

Urban Climate Framework

A system approach towards climate proof cities

TNO | Knowledge for business



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TNO Built Environment and Geosciences

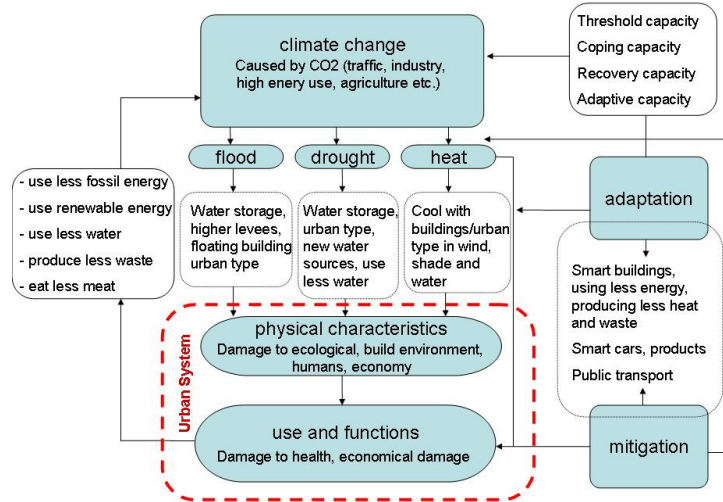
Message

- The most important goal of the urban climate framework is to connect climate tasks with common city development.
- The climate should be an integrated task in city development and incorporate the insecurities concerning climate change predictions: the **adaptive capacity**.
- Smart integration of problems and solutions.

“The integration of policies and measures to address climate change in ongoing sectoral and development planning and decision-making, aimed at ensuring the sustainability of investments and at reducing the sensitivity of development activities to current and future climatic condition” (Klein et al., 2005)



Urban Systems & Climate Change



Urban Climate Framework



Complex adaptive systems

- Cities are complex adaptive systems
 - High complexity
 - Open and dynamic
 - Uncertainties
 - Capacity to change and learn from experience
- Managing complex systems requires *Adaptive Co-management (governance)*
 - Collaborative, flexible and learning-based management across different scales
 - What city are we talking about?
- Existing decision support instruments not sufficient:
 - Emphasis on impact measurements and scenario modeling
 - Do not support stakeholder participation

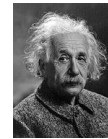
Urban Climate Framework



System approach (1)

- Origin in ecology, emerged in late 50s as reaction on the reductionist approach
- Makes the object of study simpler, but still enables to give meaningful understanding of issues that deal with elements of different nature and coherence
- Allows to study phenomena as emergent properties of the interrelated whole

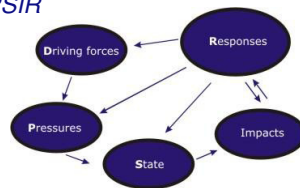
"Make your object of study as simple as possible but no simpler"



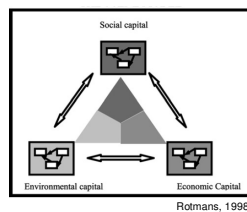
System approach (2)

4 existing concepts:

DPSIR

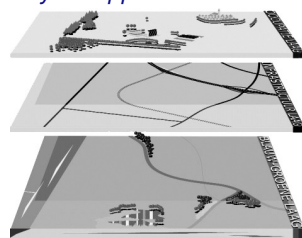


SCENE-model (stocks and flows)



Rotmans, 1998

Layers Approach



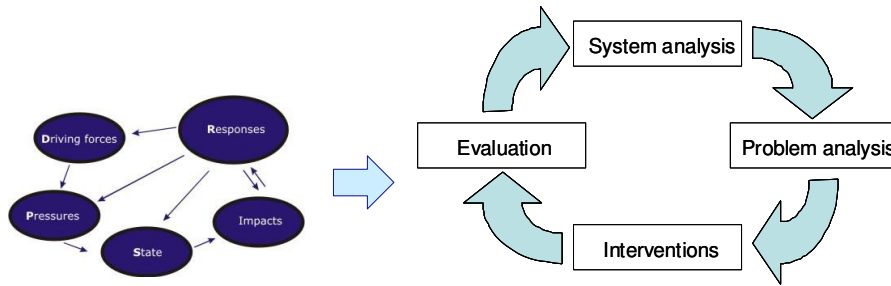
Hoog, Sijmons and Verschuuren, 1998

Vulnerability of systems

- Adaptive capacity
- Threshold capacity
- Coping capacity
- Recovery capacity

Urban Climate Framework

- System approach for developing integrated adaptation and mitigation strategies
- Practical tool (table)

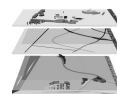
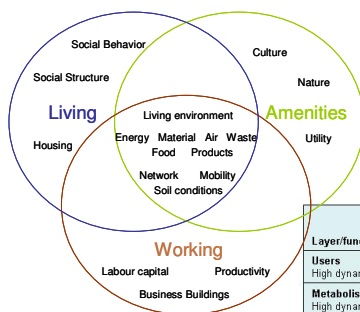


Urban Climate Framework



Urban Climate Framework

- 3 essential functions of healthy and livable cities → several *stocks*



| Layer/function | Living | Amenities | Working | General conditions (for several functions) |
|---|--------------------------------------|--------------------|---------------------------------------|--|
| Users High dynamic | Social structure Social behaviour | | Labour capital Labour productivity | |
| Metabolism High dynamic | | | | Facilities (Energy, Water, waste, air, material, food, products) |
| Occupation Medium dynamic | Housing | Utility Culture | Offices | |
| Public space Medium/low dynamic | | Nature Culture | | Living environment |
| Infra structure Low dynamic | | | | Mobility Network |
| Underground Very low dynamic | | | | Network (water, energy, waste) Soil conditions |

Urban Climate Framework



Urban Climate Framework – practical tool

| System approach Layer | Stock | State | Flow | Pressure | | Vulnerability | Impact | Response | |
|--------------------------|---------------------|-------|------|-----------------------|------------------------|---------------|--------|--------------------------|--------------------------|
| | | | | Climate Change impact | Social-economic issues | | | Mitigation interventions | Adaptation interventions |
| Users | Social structure | | | | | | | | |
| | Social behaviour | | | | | | | | |
| | Productivity | | | | | | | | |
| City metabolism | Energy | | | | | | | | |
| | Food | | | | | | | | |
| | Water | | | | | | | | |
| | Waste | | | | | | | | |
| | Air | | | | | | | | |
| | Products & material | | | | | | | | |
| Occupation | Working | | | | | | | | |
| | Housing | | | | | | | | |
| | Utility | | | | | | | | |
| | Culture | | | | | | | | |
| Infra structure | Mobility | | | | | | | | |
| | Network (physical) | | | | | | | | |
| Public space | Living environment | | | | | | | | |
| | Culture | | | | | | | | |
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| | Soil conditions | | | | | | | | |

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Urban Climate Framework Resilient Cities 2010

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| | Soil conditions | | | | | | | | |

System analysis

- What is the **state** of those stocks?
- What are the **pressures** on those stocks?
 - Climate change impact
 - Social-economic issues

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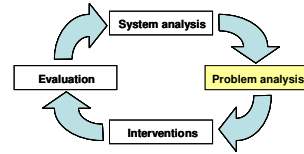
graph TD
    SA[System analysis] --> E[Evaluation]
    E --> I[Interventions]
    I --> PA[Problem analysis]
    PA --> SA
            
```

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| | Soil conditions | | | | | | | | |

Problem analysis

- What is the **vulnerability** of the stocks?
 - What might be 'damaged'
- What is the potential **impact**?
 - Result of this damage

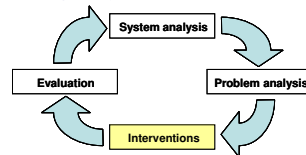


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Interventions

- Identification of **responses** (measures) per layer
 - Adaptation & Mitigation
- Based on *lowering vulnerability*
 - Adaptive capacity
 - Threshold capacity
 - Coping capacity
 - Recovery capacity



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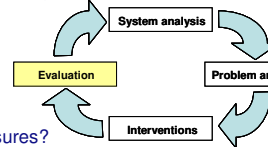
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Evaluation

➤ What is the *influence* of adaptation and mitigation measures, and impact at stocks on *other stocks* in the system? **flow**

- Win-win solutions
- Low / no-regret options
- Conflicting measures

➤ How effective are the climate measures?



Workability and usability

- Desktop study for 6 cities world wide by students of Delft University of Technology
 - Practical improvements
 - Information from one city useful for other cities
- Interviews with several public services and administration of the city of Rotterdam
(OBR, DCMR, dS+V, Public Works, Housing corporation, alderman)
- Workshop for study 'Reinventing Zevenkamp' - translation of sustainability at different spatial scales in existing building areas

Usability for public services in Rotterdam

- Climate not on top of priority list
- Need for wider perspective on urban development and climate change issues
- Linking physical and social components
- Lack of communication between services and different disciplines
- High complexity of incorporating climate issues into urban development, there is a need for instruments to support this
- Further development of UCF strongly encouraged; several (combined) workshops are planned for summer 2010



Conclusions

- UCF brings together and organizes information of different nature
 - Connects physical elements and structure of the build environment, and the social-economic aspects (and ecosystem)
 - Integrates climate change issues in general urban development
 - Shows what is known and what is unknown
- Knowledge brokerage tool: facilitates stakeholder participation and debate
 - Supports sharing of knowledge of current conditions and projects future developments
 - Raises awareness about the coherence between different domains
 - Does *not* represent the objective truth but different perspectives of stakeholders



Conclusions

- The measures taken should not imply the solution of an end situation (for a certain budget) but must always be open, adaptive and future oriented to safeguard society from climate change. In that respect, mitigating measures are always important, necessary and sensible as are adaptive measures linked to a general improvement in the quality of the city.

Work in progress..

- Visualization and practical use
- Combination with interactive (ICT) techniques
- Include quantitative / objective information

