NEW URBAN LEADERS
FOR SUSTAINABLE CITIES
OF THE FUTURE

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2011 NARST
Annual International Conference
3-6 April, Orlando, Florida
Water is Life!

10,000 to 20,000 people mainly children die every day from water-related diseases.

Water is also Killer no. 1

A child dies every 15 seconds from a disease caused by lack of access to safe water, inadequate sanitation and poor hygiene.
Response - Good News and Bad News

‘Open the loop’ - linear supply and disposal

Good News

• Upper income countries have revolutionized public health outcomes

• Also have made major progress in mitigation of environmental damage

The Bad News

• Systems built for narrow objectives with little resilience – not suited to the challenges ahead

• Extraordinarily resource intensive

• Unaffordable to 2/3 of the planet
24-Hour Water Availability

Source: McIntosh (2003)
Most wastewater is **not** treated!

- **95%** of wastewater is not treated world-wide.
- **EU**:
  - Primary/secondary treatment: <15%
  - Tertiary treatment: <2%
  - Overall: <40%
Bad News – External Pressures make the Situation Worse

• Entire earth system is changing!
Changes - Uncertainties

Source: Hadley Centre

±70%
World population prospects 1950 - 2050

Opportunity to do Things Differently

Source: UN (2003)
Opportunity to do Things Differently Comes Early

- Much of urbanization happens before countries get to $4,000 per capita.
- Change becomes complex as urbanization advances, than where it has just begun.

Source: WDR 2009.
Shenzhen

Window of Opportunity is Small

1980

Fishing village of several thousand

Today

City of 7 million – big in electronic manufacturing
Opportunity to do Things in Africa and South Asia

Never Waste a Good Crisis

- 80% of future stress from population & development, **not** climate change!
- However, climate change has focused our minds on ‘doing the right thing’ - never waste a good crisis
- Emerging regions have the opportunity to develop in a resilient and robust way.
Population Growth + Urbanization
+ Rising Standards (Health, Environ)
+ Climate Change

= Major Change and Uncertainty
Move away from 19 c. Principles

What We Currently Do

- Urban form created with little input from water professionals – we just plumb it up later!
- Systems with fixed, centralized designs (little evolutionary ability)
- Treat stormwater as waste and place treatment plants far from households (restricting reuse opportunities)
- Institutional landscape not conducive for integrated and holistic approach to urban water management.
- Regulations stall innovation, are inflexible - can’t deal well with sustainability, resource efficiency....

Education reinforces these principles
Imperative for Change?

“One of the main barriers to turning knowledge into action is the tendency to treat talking about something as equivalent to actually doing something about it.”

Knowing-doing gap (Pfeffer and Sutton)
We Need a Paradigm Shift

Drivers for water should be beneficiation
- Public Health, Aesthetics, Economic Development, Potential markets and products from water management
- Efficiencies in supply and demand, Cascade of uses, energy and nutrient recovery...

System changes are required
- Systems that can be incrementally designed, implemented and upgraded (adaptable systems)
- Urban form that allows beneficiation and adaptation
- Institutional and regulatory framework that allows beneficiation and adaptation

Focus should be on emerging towns and cities in developing countries – leapfrogging potential

Need to create new breed of urban leaders, managers – education reform
SWITCH

Managing Urban Water for the Future
32 partners from 15 countries

Netherlands, UK, Germany, Israel, Brazil, Colombia, Peru, Spain, China, Ghana, Greece, Palestine, Egypt, Poland, Switzerland

40 PhD’s
12 cities from around the globe

Belo Horizonte, Brazil
Tel Aviv, Israel
Birmingham, UK
Hamburg, Germany
Lodz, Poland
Zaragoza, Spain
Accra, Ghana
Beijing, China
Alexandria, Egypt
Chong Qing, China
Cali
Lima
Bogota
We need new urban leaders

Core Competencies

- **Participatory processes** – stakeholder analysis, institutional mapping, social inclusion, needs assessment
- **Strategic planning** - visioning, scenario development and strategy development
- **Interdisciplinary perspective** - problem based, systems approach, urban metabolism
- **Institutional systems and financial instruments** - social, economic, political, legal and regulatory contexts
- **Understanding uncertainties** – flexibility and adaptation
- **Transitioning Theory** - path taken to get from the present situation in a city to the desired future state
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Learning Alliances

• **Why?**
  - Poor uptake of available research findings
  - Fragmented institutional arrangements
  - ‘Wicked’ problems - need for ‘integrated’ solutions

• **Who?**
  - Policy makers, planners, regulators, service providers, NGOs, researchers, developers...

• **How?**
  - Inception (training, stakeholder analysis...)
  - Operational (visioning, planning processes..))
  - Backstopping support (monitoring, evaluation...)

Learning Alliances

- Univ’sty
- Water Ut
- Waste Ut
- ... (omitted)
- Planners

Catchment

Township

Urban
Example: Bogota, Colombia

Issue:

• pollution of upper Rio Bogota (tanneries)

Key players:

• Association of tanners, Regulator, Local government, NGO, University,...

Outcomes:

• Almost half of small enterprises have implemented cleaner production principles removing 90% pollution
Example: Belo Horizonte, Brasil

**Issue:**

- River restoration and flood risks

**Key players:**

- Municipality, University, State water agency, catchment committee + schools, communities...

**Outcomes:**

- More options for environmental improvements (more natural approaches to drainage and treatment) e.g. within participatory budgeting processes
Example: Lodz, Poland

**Issue:**
- restoring polluted rivers

**Key players:**
- city office, University, Ecohydrology institute, service providers, developers

**Outcomes:**
- Demonstration technologies being scaled up as part of city redevelopment
- development of a city-wide strategic plan for water
Lessons Learnt

- Improved collaboration among all professionals who influence the shape of the urban space (not a question of whose “vision” wins) – eg BH IGAM, Rio Velhas river basin committee, Copasa, Incisa...

- Greater focus on understanding integrated systems performance – using CityWater in Bham, Alex..

- Strategic planning is providing a useful focus in many cities – most SWITCH cities

- It has been possible to identify research gaps that have emerged from cities (e.g. stormwater in Lodz).

- Demonstrations provide the strongest potential for realizing action research - need to be given more priority.
What is available from SWITCH?

• Methodologies and examples on stakeholder engagement in UWM (incl. series of briefing notes)
• 12 City case studies (published by end 2010)
• Training toolkit
• For more information: www.switchurbanwater.eu
rain future urban leaders in participatory processes and strategic planning to ensure uptake of future solutions and to embed a new way of thinking about resource management

(Not a one-off undertaking, but a continuous)
We need new urban leaders

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Combination of Interventions

Interventions

- Behavior Change
  - Health Promotion
  - Advocacy
- Governance
  - Capacity Building,
    - Regulation,
    - Legislation
- Infrastructure/
  - Service Delivery
    - Water supply,
      - Drainage
    - Refuse disposal,
      - Vector control
- Finance and Social
  - Marketing
    - Promotion,
      - Credit
      - Subsidy

Outcomes

- Improved Health
- Savings in time and drudgery
- Empowering women
- Improved quality of life
- Increased attendance and better performance at school
- More sustainable livelihood

Global
National
Local
Household

Savings in time and drudgery
Empowering women
Improved quality of life
Increased attendance and better performance at school
More sustainable livelihood
The metabolism of Cities

Holistic systems approach to resource management
Greater Integration

Abiotic

Mineral Resources Planning
Water Resources Planning
Landscape Planning
Transportation Planning
Urban Planning

Watershed planning

Cultural

Biotic

Ahern, 1995
Planning - Lack Integration

Abiotic

- Mineral Resources Planning
- Water Resources Planning
- Landscape Planning
- Transportation Planning
- Watershed planning

Cultural

Urban Planning

Constrains other urban services

Ahern, 1995
Greater Integration

Abiotic

Water Sensitive Urban Planning and Design

Ahern, 1995
New challenges – New Thinking

- Multi-objective urban planning (what should drive the urban plan?)

\[ Z = (\gamma u + \beta v + \alpha w + \delta x + \varepsilon y) \]

\( u = f(v, w, x, y) \)
\( v = f(u, w, x, y) \)
\( w = f(u, v, x, y) \)
\( x = f(u, v, w, y) \)
\( y = f(u, v, w, x) \)
Urban Form Should Deliver Semi Central Systems

Density

Network Structure

Optimal Urban Form

• Medium Density (Cluster)
• Mixed Land Use
• Structure with Short Paths but connected
Greater Integration

Allows optimizing within a continuum of options

Which is more efficient?
Which is more sustainable?
Which is more appropriate?

Large Scale
Nodal
Cluster
In Situ

Highly Centralized
Highly Decentralized

a global network for water professionals
The water sector can’t do it alone

Need to create **Utilities of the Future** that lead innovation

- Direct utility investments towards integration
- Advocate for funding, regulations and incentives
- Promote new urban managers/leaders
  - education reform

Land planners
Architects
Developers
Gov’t officials
Financiers
Energy experts
Expose future urban leaders to tools and methods that allow a greater appreciation and understanding of the interactions and interrelationships between different urban systems (to allow optimal city performance)

(incl. institutional landscapes, financial tools (WLC, LCA...))
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Decision Making in Uncertain World

Source: Hadley Centre
Sustainable Urban Drainage

SUDs provides modular diversity that increases flexibility resulting in a complex adaptive system (Sieker et al., 2008, Eckart, 2008)
Examples of activities

- SWD
- Filter strips
- Open trenches
- Permeable pavers
- Bio Retention
- Green roofs
- RWH

Suite of Options
Urban Drainage Modular System

Rural

Semi-Urban

Urban

Time

Q = rate of runoff
• Real Options Theory
• Net Disturbance Propagation (NDP)
• Range of Resemblance (RR)
• Communality Index (CI)
Educate future urban leaders to understand how to design and manage urban systems, institutions and regulations in a changing world

(move away from deterministic approach)
Transitioning

Future System
Based on Old System

Future System
Totally New System

Graph Theory Transition Systems
SWITCH Emscher - SUDS

Transition Emschersystem

Emscher River around ...

1890 1980 2010
Transitioning SUDS

Transition Emschersystem 1990

Old Treatment Plant
New Treatment Plant
Old Emscher (Sewer)
New Emscher (Nature)
New Sewers
Deconnection SUDS

Emschergenossenschaft
Transitioning SUDS

Transition Emschersystem 2020
Transitioning SUDS

Transition Emschersystem 1990

[Map of Emscher system with various labels and color codes indicating different types of facilities and connections.]

Emschergenossenschaft
Transitioning SUDS

Transition Emschersystem 2000
Transitioning SUDS

Transition Emschersystem 2010

[Map showing the transition of SUDS systems with labels for old and new treatment plants, sewers, and nature areas.]

Old Treatment Plant
New Treatment Plant
Old Emscher (Sewer)
New Emscher (Nature)
New Sewers
Deconnection SUDS

Emschergenossenschaft
Transitioning SUDS

Transition Emschersystem 2020

Diagram showing the transition of the Emschersystem 2020 with various symbols indicating old and new treatment plants, sewers, and nature defenses.
Need to educate future urban leaders in the area of transitioning theory – technical, institutional, regulatory.

Institutions are the origin of change and the medium for legitimizing change.
Entrepreneurship - Water Machine

- Grey water
- Brownwater
- Urine
- Solid waste
- Potable Water
- Reclaimed non-potable Water
- Quality A,B,C

- Surface Water
- Ground Water
- Rain Water

- Energy
- Electric En.
- Heat En.

- Hygienized Sludge
- Nutrients
Water Machine: Semi-Centralized

**Water treatment**
76 L/(C·d)

**Mini Turbine**

**Greywater treatment**
41 L/(C·d)
250 g/(C·d)
25-50** Wh\textsubscript{electr.}/(C·d)
320-360 Wh\textsubscript{calor.}/(C·d)
200 Wh\textsubscript{electr.}/(C·d)
610 g/(C·d) residuals

**Waste & sludge treatment**

**Blackwater treatment**
68 L/(C·d) (for discharge)
68 L/(C·d) process water
610 g/(C·d) residuals
200 Wh\textsubscript{electr.}/(C·d)
55* Wh\textsubscript{electr.}/(C·d)

- greywater
- recyclables
- residual and biowaste
- sludge

Q = 150 l/d, Δh=40m
E = 1000*9.81*0.15*40 = 2.4 kWh

* activated sludge treatment
** MBR: membrane biological reactor

**IWA** | **TU Darmstadt | Institute IWAR | Cornel et al.**
Opportunities for Small Business

“Black Gold” Biofuels

Wastewater → FOG-to-Fuel® system

Fat
Oil
Grease

Energy

Biodiesel fuel
Biobunker fuel
Glycerin
Cluster Structure and Scalable System

A supply and treatment unit (water machine) for each district

- Semi central supply and treatment unit as part of clustered city structure
- Use scalability of treatment technology (membranes)
- Customized supply and treatment for each cluster
- Utilizing synergy effects and re-use potentials
Training Toolkit IUWM
Training Toolkit IUWM

Key SWITCH Output

(Note: All outputs include case studies illustrating best practice)

The SWITCH Global Training Package

The overall SWITCH approach to IUWM

Module 1
Preparing for the Future

Module 2
Involving all the players

Module 3
Exploring the options
- Water Supply
- Stormwater
- Wastewater

Module 4
Choosing a sustainable path

Module 5
Transitioning systems

Sustainable solutions

Decision support tools

Transitioning

Learning Alliance Manual (WP6.2, D12)
Social Inclusion case studies (WP6.3, D2)
QIB methodology (WP6.3, D6)
Lessons learnt from LAs (WP6.1, institutional maps (WP6.1, D6.1.2 & D6.1.5))
Financial Instruments (WP6.4, D6.4.4)
Transitioning manual (WP1.3, D1.3.4)

Inventory of ecological transport (WP4.1, D4.1.7)
Design criteria for self-purification (WP5.3, D10)
Guidelines for resource recovery (WP6.3, D7)
Life Cycle Cost Calculation Tool (WP2.2, D2.2.2a)
Computer model for tech. selection (WP6.3, D6)
Multi-criteria analysis tool (WP4.1, D4.1.5)
New Urban Leaders for Cities of the Future

Preparing for the future
Involving all the players
Choosing a sustainable path
Adaptation and Transitioning
Entrepreneurship (innovation & marketplace)

THEMATIC AREAS

Urban Water
Urban Planning
Transport
Energy
Urban Governance

Problem Based Approach
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Choices Before Us

- Stay in Lane - Business as Usual
- Try Harder, Spend More for Traditional Sys
- Truly Different Approach
Thank You

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