Innovation and Implementation Pathways for Urban Climate Change Adaptation

Throughout the world, climate change is influencing the water cycle. Precipitation patterns are changing and there is an increase in the frequency and severity of extreme events such as droughts and floods, all of which affect human livelihoods. Additionally, urbanisation will adversely affect the urban water cycle. Today, more than half of the world’s population live in an urban area, and this is projected to increase. Urbanisation puts stress on the freshwater security of supply and quality, and it also increases the load on infrastructure such as storm- and wastewater systems. In order to survive and thrive, cities are therefore making and implementing adaptation plans. Existing urban environmental, human and technological systems are flexible to some degree, but there is still a limit to how far existing systems can be adapted. In the face of such monumental challenges, radical innovation is bound to happen. Cities’ adaptation plans however vary greatly in regards to the scope of adaptation, by either following existing paradigms or outlining new radical ones. Little is known about how cities go through such changes, how systemic change is initiated or what actors play which roles. This project therefore examines how the work and interactions of actors in urban water management contribute to innovation and the implementation of multifunctional solutions for climate change, using Copenhagen as a case. In the last ten years, Copenhagen has experienced a series of extreme rain events. As a result, over the last six years, the city has published, improved and started implementing a cloudburst management plan outlining a combination of grey and green stormwater infrastructure, above and below ground, to create multifunctional solutions. Semi-structured interviews and focus groups were conducted with professional actors working with climate change adaptation in the urban area of Copenhagen. The qualitative data were collected in three interconnected rounds, thus allowing for the validation and testing of preliminary hypotheses and results. The research builds on the evolutionary perspective of innovation system theory in the study of changes in the City Innovation System, and innovation system theory has therefore been part of the data collection and analysis.

Innovation system actors in Copenhagen define climate change adaptation in different ways. The dominant discourse, however, is that climate change adaptation is a combination of alternative above-ground and traditional below-ground cloudburst solutions, set within a surface water catchment system and designed both to prevent damages and to generate day-to-day values for the citizens. The actors use the terms traditional and alternative with reference to the legal use of the terms usual and alternative solutions. However, both the legal and the actor’s definitions of the terms are ambiguous. In order to combat the ambiguity, this thesis proposes a novel inclusive framework for characterizing climate change adaptation according to three features: event magnitude (extreme, design and everyday domain), spatial scale (international/national, urban and local scale) and a range of goal categories (innovation; urban; water quantity; water quality; nature; economic; health and safety; social; aesthetic expression; and multifunctional goals).

This thesis concludes that the core group of actors in the City Innovation System includes the traditional innovation system actors, private companies and knowledge institutions, but it also includes utility service providers. The study showed the utility service providers as key actors who play a central role, because in the development process they function as a sparring or financing partner, and in the diffusion process they are considered a large customer or they provide links to other customers, i.e. local authorities and private citizens. The Copenhagen City Innovation System is showing signs of change through a new paradigm for climate change adaptation, what this thesis names the optimised system. The Copenhagen case is in accordance with existing theory, in that systemic changes towards a new technological trajectory are influenced strongly by external shocks, i.e. localised extreme weather events; however, a base of existing niche work is needed to catch the opportunity when it arises. As a novelty this thesis shows how risk perception plays an important role in the collaborative learning process following the extreme events. In Copenhagen a series of cloudburst have changed the public and professional risk perception and helped create a solution span for climate change adaptation for pluvial flooding. The study shows that actors in the optimised system paradigm implement below- and above-ground solutions for a range of event magnitudes; they value efficient systemic and locally adapted solutions, aiming to improve the interplay between the existing water management system and a range of new solutions. Informed system actors, both inside the optimised paradigm and outside, work with breaking and creating new institutions. Several actors are advocating for changing existing regulation and norms, which do not match the new paradigm of the optimised system. Additionally, the new knowledge paradigm and responsibility norms are now being codified and appearing in internal notes and public standards. Copenhagen is slowly transforming, as climate change adaptation are being implemented throughout the city. However, in Copenhagen a full transformation of the urban water system has not yet happened. The change process is currently at an unstable early phase partly explained by the strong path dependency of the existing drainage system.