocated, but because it had a larger impact it had to be part of the official planning, a fixed procedure, and it's still not there. "*So it could still be two years before such a small garden, that everyone wanted, and everyone supported will be created.*" – Respondent 5.

This example is part of a larger project, called the ZOHO district, which is a pilot district representing a resilient community. The ZOHO district as a whole is experiencing similar problems with moving forward as explained by Respondent 5, "*everyone seems to forget that this isn't something that you can be involved in the beginning and then you can let it go and it will go. No. You need to be promoting it all the time, otherwise it evaporates. That is what is happening now in ZOHO*". This relates to accountability, as there is no one clearly responsible for the

future of this project. "*If you take away the responsibility you can't expect that they (the citizens living there) want to do it, because they don't have a lot of spare time, they are professionals.*". These examples are related to Rotterdam's focus on international image. Although some actors are attempting to keep up with the projects, "*on the other hand, it feels like... "yah that's for spending the time on this, and now we can sell the story". But what's the next step? It's going slow, it's really going slow, too slow.*" – Respondent 5.

Internal Coordination - There seems to be a lack of internal coordination within the municipality itself. At the AF2016 Conference the challenges with internal support and organization for getting monitoring off the ground were highlighted, and a new focus on mainstreaming was put forth. There are however problems with getting specific knowledge to each area, Respondent 6 said, "*So the urban designers want to know... "So if I need to plant more trees, which trees, how many trees?". The more practical you become, the more detailed information they require.*". This section closely relates to knowledge development as well, and how this knowledge is shared. There have been a few climate groups created, such as Climate Proof Rotterdam, that involve a few key stakeholders. However, in the case of Climate Proof Rotterdam there was funding given for the creation of a Climate Adaptation Strategy, but the group has essentially disbanded. The rational is that the program has now been integrated into the sustainability program, however there is still some confusion within the municipality itself about this.

Partnerships - This category is very closely related to communication, a critical component in maintaining quality partnerships and relationships. As stated previously, Rotterdam has many different organizations responsible for overlapping regions of the city. Due to this overlap there can be problems of communication between these layers, but there was mixed response in regards to the coordination between these organizations. Respondent 5 said that, "*It seems that there is a lot of, overlap between the municipality and water boards, all of these organizations, and sometimes the communication isn't great.*" Respondent 3 stated on the topic of an inner garden project "*We tried to have a conversation with the municipality, they have many departments but they don't speak so well with each other. There are a lot of problems there.*". However, Respondent 6 said that "*actually the relationships between the water boards is really good, for example the water plan was developed with the water boards. They all signed it and it is really a shared document that we all feel responsible for...No one is hiding from their responsibilities*". In regards to international partnerships, Rotterdam is currently a leader in many international climate change related organizations.

Strategy Development - Rotterdam's strategy, the newest Resilience Strategy having just been published, is comprehensive, however it seems to be just a 'reframing' of the same thing and marketing it in a different way. Within the new Resilience Strategy of the 60+ initiatives, there is only one long term initiative. Rotterdam is very focused on it's international image, which results in a lot of framing in these strategies, with little or no content behind it, "*it's just window dressing in fact*" said Respondent 1. Many of these strategy documents are touted as lacking follow through, Respondent 5 said "*There is no implementation strategy. It's easy to put it aside. The other thing is, who is going to feel a shared ownership in the municipality for this project? It was done, very much, based on the Rockerfeller Foundation Methodology.*" However, there are projects following up these strategies, but they remain internal knowledge, to the public these strategies seem like another municipality vision or strategy to showcase, Respondent 5 stated about the Climate Adaptation Strategy, "*What is missed was really key projects, or funding for 5 years saying this and this are the things we are really going to implement right now. For instance, a district scale or project scale. That was not done. It makes it a tiger without teeth, as we say in Dutch. It can't bite.*". In addition, Respondent 1 said that the only downfall of the Rotterdam Adaptation Strategy is that there was no implementation strategy or program behind it, and that despite being well written and thought out, it has not gone to any further use.

Resources

Score: Established- Rotterdam scored a value of in progress because it has established a resources base that effectively addresses climate change. The level of resources in Rotterdam is high, there is funding available for projects, and economic opportunities for people, which makes the city open to bottom up initiatives. In addition, the municipality does a good job of involving institutions of higher education and other organizations in researching climate change disasters.

An interesting point that was brought up in one of the interviews was perhaps bottom-up planning is something only for wealthier, developed cities of the first world. This statement was made in regards to the fact that cities such as these are the only ones that can afford bottom up initiatives, as it is made much easier with an organized structure, good public transport, and a developed economy. Respondent 5 said, "*Then at that moment you can create space for people to take over their streetscapes, to bring in initiatives to their district. But if your city is not good enough… you need something more of a planning form, a structuring form, because the city is in a transition period.*". This outlines the importance of funding to create the balance between bottom up- and top down initiatives; without it the focus remains top-down centred.

Funding - The funding level for projects in Rotterdam is relatively good. The creation of different international documents is responsible for this to some extent. By mentioning one project in three different strategies it helps to get more funding and political support. Often the aim of the strategy is just to get more funding and support. However, the funding seems to be allocated only towards "flashy" structural projects that will contribute to the city's image.

Economic Opportunities - In regards to the economic opportunities in Rotterdam, and facing problems such as gentrification, the city has a very well organized social program. Poverty is not at the level that is in other first world nations, and worries of gentrification are not high. In social housing areas the municipality is aware that people are more interested in project concerning money savings than things that will make their homes worth more.

Research – There are several research programs, as mentioned before: Rotterdam Climate Proof (RCP), the national research program Knowledge for Climate (for which Climate change spatial Planning was the predecessor) and the national Delta Programme. Although the majority of these are not lead by the municipality they have provided a lot of Rotterdam specific information. These have provided insight into the vulnerability of the city, the threats to the city's functioning and the specific work that must be carried out to create a climate proof Rotterdam. The municipality is doing a good job of coordinating research through the faculties of higher education, as well as the federal government. They have city specific scenarios developed that show what would happen in the event of a flood and failure of the Maeslantkering storm surge barrier. In addition, Rotterdam does a very good job of constantly monitoring the changes in sea level, precipitation, and any other weather related situations.

Public Awareness

Score: Marginal - Rotterdam has scored marginal in this component. Currently the awareness of the community is very low, there is a large gap in every-day risks such as damage from excess precipitation. There seems to be a growing focus on citizen involvement in future campaigns, but there is still a long way to go.

Awareness – The levels of awareness in Rotterdam are fairly low, which can in part be attributed to the community's limited exposure to awareness raising campaigns and a lack of available information and programs "*Very few people know what to do in case of an emergency*", said Respondent 6, which leads to citizens not possessing the appropriate knowledge and skills. This was also found in a study by Runhaar et al. (2012)

that showed private actors are only involved to a limited extent in Dutch local adaptation policy, and therefore the general public is hardly aware of flood induced risks. In Rotterdam, particularly the areas outside the flood defenses such as the old port areas, are hotspots for population growth and are being redeveloped into housing. Legally, residents may live there at their own risk, while they are often not aware of that, and neither of the risks themselves (Wardekker, de Jong, Knoop, & van der Sluijs, 2010).

One reason for a lack of awareness is that awareness has not been made a top priority for the municipality, and thus promotion and encouragement of community lead actions is not facilitated. In the example of the inner garden project, the main goal of the action was to create a more social experience in addition to building these gardens. The education of those living around this garden about the water retention abilities of this garden, is a secondary component. Within the municipality there is change, it is being recognized now as an important point to address, "*They don't want money they want knowledge, and a bit of support*" – Respondent 1 about the residents in a Rotterdam community. One of the new movements started by the municipality, Water Sensitive Rotterdam, is addressing these issues, "*Water Sensitive is a place where people can go to gain knowledge or gain contacts and be in a network.*" – Respondent 1. However, it is a question of whether those that actually need the information, such as more vulnerable populations, would go to gain this knowledge, or if it would be those that are already educated and have the time to participate.

Disaster Influence – Rotterdam is a city that has not seen a disaster since 1953, which means citizens may not be interested in becoming aware of climate related risks. In addition, the municipality is hesitant to show citizens the seriousness of the consequences of a damn breakage, and how quickly the city will be destroyed, because they do not wish to cause unnecessary panic. The problem then comes in trying to strike a balance between letting citizens lead a life free of worry about the risks of flooding, and involving citizens enough to increase their resilience. This has made it difficult to increase citizen awareness, especially those who are living in more vulnerable areas where their concerns are related more to economic survival.

Urban Identity

Score: In progress - Although the Dutch are known for being a very tolerant and accepting culture it is important to remember that this component relates only to cultures as they link to the enhancement of community resilience to climate change disasters. The culture in Rotterdam is strong in the areas of experimentation, accepting change, new ideas, and growing, however there are gaps in social cohesion in the community.

Social Cohesion - Due to the large government presence in Rotterdam, the municipality is always the first point of contact for citizens when there is a disaster. This leads to a culture of citizen reliance upon the municipality for resources and needs, and a lack of autonomous motivation amongst citizens themselves. Respondent 6 - "*We are so well protected that every time it goes wrong, you don't ask yourself, was this something I could prevent myself, or did I do something wrong? But you immediately think, the government didn't solve my problem*". This also means that citizens do not have to rely on each other in times of need, which leads to low levels of social cohesion in neighbourhoods. There seems to be a divide between neighbourhoods and cultures in Rotterdam, this divide may be caused by a lack of understanding and integration of each side. There are areas of Rotterdam where implementing resilience related projects is easier, these areas tend to be dominated by Caucasian, educated, and affluent people, who are perceived as having a greater interest in the issue because they have more time to be involved. Rotterdam is a city of diverse cultures, and ensuring better integration of these cultures is an area of focus in the new Resilience Strategy.

Intrinsic motivations - Another one of the reasons for this low score is the attitude of the majority of people at the municipality and a lack of intrinsic motivation. Many of the employees of the municipality are there to do a

job, and are very busy with this job; however, their passion and life begins when they leave the office. In place of this intrinsic motivation people at the municipality do have a sense of responsibility. "*It is our responsibility of our cities and municipalities to be there for people who cannot organize themselves.*" – Respondent 1. A contributing factor to this is lack of internal communication, as mentioned in the communication section, as well as a focus on image. One method the municipality is using to combat this is higher more youthful staff, to replace the graying staff (e.g. average age is 40-50 or so), which would bring more energy and an inspired outlook. In regards to the citizens of Rotterdam they are enthusiastic to help when offered the chance, which will be elaborated upon in the next section.

Learning to Policy - The municipality has a large capacity to learn, as seen easily by the multiple pilot projects. They embrace uncertainty, are very open to new ideas and experimentation. In addition, new trainees are very motivated and want to be involved in new projects. However, the extent to which this learning is put into policy has yet to be seen, as the majority of these pilot projects remain just that. As mentioned previously communication was a big issue in the flood of 1953, and remains an issue in the city. It is easier for a city to implement an attractive pilot project than a social transition. This is something that the municipality is trying to recognize, Respondent 6 said, "*Yah so that's actually part of the resilience strategy, that's where the resilience strategy and CAS overlap, where we both have to move from pilots, and that's where we really need to evaluate pilots.*"

Participation

Score: In Progress - Rotterdam is in progress in this component. In the past public consultation was not a major part of project development or policy development. However, after past projects this is changing and communities are being more involved in the development process. There are still gaps in participation in policy development, and by vulnerable groups.

Communities Involvement - The communities in Rotterdam do want to be involved, they are enthusiastic and given the opportunity to join they want to contribute their time. Also, the trainees being hired are very enthusiastic about being involved in new and up coming projects. When asked how many people wanted to participate in an up coming project, Respondent 5 said, "*It was huge! It was a huge group because it was quite an urban condition.*". The Water Sensitive Rotterdam Movement is also very focused on inclusion of the communities, they want feedback and participation of all who may be impacted or involved. Although the number of community leaders compared to initiatives being run is very low, many community members expressed the desire to be part of these initiatives and share experiences and use them in other places in the city. The municipality does some stakeholder analysis for each project, which leads to the discovery of community leaders. The importance of these leaders is recognized, especially in areas where there are a lot of people from difference backgrounds.

Project Participation - At times it can be hard to distinguish how much of citizen participation there really is, and how much is marketing by the municipality. The Dak Park project, and project involving building of a large park, was very involved with the community, but the climate resilient ZOHO district was not, although policy documents say otherwise. ZOHO was more about spending time and resources, bringing people together was something that happened at the end, but people certainly were not the initiators. In addition, the municipality had to learn how important citizen participation is from their initial Water Square plan. After the first water square was no accepted by the community, they really tried to involve citizens in the second location, "*...we said we're going to make a water square and this is the main principle or idea behind it. We have the money available and we're going to organize a process in which your input is going to make a difference in the way the square is going to be laid out and designed.*" – Respondent 5. It is crucial to have local involvement in these projects to increase the chances of local acceptance. It is also very important to involve a diversity of stakeholders in the process, and to be open to new ideas. Respondent 5 said that, "*There is an architect, a landscape artist, engineers,*

but you're open to the input of the people. Everyone was giving input but it was also clear that you couldn't get 100% of your desires, we really organized the discussion between the difference groups and stakeholders. Also for everyone clear, that you needed a third part to make this design. So we very much believe in the power of design to bring people together, without getting into something like an anarchy of ideas that doesn't bring us further. We need an agenda that is relevant."

Vulnerable populations - One of the main hindrances in resilience building, as mentioned previously, is the involvement of lower income citizens. Their top priority is earning money for themselves and their families, not the climate risks of their environment. In addition, many of these poorer areas are also areas with high transient populations, which it is even harder to involve citizens. In regards to the Benthemplein water square, "*There were only people in there that were interested. All the people that were not interested in participating, they just didn't.*" – Respondent 5.

In the new Resilient Rotterdam 2016 document, the municipality recognizes that the area they need to improve upon is flexibility, meaning greater participation from citizens and stakeholders (Gemeente Rotterdam, 2016). The municipality needs to involve people more in the creation of documents. During the development of the Rotterdam Climate Adaptation Strategy for instance there were no representatives of the inhabitants of Rotterdam, just large players like the port authority and certain stakeholder groups. There the interaction was organized on a level of representatives and higher organizations and stakeholders that are needed to implement such an abstract strategy.

5. NEW YORK CITY

5.1 Introducing the City

New York City (NYC), capital of the state of New York in the United States of America, is the highest and most densely populated city in the United States; after rapid growth in the 19th and 20th century the city now counts 8 million inhabitants and the projected population in municipality area in 2050 could be as high as 23 million residents (Census Bureau, 2015). The city was originally founded by the Dutch Republic and named New Amsterdam in 1626, but came under English control in 1664 and was given its current name. New York is home to the headquarters of the United Nations and has been described as a cultural and financial capital of the world (City of New York, 2011). It is situated in one of the world's largest natural harbours and a large portion of the city's critical infrastructure is located on the waterfront, the most vulnerable area. This waterfront includes: a wide range of transportation facilities (subways, bridges, piers etc.); the main cargo ports; many commercial and industrial businesses; as well as power plants, treatment facilities and waste transfer stations (City of New York, 2011). New York City continues to be a leader of the national and global economy, an intellectual and cultural hub, and overall, a resilient city (Desouza & Flanery, 2013). The city has a temperate, continental climate, with hot and humid summers and cold winters. Records show an annual average temperature between 1971 and 2000 of approximately 12.8°C (CDC, 2015). New York's coastal location, with almost 1,500 kilometres of shoreline (including tidal wetlands), means that future climate change and associated sea level rise and increased probability of storm surge-associated coastal flooding are widely seen as the most significant challenges to the city (Solecki, 2012).

The United States is a democratic, federal republic. The chief executive and head of state is currently President Barak Obama, in office for two 4-year terms. There are two main political parties, the Democratic Party and Republican

Figure 6 - NYC located within the USA

Party, both which support the free market system (Nations Encyclopedia, 2016). Currently the Democratic Party is in power, they are liberal and generally support government action to address economic or social problems, they also tend to emphasize workers' rights and increased social spending (ibid). Both the federal and state level governments have a limited impact on the economy; most policies are designed to protect consumers and workers and to promote economic development (ibid). The tax rate in the US is much lower compared to other industrialized nations, although there are many variations since individual states can also tax citizens (Thompson, 2013). The main government expenditures are social security, welfare programs, and national defense. The size of the nation's military has created a military-industrial complex - a series of deep relationships between the military and companies that provide services and equipment for national defense (Thompson, 2013). In addition, the US army corps of Engineers are also strongly involved in water safety projects. Unlike most advanced economies, the U.S. doesn't supplement personal income taxes with a national sales tax, or value-added tax. In other words, the U.S. relies uniquely on personal tax rates to raise revenue, which are relatively low.

The United States Environmental Protection Agency (EPS) is the federal agency created to address human health and the environment (Ohlinger, 2015). This agency is required to enforce the Clean Air Act (CAA) of 1970, which has only since 2007 included greenhouse gas emissions. Even though President Obama and his administration made repeatedly clear that they would prefer to see new legislation, the Clean Air Act still remains the primary vehicle to pass federal greenhouse gas regulation in the United States (Ohlinger, 2015). Reasons that Congress has not passed any comprehensive climate legislation are, that US senators are less likely to vote in favour of climate friendly legislation when the unemployment rate in their state is high, and the Republican's tend to deny the existence of climate change (Ohlinger, 2015). In June 2013 President Obama revealed his Climate Action Plan, which focuses on mitigation of emissions and adaptation for future climate change disasters (Ohlinger, 2015). All actions proposed in President Obama's national climate action plan can be implemented via the US EPA, thus bypassing Congress. A figure depicting the current climate change action structure can be found in A5 – Appendix.

Risks

Within the United States, although the federal government has not addressed climate change issues, local governments such as New York are becoming increasingly aware of the situation and beginning to take action (Saavedra & Budd, 2009). In 2011 the City of New York came out with a document, *Vision 2020 - New York City Comprehensive Waterfront Plan,* which outlines current and future risks, as well as actions to be taken. However this document states that "*Though the most severe effects of climate change are not expected to be felt by 2020, this plan considers steps to take within the next 10 years to prepare for rising sea levels and more intense storm activity associated with climate change*" (City of New York, 2011, p. 112). This quote shows serious oversight of the consequences of climate change, and the immediate need for action. In 2012 New York City was hit by hurricane Sandy, the deadliest and most destructive hurricane of that season. A flood risk map depicting future flood risk in NYC can be seen in Figure 7. A brief summary of some of the impacts of Hurricane Sandy, as well as future risks include:

- Water: The New York City Panel on Climate Change (NPCC) states that it is likely that the number of the most intense hurricanes will increase in the North Atlantic Basin, along with extreme winds associated with these storms (2015).
- Structural: Coastal storms are expected to accelerate the erosion of un-stabilized shorelines and the degradation of bulkheads (vertical retaining structures used for shore protection) and piers (City of New York, 2011). New York City's infrastructure systems are tightly coupled, leading to the possibility of a

cascade of failures and secondary and tertiary climate impacts (Solecki, 2012). Hurricane Sandy resulted in flooding of the subway system, flooding of many suburban communities and all road tunnels.

- Economic: Coastal storms will result in damage to parks, piers, plazas, beaches, boat launches, and other facilities (City of New York, 2011). Hurricane Sandy cause the closure of the New York Stock Exchange for two consecutive days, and resulting economic losses were over $18 billion (ibid).
- Population: Thousands of homes and vehicles were destroyed during Sandy, several thousands of people were evacuated for many days, and at least 53 people died in New York as a result of the storm. Risks to the citizens will only increase as the population in NYC continues to rise.
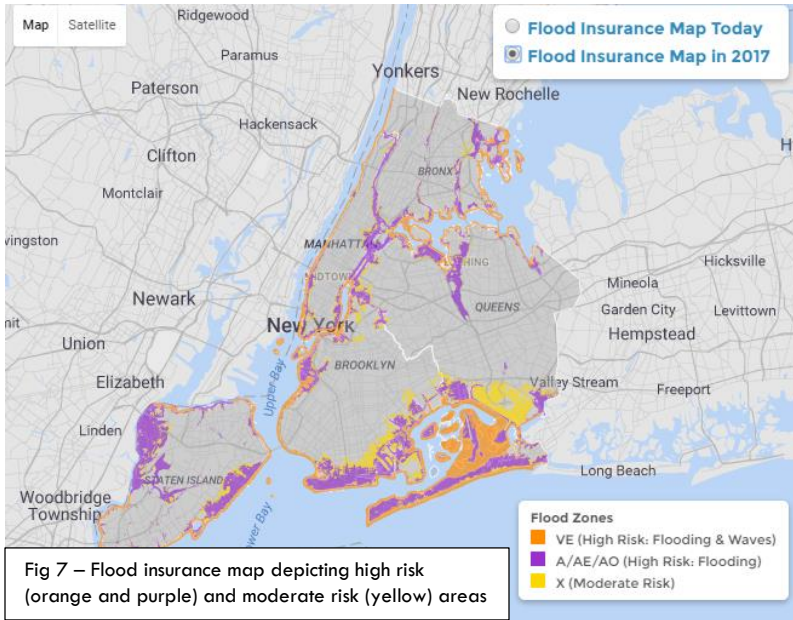

Fig 7 – Flood insurance map depicting high risk (orange and purple) and moderate risk (yellow) areas

Although the city has some of the best disaster prevention infrastructure there are still many improvements to be made. After Superstorm Sandy hit New York City and the New Jersey coastline, there was much discussion about large technical infrastructure solutions for dealing with expected future storm surge and coastal flooding: for example, closable sea gates at the narrow section of the entrance to New York harbor. However, if implemented, the sea gates proposed to deal with these serious threats to New York could lock the city into energetically, resource, and economically unsustainable long-term maintenance costs that have serious ecological side effects (McPhearson, 2014). Instead the Rebuild by Design (Williams, 2014) program was initiated to articulate visions for climate change resilience in the New York City region.

5.2 New York City's Current Vision and How It Relates to Community Resilience

When New York's Mayor Michael Bloomberg created the Office of Long- term Planning and Sustainability in 2006, with the goal of developing a comprehensive plan to create a greener, more sustainable city, climate change planning in New York City and the surrounding region was given the potential to be significantly strengthened. Since then climate change planning in NYC has only increased. On June 11 2013, Mayor Michael Bloomberg announced "One NYC – The Plan for a Strong and Just City", a comprehensive plan that contains actionable recommendations both for rebuilding the communities impacted by Sandy and increasing the resilience of infrastructure and buildings citywide (City of New York, 2015). "*We must come together again with an even stronger commitment to slow the progress of climate change while simultaneously preparing for the changes already evident around us— and those yet to come.*" – New York City Mayor Michael Bloomberg (New York City, 2013, p. 6). A brief history of New York's municipal climate change publications follows:

2007	PlaNYC - Climate Change Strategy
2008, 2009, 2010	PlaNYC - Progress Reports
2009, 2010, 2013, 2015	NYC Panel on Climate Change – Various Reports

2011	PlaNYC - Updated Report
2011	Vision 2020: Comprehensive Waterfront Plan
2012, 2013, 2014	PlaNYC - Progress Reports
2013	A Stronger, More Resilient New York (A compliment to PlaNYC)
2013	One NYC – Climate Resilience Strategy
2015	Building the Knowledge Base for Climate Resilience - Report

One NYC – The Plan for a Strong and Just City

With this plan New York has recognized that climate change affects everyone, *"Not just those whose home or businesses were flooded during hurricane Sandy, or those in the South Bronx or East Harlem or a hundred other neighborhoods that could be struck during a future storm, but every man, woman, and child who may not be able get to work or school because the subway is shut due to flooding, or whose health is at risk during a prolonged heat wave or power outage—that is, every man, woman, or child who calls New York City home"* (New York City, 2013, p. 7). This plan includes $1 billion in funding for over 250 initiatives and has four main visions: Growth (A thriving city); Equity (an equal city); Sustainability (a sustainable city); and Resilience (a resilient city). The fourth vision, Resilience, (Figure 8) touches on community resilience within the sub-category 'neighborhoods'.
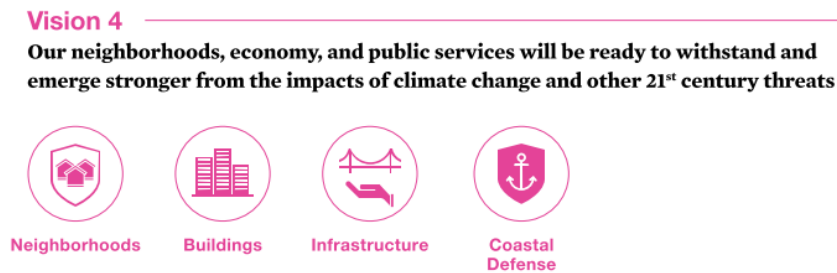

Vision 4

Our neighborhoods, economy, and public services will be ready to withstand and emerge stronger from the impacts of climate change and other 21st century threats

Neighborhoods   Buildings   Infrastructure   Coastal Defense

Figure 8 – Vision 4 of NYC's Climate Change Strategy

Sub-category: Neighborhoods

Goals: Every city neighborhood will be safer by strengthening community, social, and economic resiliency.

This goal relates to the components in the research in:

- Initiative: Strengthen community-based organizations
- Initiative: Improve emergency preparedness and planning.
- Challenges: Communication between government and community stakeholders.
- Opportunities: Establish communication links, emergency on-call contractors for recovery, access to emergency shelter sites, and off-the-shelf recovery programs for communities, residents, and businesses.

5.3 Definition of the Community

New York City is very large, almost like several cities in one, perhaps the most noticeable of these divisions can be seen in New York City's five boroughs. These roughly correspond to the counties that the English etched out when they seized control of the area and drew up a map in 1683 (Keppler, 2016). The five boroughs, the Bronx, Brooklyn, Manhattan, Queens, and Staten Island are each a smaller government entity within the city's broader system of government. Each has its own borough president and limited governing powers, plus its own culture and reputation, and each overlaps with a county of New York State and has its own district attorney (Keppler, 2016). For this research the term community will refer to citizens residing in each of the five boroughs as seen in Figure 9.

Figure 9 - The five boroughs of New York City

5.4 Grading on the Municipal Efforts to Increase Community Resilience

Although there will be no formal grading comparison of the two cities, overall the municipality of New York City seems to be putting more established efforts towards the development of a resilient community than Rotterdam. New York City is strongest in the areas of communication with citizens, and their education and training. One of the main vulnerabilities of New York is the component resources and can be attributed to a lack of funding for city initiatives and projects, as well as a large gap in economic opportunity between the rich and poor. Efforts by the municipality to improve the outcome components are largely in progress, but advancing well.

Following is the grading of the municipality of New York City and how it approaches the seven components in its policy, based on the information gathered from interviews with key policy makers and other stakeholders, key documents, participation in working sessions and conferences, as well as site visits (A1- Appendix). Each sub component is given a grade based on the scheme presented in the Methods section, in addition each of the seven components is given an overall grade.

Communication with Citizens

Score: Established - New York City scored established in the category of communication, the city has made this a priority area and has many projects and efforts that address the community. Although there are still portions of the population that remain uninformed the municipality is maximizing its efforts in this area, "We've been trying to work on how to, by doing layered approaches, reach people who don't necessarily come to community meetings" – Respondent 8.

Information Systems and Availability - In regards to the availability of accurate information on threats, the FEMA (Federal Emergency Management Agency) is developing updated flood risk maps that will be available this year. This action was largely in response to hurricane Sandy; before this the maps had not been updated before 1980. There is readily available information on how to understand these flood maps, weather related risks, information on insurance, as well as information specifically for vulnerable groups. The municipality also utilizes multiple information dispersal paths. The Office of Emergency Management sends out information on emergencies using: text messages (free for the public), broadcast media, newsletters, email, Facebook, Twitter, Instagram, LinkedIn, Tumbler, and YouTube. There is also a specific division dedicated to emergency messaging

for people with access and functional needs. In addition, the majority of the information is available in a wide variety of languages and formats.

Community – Municipality Information Exchange - One of the primary reasons for New York's high score in this area is their community board structure. Community boards represent numerous small jurisdictions of the city and these boards have a community liaison that communicates with the municipality. Respondent 8 said, "*There is a lot of community outreach that is done and community engagement with groups in the area, with community leaders in the area, whether they are from community boards or other organizations.*" The changes that each community sees, from new buildings to liquor licences, have to first go through the community board. In this sense there is already a better connection between the municipality and its citizens.

The information on risks and management is both shared amongst those at risk and its content and methods of communication are developed with communities. "*We have been working on communicating with the neighbourhoods that are in the flood zone about the changes that are coming. So we've done a tremendous amount of outreach. Going into the communities, appearing at community meetings, working with the community boards, working with the local officials, and going and doing presentations, answering questions.*" – Respondent 8.

Local Knowledge Utilization - In regards to knowledge flowing from the community to the municipality, at the research institutes community leaders are offered both the opportunity to take the courses, or to participate in teaching them. Respondent 7 said that, "*... the best lessons to be learned from Sandy would come from the community.*". However due to the large population of the city, and relatively small municipality, it is difficult for citizens to have their voices heard.

Education and Training

Score: Established - New York City scored established in this section because there are currently opportunities for both municipal workers and citizens to be trained and educated. However, there could be room for improvement and this area has been made a priority for the municipality.

Training for Citizens and Municipality - There are many programs offered by the municipality, or funded by the municipality and offered through a community based organization. There are, "*meetings at city hall, trainings, for elected officials and also for community leaders and community board organizations.*" – Respondent 8. One example is the "Build it Back Program", a home recovery project that was created after Hurricane Sandy and works with the community to ensure that they understand flood insurance. In addition, the CERT (Community Emergency Response Teams) which are volunteer based, are all fully trained. The Office of Emergency Management also has a lot of programs and training sessions available.

Municipal workers at the Office of Resilience and Recovery are at times requested to speak about climate related issues, and for these occasions they are offered internal training. There is also training available internally for government employees at other agencies besides the Office of Resilience and Recovery.

Education for Citizens

One of the roles of the Office of Emergency Management (OEM) at the municipality is educating New Yorkers about preparing for emergencies. Its 'Ready New York' community-outreach program educates city residents about hazards such as coastal storms and flooding, and encourages the public to prepare for emergencies. Many of the educational opportunities are offered through private institutes, that work with community based organizations (CBOs). However, these community based organizations receive the majority of their funding from the municipality. The research institute Pratt offers the community courses focused on community solutions or technical solutions geared towards resilience, as well as community board fellowships in which students are able to work on many of the Brooklyn community boards. They also offer interdisciplinary courses for community

members and teaching opportunities. This component is closely related to communication, as education and training of citizens helps transfer knowledge to them as well as spreading their knowledge.

Governance

Score: In Progress - New York City scored in progress in this section because they are doing very well in the area of community boards and strategy development, however there are some tension between public and private sector as well as areas to address in coordination.

Internal Coordination - The municipality has a well integrated system (A5 - Appendix), the Office of Resilience and Recovery is tasked with working across all of the agencies in the city, "*because we're housed in the mayor's office, all of these agencies to build in the resilience thinking into everything they do.*" – *Respondent 8*. However, it is hard to say to what extent they really coordinate across all agencies as this is something many municipalities struggle with. New York has a climate change task force which is housed within the Office of Resilience and Recovery. The task force was created to work with community groups and shore up the relationships between the city and those community organizations in order to bolster community resilience. There is also a community social resiliency team in the office, they work with community groups, and small business, and work force development.

However due to this large number of state level sustainability initiatives, the fact remains that they exist within multiple state agencies, and are largely uncoordinated (Salkin, 2009). In addition, several of the agencies and authorities within the municipality have overlapping responsibilities and objectives for climate change programs. In a report done by the University of Colorado Law Review it was found that there are a lot of bills introduced that address a variety of programs, such as energy efficiency loans or renewable energy expenditure, however none of these bills contains proposals to streamline and coordinate the state's various sustainability programs (2009).

Partnerships - Due to the structure of the United States there is a great divide between public and private institutions. In NYC many of the private institutions do communicate frequently with the municipality. For example, the RAMP (Recovery, Adaptation, Mitigation, Planning) program created by Pratt is something that the municipality's Office of Resilience and Recovery is involved in. However sometimes issues of funding and control can make this communication very tense. Difficulties arise in areas of project cross over, where the municipality is providing funding and private organizations are trying to involve citizens.

One of the significant partnerships that the City of New York has is the NYC Climate Change Adaptation Task Force, which provides a forum for middle level administrators and officials to discuss and debate new knowledge and information about climate change impacts and adaptation opportunities. The Task Force includes representatives from all the relevant city agencies, as well as quasi-public regional entities such as the Metropolitan Transportation Authority and the New York–New Jersey Port Authority, and selected private transportation (i.e. railroad companies) and telecommunications companies (e.g. mobile phone service providers) (Solecki, 2012). The task force also enables climate change discussion among stakeholders beyond the political boundaries of New York City, to include representatives of regional organizations such as commuter rail authorities and communications companies, thereby facilitating opportunities for regional coordination, with New York City as a leader (ibid).

Community Boards - New York City has a community board for each constituency, as mentioned previously. These boards are the smallest form of government, they only have so much power and only certain things pass in front of them, but they are closely connected with the community and can therefore voice the opinions of more vulnerable groups that may have been lost before. "*They can be very vocal in pressing elected officials at the council district level, so we have council members and there is a whole city council for New York, and the city council has a speaker, and then above the speaker is the mayor. So that's kind of like the division. With many things like*

the ORR that you went to visit, they're sort of on par with other city agencies, transportation, water utilities" – Respondent 7.

Strategy Development – After Hurricane sandy the city of New York considered implementation of 'hard measures', similar to those used in Rotterdam. These measures would include actions such as shoreline armouring including sea walls, jetties, breakwaters, bulkheads and piers, as well as actions to bulkhead the entire waterfront. Many of these hard structures, although effective over the short term, can lead to shifts in the physical systems that undermine their long term effectiveness. For example, sea walls and bulkheads, a common form of shore protection in the city and extended metropolitan region often intercept wave energy, increasing erosion at their bases which eventually undermines them (Solecki, 2012). In addition the city recognizes that these types of measures would not adequately address the risks, would be costly, and have negative ecological consequences for the waterways and coastal areas (City of New York, 2011).

Resources

Score: Marginal - New York City scored marginal in this component because although there is a large research body, there is a lack of consistent funding as well as large gap between rich and poor people that only exacerbates economic issues.

Funding - Many of the recovery groups and community based organizations rely heavily on funding support from the municipality or other donors. In many cases there are limits to their innovation because they need to fit into the funding organization's budget. Private organizations generally do not receive any funding from the municipality, but they work in parallel with the work done by the state and try to educate the community about the state work.

Despite the numerous programs and initiatives developed to address human rights, only sporadic public financial support exists to carry out these programs (Pratt Institute, 2015). In addition given the partisan/political divide on the national level, the federal government cannot be relied on for any financial support for human rights related activities, (Pratt Institute, 2015) which often are tied to environmental disasters. The exception has been funds allocated to the city in response to Superstorm Sandy, however these funds would have been better utilized had they been issued before the storm for pre-emptive measures. The city is dependent on its own revenue sources and ability to leverage private financial sources. The 2008 global economic crisis and resulting recession in the US dramatically impacted NYC's climate adaptation efforts (Solecki, 2012), as many of the scheduled plans had to be postponed due to reduced revenue streams. While city budgets have recovered somewhat with the increased strength of Wall Street's financial markets, money for ambitious, large-scale adaptation projects is still not present (Solecki, 2012).

Economic Opportunities - When New Yorkers were asked what the most important issues that the city government should be addressing are, the top three issues identified were Education, Housing, and Public Safety (City of New York, 2015). There is an ever widening gap in New York, and the USA in general, between rich and poor people, and as consequence to this gap there are some very poor areas of New York City in which gentrification is a constant concern. The residents of these areas know that if they have a better flood protection system, or more resilience projects, it will be come more desirable to live in that area and their rents will increase. Therefore, they would rather live in a more flood prone area where rent is lower. One approach NYC is taking to tackle this program is inclusionary zoning that requires in certain areas the developer set aside a fixed percentage of units for low/moderate income families (Pratt Institute, 2015).

In addition, one of the side effects of citizens' increased awareness of flood risks, as well as the updated flood risk maps, is that some individuals, communities, and businesses that previously did not consider themselves to be at risk now do. This comes with challenges with respect to potential liability (i.e. what is the city's responsibility

vis-à-vis protecting citizens and property from this risk) as well as to changes in private property values (i.e. properties with projected increased risk of flooding might incur a loss in property value).

Research - In regards to research the city has its own panel on climate change, the NYCPCC, which creates climate projects that are city specific. The New York Panel on Climate Change (2015) recognizes that throughout all recommendations for climate resiliency it is essential to facilitate an ongoing and continuous process of stakeholder—scientist interactions with cross-linkages between the NPCC, other experts, the city, the other municipalities of the New York metropolitan region, New York State, relevant agencies of the federal government, and the U.S. National Climate Assessment. One a side note, there was debate over whether or not scientists should be involved in the programs and what the of consequences of that would be. There is worry that they would actually detract from initiatives because people in poorer areas don't care as much about the science, or might find it intimidating.

Public Awareness

Score: In Progress - New York City scored a rating of medium in this first criteria. The city's residents have a relatively high level of awareness, largely due Hurricane Sandy, however the task is to continue engagement of communities, as well as raising the awareness of more vulnerable populations.

Awareness - New York City has a large number of community lead actions aimed at the promotion of awareness, knowledge, and skills and the availability and dissemination of information relating to climate change disasters and preparedness. There are also campaigns to increase the possession of appropriate knowledge and skills for disaster response actions at a local level by individuals of the community. The city places a greater emphasis on the promotion and encouragement of community lead actions, both through the availability of funding for these programs, and also by keeping community resilience high on the agenda and ensuring that it is integrated into policy. Community and individual preparedness is incentivized, such as individual efforts to become educated, prepared, and to help motivate and inform others within the community such as neighbors, family members, and members of social, cultural, and religious groups. Local organizations and community members encourage families to develop response plans to designate locations and any action steps for reuniting after a disaster.

Disaster Influence - One thing that makes New York a unique case study is that the city has recently witnessed a large climate event, which has generated greater awareness in the citizens. Although even with this event, according to Respondent 8 there is still a minority of the population that still believe, "*we've had our one disaster and now I can move on with my life*". In addition, the city will need to work to keep the hurricane and its impacts from being forgotten over time, and having people shift back to previously unsustainable or un-resilient ways of life. "*There is still a long way to go, in variables such as awareness. Those that were affected by Sandy are aware, but there are still a lot of people who don't have a clue.*"- Respondent 9.

Urban Identity

Score: Established - New York City scored established in this section because although there are some issues with income inequality there are high levels of social cohesion as well as intrinsic motivation amongst citizens.

Social Cohesion - New York is a city of numerous cultures and economic diversity that have in the past been segregated by class, ethnicity, race, as well as income inequality as mentioned previously. However the present administration led by Mayor de Blaisio are collectively more focused and supportive of human rights related issues and programs that any city administration in the last three decades (Pratt Institute, 2015). This is shown

in the report "One New York" (City of New York, 2015), where Mayor de Blasio has added the issue of equity and human scale development to the environmental and sustainability focus.

In NYC, and the whole of the United States in general, the government is not as involved in its citizen's daily tasks. In the event of financial or health trouble citizens turn first to family and neighbours; the dependence is not on the municipality so much as it is on each other. These pre-existing relationships, built from years of contact, are critical for communicating needs, sharing resources, and passing along critical information before, during, and after an emergency (Williams, 2014). Groups and individuals with strong networks across their community can help connect resources and identify those in need. This also aids in the integration of different cultural groups.

Intrinsic Motivation - The municipality and private organizations in NYC really value the contributions of its citizens, "*We really took this approach that the community knows best, because they were the first responders, before FEMA and before all that relief work came, they were there and communicated. So the best lessons to be learned from Sandy would come from the community. So that was kind of the genesis of RAMP, was to really focus our studios, which we do anyways, with clients, on the most vulnerable communities in the city of NY.*". This emphasis really puts the community first, and better enables community resilience building.

Participation

Score: In Progress - New York City scored in progress in this section because they have a very large amount of community participation and are involving community leaders. In addition, the community boards are made up of a diverse population group, although there is a chance that not all of them are having their voices heard.

Community Involvement - There are many community lead groups, as well as community members that want to join the effort. The community based organizations contact private organizations to help organize community lead events. There is also a lot of community leader involvement, Respondent 8 said "*The planning team works on some of the bigger projects that are going on right now, like east side coastal resiliency, which is part of protecting the part of lower Manhattan. There is a lot of community outreach that is done and community engagement with groups in the area, with community leaders in the area, whether they are from community boards or other organizations.*" A consequence of the large number of initiatives and organizations involved in climate change related projects, is a tendency to over plan. Respondent 7 said, "*I think there is a lot of opposition to over planning. So people get tired of participating in visions, and plans, and meetings, when they don't see anything.*". This deters people from attending planning related project events.

Vulnerable Populations - There is a diverse group of people are being reached by the municipality. There are over 70 community based organizations the municipality has contact with, which focus on people in flood risk areas. In addition, there is good turnout at community meetings. However, within the community boards there is a diversity of cultures and vocations, but from the municipality's perspective these boards are made up of '*mostly old white people*' said one of the respondents. This indicates that perhaps it is only certain ethnic groups, that are having their voices heard by the municipality.

6. MAIN FINDINGS, DISCUSSION, AND CONCLUSION

Main Research Question (Sub Question 3 - Main Findings): What components should the municipalities of Rotterdam (NL) and New York City (USA) include in policy in order to build community resilience to climate change disasters?

Components developed from framework: (1) Communication; (2) Education and Training; (3) Governance; (4) Resources; (5) Public Awareness; (6) Urban Identity; and (7) Participation.

Components developed from case study exploration: (8) Community Leaders; and (9) Strategy.

This section is a synthesis of the findings from the individual comparisons of Rotterdam and New York City with the framework developed. What follows is an elaboration of the new components developed from the case study exploration and highlights. New components appeared during the case study exploration as critical to implementing community resilience in municipal policy, but were not present in the current framework. Highlights were components found during the grading to be weak/strong areas for both Rotterdam and New York city. Following this are general recommendations for the improvement of community resilience by municipalities.

6.1 Main Findings

New Component: Strategy

One area that Rotterdam excels in is promotion of its international image, it is a city of world renown projects. One reason for this is to gain international funding support, however it seems that a project's image at times can take away from its success in the long run. This differs from NYC, where the focus is not on physical projects, but on creating a stronger network. One reason for this could be the fact that NYC has faced a recent climate disaster, hurricane Sandy, which really puts the focus on creating quality resilience projects. Rotterdam has not had a large climate disaster in many years, so the concentration can be on quantity and on image. In the new Resilience Strategy published by Rotterdam, out of all 68 actions presented in the strategy, only one of them is long-term, with the vast majority of them being short term new solutions. The amount of pilot projects also brings into question the level of learning, why they are not being followed through on, or put into further policy. This focus on international image and project creation can be seen when comparing the climate adaptation strategies of New York and Rotterdam (Figure 10). The NYC strategy includes words such as neighborhoods, support, and community, whereas the Rotterdam strategy includes words such as developments, and strategy. The importance of strategy could be a new sub-component in governance, it relates to other components: communication, both on an international and local level; resources, relating to funding support; as well as disaster influence in awareness; and urban identity.
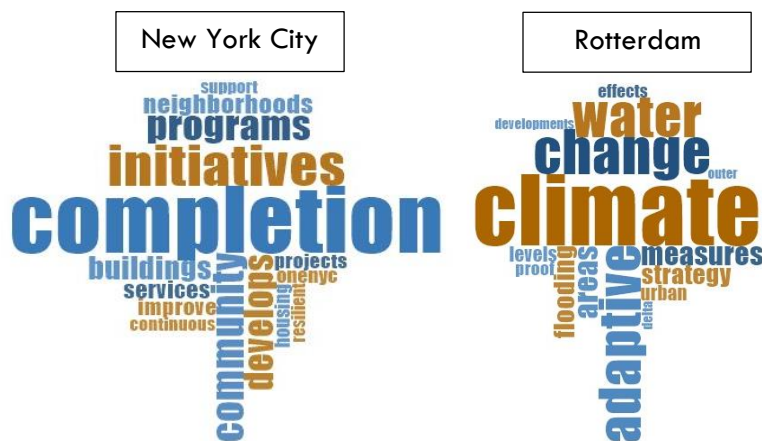

Figure 10. Rotterdam Climate Change Adaptation Strategy and NYC Plan are compared with a word frequency query in NVivo including stemmed words and a minimum word length of 5. NYC on the left, Rotterdam on the right.

New Component: Community Leaders

After investigation into both case studies the benefits of community leaders are clearly shown. This concept was first mentioned in a pilot interview with Respondent 2 where the importance of these leaders was underlined,

and it was clear that without community leaders it would be next to impossible to reach all of the most vulnerable populations. After further communications with respondents from both cities it was clear that having community leaders, and especially utilizing these leaders, is a crucial part of building the capacity of a community. In NYC the use of community boards has been especially helpful in facilitating better communication with the community. The importance of community leaders relates to the tool components: education and training, in the area of citizens as first responders; and communication, in the areas of exchanging local knowledge with the municipality. It helps promote the outcomes: Public awareness, as more information can be exchanged; urban identity, as community leaders can help promote social cohesion in an area; and participation, especially in the involvement of vulnerable stakeholders

Highlight: Participation

One problem that both case study cities face is the inclusion and involvement of populations, whether that be raising their awareness, or raising the participation levels. This is especially prevalent in areas of the city that have lower income populations where citizens' main concerns are centred around economic and health issues, not climate resilience. In these areas many citizens do not have the time to come to meetings or participate in events, nor are climate issues their primary concern. In some cases, the people in these areas are even opposed to any resilience building efforts because it may result in gentrification of their area. One way that NYC was able to overcome these issues was to ensure that programs implemented in these areas include incentives, from food supplied at meetings, to full employment projects. The issue however is that often citizens will not bother to access the information if there is no need, which relates to the disaster influence, "*This is when I want to find information, only after the event.*" – Respondent 6.

Highlight: Governance - Accountability

In both municipalities delegation of responsibility and accountability is to some extent a problem. For example, in Rotterdam the matrix structure of the municipality is such that employees are involved in many areas at one time, which can result in poor clarity of responsibilities. Because of this, pilot projects are not properly evaluated and lessons learned not documented. This has caused the city to become a city of pilot projects with few long term strategies. In addition, there is overlap in numerous policy documents created, but little realization of the boundaries of each project, and who is accountable for what. One method NYC uses to combat this is to release an evaluation of its climate change strategies every year in the form of a public progress report. Low accountability and clarity of responsibilities results in low success of the projects developed to address community resilience.

Highlight: Urban Identity – Social Cohesion

Due to different forms of governance as well as disaster influence, NYC and Rotterdam have very different levels of social cohesion, which is a form of social capital that heavily influences the level of community resilience. The Netherlands is more of a welfare state; taxes are high but citizens are taken care of and provided for. This means that usually in Rotterdam the municipality is the first point of contact for citizens when there is an emergency or when they have a question. In the USA the government is less involved with its citizens, and the society is more capitalist based. Due to this form of governance citizens in NYC cannot fully rely on the municipality to provide for them, thus there is a much higher reliance of one citizen to the next. This reliance promotes social cohesion and community integration, which heavily impacts levels of community resilience. Pre-existing habits of communication and interaction allow greater transmission of information, coordination, and distribution of resources during an emergency, which was seen in many communities following Superstorm Sandy "*Maybe that is the culture difference between the Netherlands and the US, we are not very community oriented. In the US there are way more volunteers… we have the municipality. In the communities there is not much social cohesion*" said Respondent 6 about Rotterdam.

6.2 Recommendations for Municipalities

These recommendations incorporate findings from the framework creation and from the case studies. They address key issues that inhibit a municipality's ability to increase community resilience to climate change disasters. With these implementations both Rotterdam and New York City, as well as similar municipalities should be able to better include community resilience in policy.

Creation of a Project Management Group.
Components: Governance (Accountability), Governance (Strategy), Communication (Information Exchange), Participation

- Will consist of all project leaders, and a few other key stakeholders.
- Can create one consistent monitoring/evaluation system for all projects
- Will reflect on and evaluate published municipal strategies/documents
- Can consolidate all of the various policy documents so that information provided to the public is coordinated and consistent across all responsible organizations
- Can ensure effective project delivery by establishing a process of project prioritization whereby multiple projects can have simultaneous oversight so that resources (funds, people) can be allocated appropriately and project execution (timing), can be effectively managed

Creation of Project Leaders

Components: Governance (Accountability), Governance (Strategy), Governance (Internal Coordination), Communication (Information Exchange)

- One or two project leaders for each resilience related project
- Can delegate tasks to specific groups, but will keep an overview of all goings on
- Can communicate about the project to the municipality, citizens, and other groups
    - Use of social media, email, in person meetings etc.
- Will lead coordination within the municipality
- Is responsible for the project from start to finish
- Is held accountable, to some extent, for the project's success
- Will monitor the project as it progresses (Where do we stand, what else needs to be done?)
- Will reflect on the project once completed (What are the lessons learned? Should this project enter the next phase? How?)
- Will help to involve all stakeholders (Can appoint a community leader)

Creation of designated Community Leaders

Components: Participation, Awareness, Urban Identity (Social Cohesion), Community Leaders, Communication (Local Knowledge), Education and Training

- One or two people designated by the project leader at the beginning of a new project
- Someone who is educated and connected with the community
- Will communicate with the project leader and with citizens
- Will bring communication to a more local level, especially to vulnerable populations
- Will be in charge of educating the community about the project
- Will communicate about what people can do for themselves (Can facilitate training exercises if needed)

Data Base

- Central location for information on all sustainability and resilience related initiatives
- Incorporates input from multiple public officials by integrating information from scientists, emergency responders, officials and community leaders with appropriate training.
- Central location to capture project learnings from the evaluations to ensure lessons are easily accessible and shared for the benefit of future projects.

7 DISCUSSION AND CONCLUSION

This section will address the research question posed, other research in this area, unexpected findings, main findings, limitations, recommendations for future research, and concluding remarks.

7.1 Discussion

Answering the Research Question

Community resilience is an important issue that is not being address to its full extent in municipal policy creation. Part of the reason for this is that community resilience is an abstract and qualitative concept. It is not a matter of just building a storm barrier and having the problem solved, people are complex and need tailored solutions. The problem this study initially posed is that although the importance of having resilient communities is clearly recognized by governments and researchers, the components that a municipality should address to contribute to their creation remain unclear, and are therefore not being addressed to the extent that they should be in climate resilience policies. In order to better explore this issue, a more specific research question was formulated: What components should the municipalities of Rotterdam (NL) and New York City (USA) include in policy, in order to build a community that is resilient to climate change disasters?

This study answered this question and addressed the initial problem posed through the development and testing of a community resilience framework. The framework is specific to resilience building at the local government level, in this case municipalities, and what they can do to increase resilience at a community level. The developed framework outlines the components that a municipality should address in its policies in order to build a resilient community, as based on a literature review. These are: (1) Communication; (2) Education and Training; (3) Governance; (4) Resources; (5) Public Awareness, (6) Urban Identity; and (7) Participation. After testing this framework through the use of two case studies some of the highlighted components and their sub components were: Urban Identity (Social Cohesion); Participation; and Governance (Accountability). In addition, the new component Community Leaders as well as sub component Governance (Strategy) were discovered.

Addressing other Research

This research has similarities to other studies, which can be seen in the development of the framework, which synthesizes similar components mentioned in other research. Although the current level of research being done on community resilience is not insignificant, the majority of it focuses on work being done by non-governmental organizations, which is a knowledge gap this research contributes to. There are a few key documents on community resilience that specify municipalities, such as the United Nations document "How to make cities more resilient - A handbook for local government leaders" (2012). This document corroborates the findings in this research, and the recommendations made in this paper are closely linked to the '10 essentials for community resilience' outlined by the United Nations, such as the first essential "*An Institution and Administrative Framework - Put in place an organisation and coordination to understand and reduce disaster risk, based on participation of citizen groups and civil society. Build local alliances. Ensure that all departments understand their role in disaster risk reduction and preparedness.*" (2012, pg. 26).

In the paper by Salkin (2009) "New York Climate Change Report Card: Improvement Needed for More Effective Leadership and Overall Coordination with Local Government" there are several recommendations made for municipal action, and although the research is not specific to community resilience they also corroborate the results found in this study and the recommendations made. Salkin's (2009) recommendations include:

- Creating a central location for information on sustainability initiatives at all levels
- Creating a state climate change officer position
- Cataloguing state and local climate change laws
- Establishing benchmarking programs to measure the success of different types of municipal sustainability programs
- Establishing a state local climate change task force to study and recommend best practices

In addition, the paper by Runhaar et al. (2012) touches on a lot of these similar issues in a study of barriers and stimuli to climate change adaptation in Dutch urban areas. Runhaar et al.'s research found that the most often mentioned barriers to problem recognition of heat stress are: unawareness; a lack of local projections; a lack of legal obligations; and in some cases the expectation that the phenomenon will not occur. The main barrier was identified to be the absence of a clear 'problem owner'. This main barrier relates closely to the problem of lack of accountability and leadership found in particular in the case study of Rotterdam in this research. The main stimuli for urban planners who have actively explored the phenomenon of heat stress and who were interviewed in the Runhaar et al. (2012) study are curiosity, ambitions to be seen as 'adaptation leaders', support in the form of funding and knowledge, and existing policies related to climate change to which heat stress could easily be linked. These are closely tied to the components developed in the framework for this research, linking to specifically to: Resources; Education and Training; Communication; and the new component found – Community Leaders.

Other stimuli found by Runhaar et al. (2012) include: ambitions for cities to be seen as adaptation leaders; the wish to remain an attractive location for companies; restructuring plans providing windows of opportunity; public pressure; and unclear responsibilities for dwellings around dykes. These stimuli relate to the Governance (Strategy) component found in this research, in particular the ambition to be seen as an adaptation leader is a main stimulus for Rotterdam, and the public pressure could be seen as a main stimulus for NYC after the devastation of Hurricane Catrina. In addition, Runhaar et al. (2012) showed in their study that private actors are only involved to a limited extent in local adaptation policy, and therefore, the general public is hardly aware of flood induced risks.

Contributions and Future Research

This research synthesised a very large body of previous research on resilience, and applies it to both the community context as well as making it municipality specific. This framework can be used in practice by municipalities to ensure that they are addresses all of the necessary components to contribute to a resilient community. In addition, municipalities can use the snapshot of how municipalities of Rotterdam and NYC currently deal with issues of flooding and community resilience developed in this research to contribute to their own municipal strategy. Third party organizations can also use this research in practice for further comparisons or evaluations. This research will also contribute to community resilience building by showing policy makers the importance of accountability and responsibility in project success as well as the importance of involving community leaders.

Further research could develop the framework created in the study and test it in different city contexts. A future framework should include the new components developed as well as research further into these components. In particular, this research yielded new questions that relate to the impact of community leaders to community

resilience, and community leaders as enablers of community resilience. The new component Governance (Strategy) and the influence of disasters should be investigated. In relation to the component participation, its relation to awareness and disaster influence should be studied further, and in particular methods for municipalities to involve these more vulnerable populations.

Unexpected Findings

The unexpected findings of this research came through the investigation into Rotterdam and NYC, and resulted in new components that should be added to the developed framework. The first of the new components discovered was the importance of community leaders in community resilience projects. This factor was addressed in the literature review and the component came up in a few studies, but initially it was not explicitly found to be a major influence. However, the concept was mentioned numerous times in interviews, as well as being part of a successful project implemented in NYC and Rotterdam. Related to the importance of community leaders, is the concept of leadership in general. It was unexpected to find how much a lack of accountability or vague levels of responsibility within the municipality could impact levels of community resilience, as the two seemed to be distant concepts at first. The other new component added was Governance (Strategy), which relates closely to disaster influence and international promotion. This component is applicable in particular to Rotterdam, a city that was chosen for this study because it seemed to be a leader in resilience and climate change related measures, especially related to flooding and precipitation. Although the city is still undoubtedly a leader in resilience efforts it is unclear how far the newly proposed initiatives in the Resilience Strategy will really go, and how much of it is window dressing for international promotion.

Main Finding

All of the findings in this study are relevant and important in their own respect, but there is one overarching main finding which relates closely to the unexpected findings mentioned above. Mainly, that in order to build community resilience, leadership is needed at both the community level, and the municipal level. This finding encompasses the notion that even when community resilience is placed high on the political agenda, actions will not be successful without high levels of accountability and responsibility within the municipality. In addition, in order for a municipality to increase its community resilience it must have high levels of communication with the community and coordination within the municipality itself. These two factors determine how much information the community receives, as well as the success of projects in the community.

Limitations

The limitations of this study were most significantly related to the fact that this is a master's thesis, and not a PhD dissertation or larger study. With more time there could have been more interviews done, and more data collected for the case studies. The sample size was a limiting factor for this research, with the addition of more case studies the results would be more generalizable. It would have been very interesting to delve into some of the community resilience projects on an individual level, as well as to further explore the sub components within the framework. Mainly, it would have been very interesting to further investigate into the issue of leadership and responsibility within the municipalities. A more practical limitation was language, many of the results relating to Rotterdam were in Dutch and so they were harder to find. In addition, it was harder to get interviews for New York City, due to geographic distance and lack of contacts.

One of the largest limitations was self-reported data, and the fact that this research cannot be duplicated or independently verified to the full extent. What people have said during interviews, working sessions, and conferences was taken at face value and most probably certain biases. There is risk of attribution, attributing positive events and outcomes to one's own agency but attributing negative events and outcomes to external forces, as well as exaggeration. In addition, the fact that this research was part of an internship at the

municipality of Rotterdam meant that more information was available for this case study and could have resulted in bias or misrepresentation of the city.

7.2 Conclusion

Community resilience has become a key policy issue which is being embraced at federal, state, and local levels. It is made an even more crucial issue in the face of a changing climate and increasing risks in urban areas. However, the development of a resilient community can be a difficult endeavor that requires effort from both the community level and local government level. This study investigated the way that a local government, in this case the municipalities of Rotterdam (NL) and New York City (USA), can impact the resilience of its communities. The results of this study include the seven components that a municipality needs to address when creating community resilience building policy as found in the literature, these are: (1) Communication; (2) Education and Training; (3) Governance; (4) Resources; (5) Public Awareness, (6) Urban Identity; and (7) Participation. After the case study analysis several new components were discovered: Governance sub component Strategy; and Community Leaders. As well there were highlighted components: Social Cohesion; Participation; and Governance sub component Accountability. Applying community resilience to climate change risks and in particular flooding, the most important issue that municipalities need to address seems to be leadership, in particular lack of an established project delivery process with specifically trained project leaders. Improvements to leadership in communities and municipalities can not only improve community resilience, but general project success as well as communication of all types of issues. Climate change impacts and their corresponding disasters are a risk to current as well as future citizens, and bolstering the resilience of citizens is a crucial part of decreasing their vulnerability to these risks. Municipalities need to take action to improve the resilience of their citizens to ensure a healthy and safe population.

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APPENDIX

A1 – A table detailing the type of observations made in order to complete the analysis of the case study cities.

Interview Respondent	Place of Employment
Respondent 1	Rotterdam Municipality
Respondent 2	Other (C40)
Respondent 3	Water Board
Respondent 4	Rotterdam Municipality
Respondent 5	Other (De Urbanisten)
Respondent 6	Rotterdam Municipality
Respondent 7	Other (Pratt)
Respondent 8	NYC Municipality
Respondent 9	Other (C40)
Respondent 10	Other (C40)
Conferences and Working Sessions	**Host**
Adaptation Futures 2016 Conference	City or Rotterdam
- Session: Mainstreaming Adaptation	Speakers from Rotterdam City, New York, and C40
- Session: Community Based Adaptation in the USA	Speaker from USA
- Session: Advancing city adaptation monitoring, evaluation, and reporting	Speakers from C40, Rotterdam City, Rio e Janeiro, Melbourne City Government and UK
- Session: Pathways to Resiliency – A co-creation workshop with expert from Rotterdam and New York City	Speakers from Rotterdam City and New York
Rotterdam Resilience Working session	Utrecht University
Site Visits	**Date**
New York City, USA	April 2nd – April 10th, 2016
Rotterdam, NL	January 1st – June 30th, 2016
Key Documents	**Type**
Resilient Rotterdam 2016	Most Recent Climate Strategy
One New York 2015	Most Recent Climate Strategy

A2 – **A list of the international organizations that both Rotterdam and New York City are a part of.**

100 RC

The 100 Resilient Cities (100RC) is a program pioneered by the Rockefeller Foundation, and is dedicated to helping cities around the world become more resilient to the physical, social, and economic challenges that are a growing part of the 21st century (Rockefeller Foundation, 2014). Cities that have been approved for the program are provided with resources to develop a resilience roadmap, these resources include financial funding for a Chief Resilience Officer to lead the efforts, and expert support such as access to partners, solutions and service providers (Rockefeller Foundation, 2014). Both Rotterdam and New York City were among the founding members of this program.

C40 and Connecting Delta Cities (CDC)

C40 is a network of forty of the world's megacities committed to addressing climate change, of which both Rotterdam and New York City are also members. Acting both locally and collaboratively, C40 cities are having a meaningful global impact in reducing both greenhouse gas emissions and climate risks. C40 brings together a unique set of assets and creates a shared sense of purpose. C40 offers cities an effective forum where they can collaborate, share knowledge and drive meaningful, measurable and sustainable action on climate change. (http://www.c40.org/).

The Connecting Delta Cities network is a network within CDC, created and chaired by Rotterdam, and which New York City is a member of, with a focus on adaptation and water. Connecting Delta Cities is a network of delta cities that are active in the field of climate change related spatial development, water management, and adaptation, in order to exchange knowledge on climate adaptation and share best practices that can support cities in developing their adaptation strategies. In order to manage the flow of information between the CDC cities, a small CDC secretariat has been installed in Rotterdam. (Molenaar et al., 2010).

Document

Connecting Delta Cities 2013

The overarching policy report for the CDC, describing their current and future initiatives and goals

Citation:
http://www.rotterdamclimateinitiative.nl/documents/Documenten/CDC_volume_3_Resilient_Cities_and_Climate_Adaptation_Strategies.pdf

Document

Cities 100

Sustainia, in collaboration with C40 and Realdania, presents Cities100. This publication is filled with successful city solutions showing that cities are taking action on climate change on a global scale.

Citation: http://www.sustainia.me/cities/ ,
https://issuu.com/sustainia/docs/cities100/47?e=4517615/31305566

A4 – A list of Rotterdam policy documents, programs, and organizations used for this analysis. A description of the current organizations and departments set up to inform citizens and create community resilience programs, as well as brief descriptions of some of the key documents produced.

Rotterdam Climate Initiative (RCI)

In addition to these other networks there is the Rotterdam Climate Initiative (RCI), a knowledge portal for the city meant to help spread awareness of climate issues in Rotterdam. Under the umbrella of the Rotterdam Climate Initiative, the Port of Rotterdam Authority, Deltalinqs, DCMR Environmental Protection Agency Rijnmond and the City of Rotterdam work as partners to enhance the sustainability of the city, the port and the industrial complex. Link: (http://www.rotterdamclimateinitiative.nl/uk/about-rci/rci-at-a-glance)

Program

Rotterdam Climate Proof (RCP)

Within the RCI is the Rotterdam Climate Proof project (RCP). Rotterdam Climate Proof is a brand, and the main project of Rotterdam Climate Proof is the climate adaptation strategy. RCP had two main tasks, to deliver an adaptation strategy, and that Rotterdam should be the number one climate and adaptation city. Now that the adaptation strategy has been published this program has largely become dormant.

Document

Rotterdam Climate Change Adaptation Strategy 2013

The Rotterdam Climate Change Adaptation Strategy (van Peijpe et al., 2013) provides guidelines for creating a climate proof city, what actions are intended and how the city will benefit.

Action

Water Sensitive Rotterdam

This action will develop and enhance existing programmes aiming to prepare the city for the impacts of climate change. Measures included within this action are in line with projects already completed in Rotterdam, and will be designed to support community learning – specifically in respect of understanding the urgency of the need to take action on climate change. We specially want to seed a new way of thinking. To not see rain water as a problem or a threat but to recognise it as a valuable raw material that should be utilized as much as possible locally. We want to move further towards fully integrated water cycle management – integrating the water cycle into our urban environment including collection (attenuation), treatment and conveyance. We will seek to related our climate change projects to other resilience actions and to publicise the synergies.

A5 - A list of New York City policy documents, programs, and organizations used for this analysis. A description of the current efforts to inform citizens and current programs, as well as brief descriptions of some of the key documents produced.

Mayor's Office of Recovery and Resiliency (ORR) and Mayor's Office of Sustainability (MOS)

The Mayor's Office of Sustainability (MOS) and the Mayor's Office of Recovery and Resiliency (ORR) oversee and implement the sustainability and resiliency initiatives in the 2015 document One New York: The Plan for a Strong and Just City. They work together with collaborators –agencies, organizations, and New Yorkers.

Under the previous administration there was one office of long term planning and sustainability, that was the office that put out PlaNYC. After Sandy the Special Initiative for Rebuilding and Resiliency put out a plan, which became the city's comprehensive plan for rebuilding and laid out the 257 initiatives. The office of long term planning were the source of the ORR and MOS. Both of these offices have the same director, so they work together a lot.

Mayor's Office of Recovery and Resiliency (ORR)

The Office of Recovery and Resiliency seeks to understand each impacted area's built environment, its buildings, man-made structures, and spaces, in order to have a clear sense of its unique strengths, vulnerabilities, and priorities. The ORR was originally started after the OneNYC document, and was using the initiatives in the document as its 'playbook'. It now does many other projects, some in collaboration with the MOS. Community rebuilding and resiliency efforts are focused on the following areas:

Neighborhood Rebuilding Plans, Economic and Social Assets, Community Preparedness, Flood Insurance, and Resources

Mayor's Office of Sustainability (MOS)

The Mayor's Office of Sustainability (MOS) addresses work in the following areas: Housing, neighbourhoods, parks and public space, transport, energy and buildings, waste and recycling, clean air water and land, and access and opportunity.

Document

One New York: The Plan for a Strong and Just City. (2015)

Originally released in 2007 under the name "PlaNYC," One New York: The Plan for a Strong and Just City (OneNYC) is a ground breaking effort to address New York City's long-term challenges: the forecast of 9 million residents by 2040, changing climate conditions, an evolving economy, and aging infrastructure. Resiliency is one of the four visions for this plan, released April 2015. The goals and initiatives outlined for Resiliency are our Office's current priorities

NYC Special Initiative for Rebuilding and Resiliency

In December 2012, the Special Initiative for Rebuilding and Resiliency (SIRR) convened to address the creation of a more resilient New York City in the wake of Hurricane Sandy, with a long-term focus on preparing for and protecting against the impacts of climate change. A final report, released in June 2013, presents actionable recommendations both for rebuilding the communities impacted by Sandy and increasing the resilience of infrastructure and buildings citywide.

Document:

2013 - A Stronger More Resilient New York

A comprehensive plan that contains actionable recommendations both for rebuilding the communities impacted by Sandy and increasing the resilience of infrastructure and buildings citywide. This is the original roadmap for Resiliency in NYC.

New York City Office of Emergency Management (OEM)

Established in 1996, NYC Office of Emergency Management is a coordinating agency for organizations and agencies involved in emergency planning, education, and information dissemination, for the City of New York. The agency plans and prepares for emergencies, educates the public about preparedness, coordinates emergency response and recovery, and collects and disseminates emergency information.

The OEM also provides assistance to the city's Community Emergency Response Teams (CERT) and New York City continues to look for opportunities to develop local community capacity and will work with local organizations to improve emergency planning and the flow of information following a disaster. The OEM maintains plans to deal with specific events. These plans include the Citywide Debris Management Plan, Power Disruption Plan, Flash Flood Emergency Plan, and Coastal Storm Plan these plans could be used to respond to disasters caused by climate change. (City of New York, 2011). The ORR and MOS work together with the OEM a lot. The OEM deals more with the acute hazards, disasters and emergencies, the ORR is more long term looking.

Document

> The Hazard Mitigation Plan (HMP) - 2014
>
> Created by OEM and DCP (department of City Planning). The Hazard Mitigation Plan outlines goals, objectives, and specific actions New York City can take to reduce risks. Part of the plan development process includes identifying what initiatives — mitigation actions — the City is taking (i.e., existing) or could take (i.e., potential) to minimize the effects of a hazard event on New York City's population, economy, property, building stock, and infrastructure. The comprehensive list of mitigation actions can be found in section 4 of the plan. http://www1.nyc.gov/site/em/ready/hazard-mitigation.page

Document

> NYC's Risk Landscape: A Guide to Hazard Mitigation? (2015)
>
> This guide is based on the 2014 Hazard Mitigation Plan but focuses on a targeted group of hazards that pose a risk to New York City and includes information on how the City approaches risk management in a user-friendly and accessible format. Hazards featured in the guide include: coastal storms, coastal erosion, flooding, strong windstorms, extreme heat, winter weather, water shortage, earthquakes, and pandemic influenza.

Program

> NYC CERT - Community Emergency Response Teams
>
> New York City Community Emergency Response Teams (NYC CERT) are groups of dedicated volunteers who help to prepare their neighbors and communities for different types of disasters. NYC CERT falls under the Community Outreach unit within New York City Emergency Management. During non-emergency times, NYC CERTs educate their communities about emergency preparedness by working with the Ready New York program and building community disaster networks through the NYC Citizen Corps program. The NYC CERT is a part of the FEMA CERT program, but more specific to NY. https://www.fema.gov/community-emergency-response-teams

Program

Ready New York – Education campaign

Ready New York is NYC Emergency Management's public education campaign. Through the program we encourage New Yorkers to learn about the hazards they may face in NYC and prepare for all types of emergencies by writing an emergency plan, choosing a meeting place, gathering supplies for their home, and preparing a Go Bag in case they need to leave their home in a hurry.

Program

NYC Citizen Corps – Outreach training for preparedness

Coordinated by NYC Emergency Management, NYC Citizen Corps is part of the national Citizen Corps initiative that seeks to make communities safer, stronger, and better prepared to respond to and recover from emergencies. Through outreach, training, and volunteer service, NYC Citizen Corps brings together leaders from volunteer programs, community and non-profit organizations, the private sector, and government to promote preparedness at the local level. The program is also behind National Preparedness Month, a month-long initiative that emphasizes the importance of being prepared for emergencies at home, school, work, and in the community. NYC Citizen Corps is an open network available to anyone interested in local disaster preparedness. Participation is encouraged from community-based organizations, non-profits, relief organizations, government agencies, and individuals of all backgrounds who have an interest in building resilience throughout NYC communities.

NYC Citizen Corps Goals:

• Prepare the public for emergencies through targeted outreach, with special attention to vulnerable populations and communities.

• Engage voluntary and community-based organizations in planning, developing, and sharing resources related to preparedness, public safety, and local emergency response.

• Host discussions and training workshops aimed at building the capacity of the volunteer and emergency preparedness community.

• Provide information, resources, and emergency updates through a communications network

New York City Panel on Climate Change (NPCC)

A group comprised of scientists who study climate change and its impacts as well as legal, insurance, and risk-management experts. In 2010 the NPCC issued Climate Change Adaptation in New York City: Building a Risk Management Response, which presented an iterative, risk-management approach to climate-resilience planning for both the public and private sectors that involves near- term actions and periodic re-evaluation of long- term risks and strategy. The NPCC – a body of leading climate and social scientists and risk management experts – is charged with advising the Mayor and the New York City Climate Change Adaptation Task Force on issues related to climate change and adaptation. The NPCC develops local climate projections for the NYC region. An overview of their most recent projections can be found here:

http://onlinelibrary.wiley.com/doi/10.1111/nyas.2015.1336.issue-1/issuetoc

Document

> NPCC 2015 Report Executive Summary

Center for New York City Neighborhoods

They manage FloodHelpNY: http://floodhelpny.org/ Their report on Rising Tides, Rising Costs reveals how rising flood insurance costs and increased flood risk threaten both the housing affordability and safety of the over 400,000 New Yorkers who live in neighborhoods at high risk of flooding along and around New York City's 520 miles of coastline. http://cnycn.org/risingtides/

Other Documents

Document:

> New York City Comprehensive Waterfront Plan – Vision 2020
>
> Developed March 2011. This plan is based on three general categories of resilience building: retreat, accommodation, and protection. However thorough, all three of these are focused on structural improvements. However, it does recognize the importance of communication and knowledge sharing between other governments, as well as education of citizens.

Other Projects

> Red Hook - An area with a lot of public housing, which means any resilience project needs to have an employment aspect. RETI Center and NY Rising

A5 – A figure depicting the New York City climate change action structure, from Solecki (2012)