


Toolkit for the 21st-Century Urban Sanitation Planner



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Presentation Overview



- Research Background
 - Relevance
 - Driving questions
- Research Components
 - Sustainability Assessment
 - Goals of framework
 - Sample indicators and results
 - Design for Service infrastructure planning approach
 - Goals of planning approach
 - 5-step process and methods

Global Context

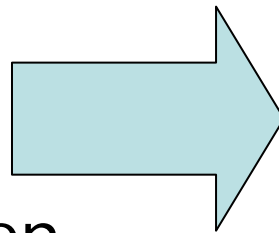
- Status
 - 2.6 billion people without *improved* sanitation
 - >85% of wastewater that is collected is disposed untreated
 - <15% receives primary or secondary treatment before release
 - 2% receives tertiary treatment
- Drivers
 - Rapid urbanization
 - High cost – very capital intensive
 - (Perceptions of) limited effective demand



A Necessary Shift

Design for Disposal

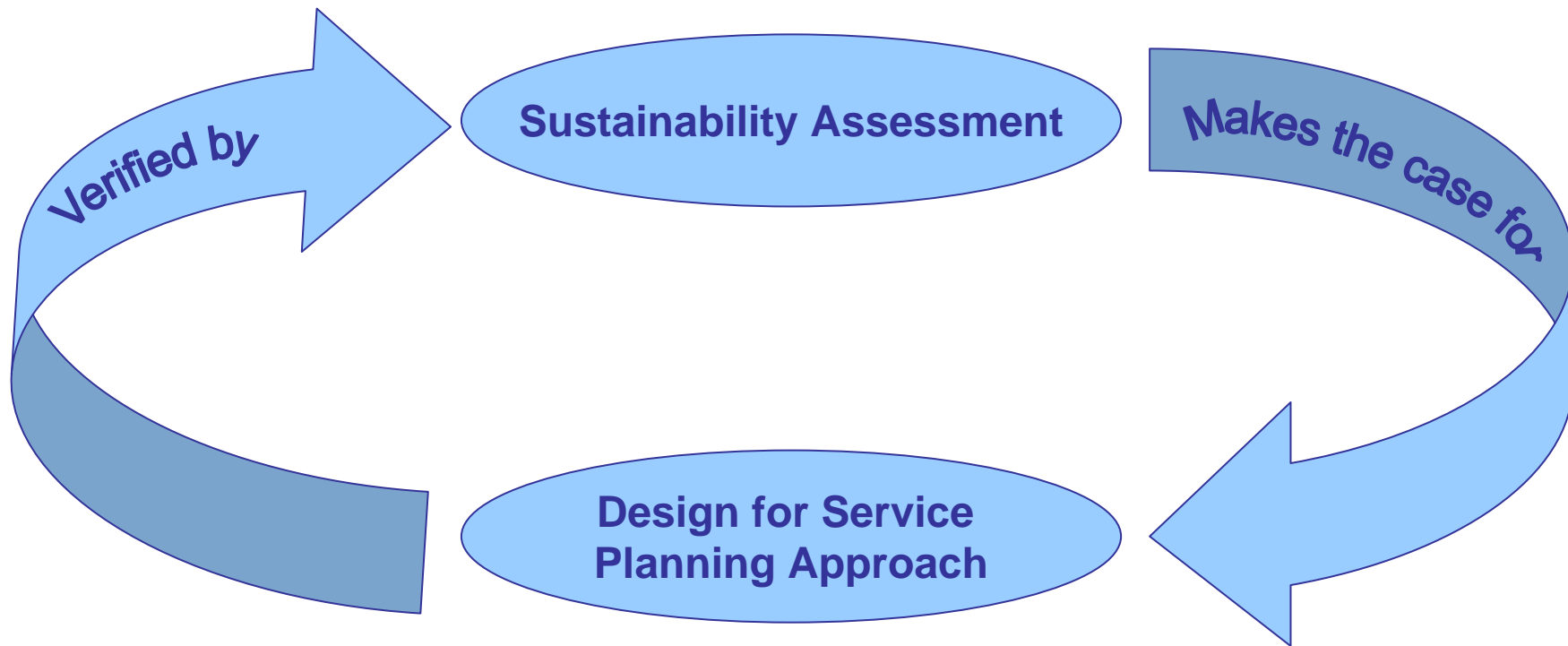
- Linear
- Energy intensive
- High capital, operation and maintenance costs



Design for Reuse

- Circular
- Low energy
- Lower capital, operation and maintenance costs





Sustainability Assessment

Unit of Analysis: 4 conventional wastewater treatment plants in Chengdu
Plans for wastewater handling generated by DFS

Key Elements: Sustainability indicators

Design for Service

Unit of Analysis: Pixian urban population; Pixian agriculture

Key Elements: Methods for step-wise planning approach
Recommended handling scheme

Limitations of Existing Sustainability Indicators



1. Ambiguous

- Risk arbitrary, value-laden targets (Farrell and Hart 1998)
- Precise expressions w/o precise representation (Sen 1989)

2. Lack Site-Specificity

3. Measure passive but not *active* sustainability

A drawback that is common to indicator sets is that they do not provide enough information for decisionmaking –Farrell & Hart 1998

“These indicators serve an important social function in translating the abstract notion of sustainability in practical, measurable conditions that have meaning for citizens and decision-makers. The indicators are generally not linked to any explicit model of ecological economics, however, which limits their usefulness for evaluating sustainability in a more systematic way,” Collados & Duane 1999.

“The first question to be answered is not ‘what do we want to measure?,’ as one is often tempted to do, but rather, ‘what question do we want to answer?,’”
Bertrand-Krajewski 2000

“Unconnected indicators encourage the same fragmented view of the world that has historically led to some of our most serious problems. Decision makers need indicators that show the links between social, environmental, and economic goals to better understand how to achieve economic growth that is in harmony with – rather than at the expense of – the natural systems within which we live,”
Farrell and Hart 1998

“Indicators will not help address urban sustainability problems unless clear linkages can be established between urban patterns and the state of the natural resource base,” Alberti 1996

A New Sustainability Assessment: Burden-to-Benefit Ratios

Examples:

| | |
|---|---|
| Energy Used to Treat WW | Theoretical Energy Value of WW |
| Cost of Nutrient Removal | Local Value of Uncaptured Nutrients |
| Acidification Caused by WW Treatment | Eutrophication Avoided due to WW Treatment |
| Cost of public health damage caused by WW Treatment (Air Pollution) | Value of Public Health Risk Avoided due to WW Treatment |
| Land Area Used | Land Area Creating Habitat/Parkland |
| Sewage Sludge Landfilled | Daily Tipping Capacity of Landfill |

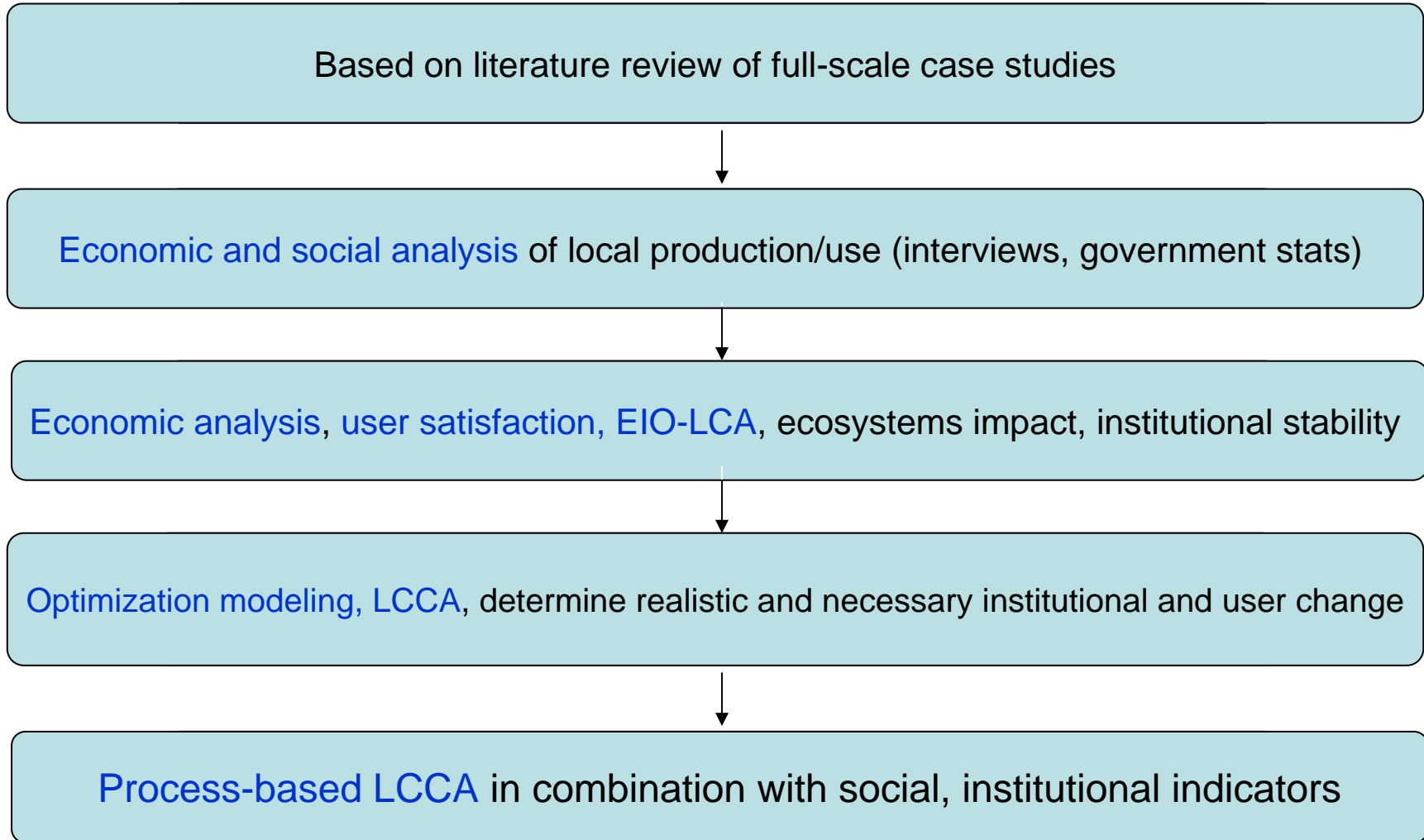
Sustainability Assessment Organization and Presentation

- Indicators organized by wastewater phase: production, treatment and end use
- Practitioner's Handbook
 - Detail indicator rationale, evaluation methods, boundary conditions, data requirements, links to other indicators and links to policy
- Evaluated sustainability assessment will reveal new information about existing wastewater treatment infrastructure
 - Highlight “low hanging fruit” and areas of weakest sustainability
 - Provide insight for future sanitation design

Design for Service: Planning Approach for Sustainable Sanitation Infrastructure

- Desired Planning Process Outcomes
 - Closed-loop design: shifts paradigm from disposal to reuse (Esrey 2001, Mara et al. 2007)
 - Pollution prevention approach (Otterpohl et al. 1999)
 - Site-specific (Hellstrom et al. 2000)
 - Holistic with respect to watershed management and urban/peri-urban planning (Allen 2003)
- Desired Characteristics of Urban Planning Approaches
 - Facilitate **dynamic, continuous, multi-dimensional** processes (Brueck 2005)
 - Improve **processes** that lead to choices (Bertrand-Krajewski 2000)
 - Facilitate **iterative** (vs. prescriptive) planning; organize tools in a **coherent system** for application (Allen 2003)

Design for Service Framework and Methods



Field Activity in Chengdu, China

DFS Planning Approach

Objective

- Test feasibility of using DFS to generate recommendations for sewage infrastructure in Pixian
- Identify barriers to use of DFS

Data Sources

- Farmers, Municipal & District Water, Environmental & Planning Bureaus, Ministry of Finance

Methods

- Archival reviews, stakeholder interviews, surveys



Application of DFS

Wastewater Reuse in Agriculture

- Assessing Demand for Irrigation in Pixian (peri-urban Chengdu)
 - Mapping current spatial and temporal use of water (crop-specific)
 - Evaluating water productivity in agriculture (Value of Yield/Vol Water)
 - Evaluating value of additional water (Value of Additional Yield/Increment Water)
 - Account for nutrients – freshwater not a perfect substitute for wastewater



Application of DFS

Wastewater Reuse in Agriculture

- Assessing Sustainability of Irrigation in Pixian (peri-urban Chengdu)
 - Mapping user satisfaction (quality and quantity)
 - Costing provision vs value of output
 - Measuring competing demand for water (domestic, industrial, environ)
 - Environmental impact of water diversion from rivers
 - DFS – Institutional flexibility for change



Application of DFS

Wastewater Reuse in Agriculture

- Design WW Treatment Infrastructure to Optimize Irrigation
 - Recommend appropriate WWTP size, location, storage capacity
 - Present a suite of technology options that could be used
 - Compare economic, environmental characteristics of different technologies (LCA approach)
 - Apply indicator framework and compare results to urban core



Next Steps

- Identify and work with **3 new partner cities in China** to pilot sustainability assessment and Design for Service
- Identify and work with **1 new partner city in Africa** (likely Senegal) to pilot sustainability assessment and Design for Service
- Identify and collaborate with **local and international partners** to enhance institutional capacity and improve outcomes of pilot projects

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