Dealing with Weather Extremes in a sustainable Design of the City (using advanced IT tools)
Nelen & Schuurmans

› Knowledge Bureau on Water & IT, based in the City of Utrecht
› Staff: 75 people (MSc & PhD)
› IT-services
  › Lizard: data warehouse and analytics platform
  › 3Di: hydrodynamic modelling instrument
› Consultancy-services
  › Climate and Environment
  › Urban Water Management
  › Energy and Operational Systems
  › Flood Risk Management
  › Water & Agriculture

*The Old Canal in the center of Utrecht*
The team in Taiwan

Kuan-Wei, Chen

Yung-Chia, Hsu

Meeting with Prof. Liu
Commissioner of Taoyuan, 2018
Welcome, introduction

The challenges for the urban planner

More data ...

... and how to use this to get better insight?

The next generation modelling tools

Example: Flood modelling in Tainan

Towards a new design approach
Globally, over 50% of the population lives in urban areas today. As cities grow, and severe weather conditions will continue to intensify, flood risks and drought risks in urban areas will drastically increase.

The economic risks due to coastal, fluvial and pluvial flooding is estimated by the WB at trillions of dollars. Heat waves and droughts have great impact on the quality of life in the city.

Building inclusive, healthy, resilient and sustainable cities requires intensive policy coordination (with all stakeholders involved) and well-founded decisions on the possible solutions and the large investments needed to reach our goals.
Increased awareness of coastal, fluvial and pluvial flood risks, and other effects of extreme weather conditions - among decision makers, engineers and the public - is critical to prevent devastating loss of life and property worldwide.

To create this awareness and to build resilient and sustainable cities, we need better information to understand the risks and to make the right decisions.

Due to the complexity of the urban environment, we need better tools to help assess the available data and information.
We gather a lot of data. The terms IoT, Big Data, ML, AI, and others (see figure) have become very trendy.

Every design or analysis has always been “data driven” (for centuries !)

Added value (= better insight) can be created through data integration and new analysis techniques. The possibilities for this are increasing very rapidly.
Proper mapping of all characteristics of the city and monitoring of weather and water system is very important, but not enough to understand the behavior of the system and to predict the effect of measures. This requires *data integration* and *integrated systems analysis*.

<table>
<thead>
<tr>
<th>Characteristics of the City</th>
<th>Water System Components</th>
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<tbody>
<tr>
<td>Rainfall</td>
<td>Groundwater</td>
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<td>Evaporation</td>
<td>Drains</td>
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<td>Wind</td>
<td>Canals</td>
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<td>Temperature</td>
<td>Rivers</td>
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<tr>
<td>Terrain data</td>
<td>Sea (tide)</td>
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<td>Land use</td>
<td>Basins</td>
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<tr>
<td>Elevation</td>
<td>Retention facilities</td>
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<td>Vegetation</td>
<td>Water levels</td>
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<td>Buildings</td>
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<td>Structures</td>
<td>Energy consumption</td>
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<td>Vulnerable objects</td>
<td>Flows</td>
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<td>Roads</td>
<td>Pumping stations</td>
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<td>Traffic</td>
<td>Weirs</td>
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<td>Soil</td>
<td>Other assets</td>
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<td>Sewerage system</td>
<td>etc.</td>
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</table>
A sustainable design and management of urban areas require new design standards and methods; which are not based on a "design storm" or "design load" with a certain return period, but on risk assessment and risk management.

Observation 1: The implementation of ‘risk based’ standards requires time; Policymakers don't like to change and try to avoid uncertainty

Observation 2: The implementation of new design tools requires time; Engineers don't like to change and love known methods.
The next generation of hydrodynamic simulation software
Digitization can improve the quality and efficiency of decision-making (and therefore reduce costs)

**Awareness**
- Interactive modelling
- Communication
- Decision makers
- Engineers
- The Public

**Prevention**
- Integral modelling
- Better Insight
- Better Design
- Better Urban Planning
- Better Operation

**Response**
- Real Time Information
- Flood Early Warning
- Calamity management
- Restore measures
- Recovery
Flood risks in Tainan

A research into flood risk management in Tainan, in collaboration with the Research Center for Hazard Mitigation and Protection of National Central University (NCU), Taipei and the City of Tainan.

Fort Zeelandia
(Old Dutch fort, Formosa, 1624 - 1662)
Demo: Flood risks in Tainan

- Terrain (DEM)
- Storm sewer network
- Pumping stations
- Weirs + other structures
- Roads
- Buildings
- Landuse
- Weather data
- IoT sensors
Different data layers

- Landuse
- Farms
- Business, industry and households
- Roads
- Buildings (topographic map)
- Terrain (elevation)
Flood risk analysis on household level

Combine data on buildings, terrain, landuse and water to obtain insight into flood risks and effects of measures, for different scenario’s.

Assessment of measures for flood risk reduction on household level
Flood risk analysis: accessibility

Using data on roads, elevation, and water depth to obtain accessible/inaccessible roads immediately

Optimize accessible routes for police, ambulances, fire brigade, etc and/or to warn the public to move their car on time
Configurable dashboard (for various user groups)

Weather data, rainfall (nowcasting + prediction), actual floodmaps, IoT sensors, flows, results of different scenario’s, KPI’s, emergency plans, etc
Integrated design and urban planning
Awareness (public) + improved decision making
Traditional reports .... or a digital twin?