Demonstrating New Sanitation Solutions through the Engineering Field Testing Platform in eThekwini

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Prof. Chris Buckley, Head of Pollution Research Group, UKZN

Buckley@ukzn.ac.za

N Alcock, R Cottingham, S Dhlamini, T Gounden, S Mercer, L Ngubane, R Sindall, C Sutherland
eThekweni Municipality

- 2,297 km²
- Mostly hilly topology
- 3.6 m people
- 53% in formal housing
- 32% in informal settlements
- 15% in peri-urban & rural areas
- 23% unemployment (Jan-Mar 2019)
Sanitation Challenges

• Access to basic water and sanitation has been a constitutional right since 1994;

• Water Service Authorities provide water and sanitation services;

• Pro-poor transformation agenda;

• Clear need for innovative solutions:
  – Water shortages, drought area
  – Historically unequal service provision, particularly in rural homeland areas
  – Proliferation of informal settlements
  – Perception of ‘inferior technology’

• ‘Learn by doing’ approach

Source: Pictures for Unequal Scenes, www.unequalscenes.com
Non-sewered sanitation (NSS) solutions

- Non-sewered sanitation recognised as critical for the future by International Water Association (IWA) and World Toilet Board
- Do not require connection to sewer
- Can offer the same level of user experience as a regular flush toilet
- Can be desirable, aspirational products
- High tech systems, produced at scale, at an affordable price
- Innovative – the ‘Reinvented Toilet’
- Contribute to the circular economy
Excreta waste (urine+faeces or separated)

Reinvented Toilet

Heat/energy (recovered for process operation and/or external use)

Air emissions

Liquids (recycled for flush or handwashing / recover nutrients)

Noise emissions

Solids (recover nutrients/ agriculture/ fuel source/ non-hazardous waste disposal)

End products
Rethinking sanitation delivery: the full sanitation value chain

- Understand and support the **full sanitation value chain** (not just building toilets)
- NSS with resource recovery implies:
  - New technologies and rapid innovation
  - New service models needed
  - Jobs created at all levels of the value chain (R&D, manufacturing, sales, servicing)
  - New local markets opening up

(Source: Bill & Melinda Gates Foundation, 2012)
Rethinking sanitation delivery: the enabling environment for NSS (1)

- Remove bureaucratic barriers that impede innovation in the sector
- Invest in research that leads to implementation of new NSS technologies
  - Critical review of appropriateness/readiness of proposed technologies
  - Field testing in real world environments
  - Practicalities of adaptation
  - Market research, detailed business modelling and support for adoption
- Support for technology transfer (technology developer to local manufacturing, distribution and servicing)
  - Developing new service models
  - Skills training
  - Investment
  - Sharing of lessons learned across different technologies
Rethinking sanitation delivery: the enabling environment for NSS (2)

• De-risk the process for municipalities:
  ● Define appropriate (global and local) standards that NSS technologies must comply with
  ● Enable meaningful demonstrations of technologies in relevant environments to build municipal confidence
  ● Create new service models that work with the requirements of the new technologies AND the municipal structures and supply chains
  ● Look at how procurement processes can be adapted to situations where there is only one supplier of a particular product (specific NSS technology)
  ● Update existing standards/guidelines that may prevent NSS being easily adopted (e.g. Red Book guidelines for sanitation)

• Dedicated team in place from the start to ensure that skills transfer is integral to the roll-out of NSS, rather than an afterthought
Building confidence in innovative NSS solutions

- Municipalities need confidence that systems will work in their local context:
  - Will they perform technically?
  - Will people want to use them?
- Communities need to be heard and encouraged to participate in developing sanitation solutions that meet their needs.
- Technology developers need to test their systems in real world conditions.
The Engineering Field Testing Platform (EFTP) in eThekweni:

- **Real world testing, many users**
- **Evaluates performance over an extended period**
- **Feedback from community** on suitability and impact
- **Uses the information and data generated to improve sanitation for all**
Durban Engineering Field Testing Platform (EFTP): A research and product development collaboration between the municipality, academic and private sector partners:
Why test in eThekwini, South Africa?

• Water-constrained
• EWS reputation for innovation
• Inward migration to Durban = significant numbers unserved with sanitation
• EWS want systems that:
  – Are acceptable to customers
  – Reduce water use
  – Improve health and hygiene
  – Reduce environmental impact
• EWS, PRG and Khanyisa have had a long-standing research partnership
• PRG has a well-equipped faecal sludge laboratory
The EFT platform and Product development

Phases of new product development:
Field Testing phase
What does the EFTP achieve?

• Technologies are **not yet proven**
• Data from field testing performance is fed back to technology developer so that they can **make improvements**
• Systems are exposed to real world use, different cultural practices, different wastes – can push product development back a stage
• **EFTP provides ‘safe space to fail’**
How the EFT platform works:

SITE SELECTION > COMMUNITY ENGAGEMENT > SITE PREPARATION > INSTALL & COMMISSION > TESTING > DECOMMISSION

- TECHNOLOGY CONSTRUCTION
- SHIPPING

FEEDBACK AT ALL STAGES TO:
- TECHNOLOGY DEVELOPERS
- DURBAN EFT TEAM
- COMMUNITIES
- FUNDERS
SITE SELECTION

COMMUNITY ENGAGEMENT

SITE PREPARATION

INSTALL & COMMISSION

TESTING

DECOMMISSION
SITE SELECTION
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DECOMMISSION
SITE SELECTION

COMMUNITY ENGAGEMENT

SITE PREPARATION

INSTALL & COMMISSION

TESTING

DECOMMISSION
Testing on the Durban EFT platform:

2017 – 2019, currently testing or confirmed for testing

11 TECHNOLOGY DEVELOPERS
19 PROTOTYPES
20 TESTING SITES
Testing on the Durban EFT platform:

19 prototypes:

- **Community Scale**: 8
- **Household Scale**: 11

- **Front End**: 6
- **Back End**: 3
- **Component**: 5
- **Integrated Systems**: 5
Selection of technologies tested on the EFTP
Eco-san: off-grid blackwater recycling

- Toilet block + wastewater treatment system
- Treats toilet wastewater only and recycles for toilet flushing
- Serves 250 people/day
- Biological pre-treatment + electrochemical oxidation
- Solar powered
- Some modifications needed to make it more suitable for South African context
- Has operated in recycling mode in SA
- Currently operating at informal settlement & school
- System is socially acceptable, toilets are small, smell from tanks has been addressed, prefer toilet blocks with showers attached
Yixing Eco-sanitary Manufacture Co., Ltd

Eco-san: off-grid blackwater recycling

Strengths:
• Has operated in recycling mode
• Complete integrated off-grid system

Challenges:
• Wastewater profile at school different to residential (more toilet paper, less faeces)
• Security (theft) issues at school (little community ownership of system)
• Residual chlorine in treated water exceeded permitted standard, additional GAC filters required
• Difficult to predict design capacity required in informal settlement situation – currently demand exceeds treatment system capacity
Autarky: household flush toilet + handwashing with recycling

- Household toilet & handwashing facility with integrated wastewater treatment
- Recycles treated wastewater for toilet flushing & handwashing
- Serves 1 household (5 to 10 people)
- Process summary: urine separation toilet, urine dehydration, solids/flushwater separation, liquid treatment (gravity driven membrane filtration + electrolysis)
- Solids treatment still under development – therefore system not commercial-ready
- Currently grid-powered
- High level of social acceptance of system
- Operated successfully for three months at a rural household in eThekwini
EAWAG

Autarky: household flush toilet + handwashing with recycling

Strengths:
• Liquid treatment and recycling system functioning well
• Integrated handwashing solution
• Compact design
• Social acceptability of system good

Challenges:
• Small pumps currently experience frequent blockages
• Poor separation of solids and liquids by Aquatron leads to solids tank requiring frequent emptying
• Current dependence on grid electrical power
**EOOS Urine Trap**

**Urine diversion flush toilets**

- Pedestal designed to separate urine from solids and flush water
- Three pedestal designs tested at UKZN to determine separation efficiency
- Testing in communities from 2020
- Partnering with Envirosan (local commercial/manufacturing partner)

**Strengths:**
- Flushing toilet using very little water
- Separation of urine allows for capture and reuse, and reduced nutrients in waste stream requiring treatment

**Challenges:**
- Collection and management of urine on a large scale
Transdisciplinary Innovative Networks and Knowledge Co-production

- Establishing a **network of actors/stakeholders** in the Durban EFTP co-production process
- Share **experiences, skills, and information** to **co-generate** new innovative **knowledge**.
- Applied participatory research
- Learn-by-doing approach

(Odili, 2018)
## Benefits for stakeholders

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<th>Municipality/Regulators</th>
<th>Technology Developers</th>
<th>End-Users/Communities</th>
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| - Exposure to innovative and progressive sanitation solutions  
- Local and international collaborations  
- Bringing services closer to people.  
- Achieving national water and sanitation mandate  
- Better understanding of community needs and interests | - Testing in a safe ‘real world’ environment.  
- **Data generation** on system performance & user acceptance  
- Design and improve systems to suit local context  
- **Feedback from users**  
- EFTP provides ‘safe space to fail’ | - Given a voice to be heard  
- Learning by doing and participating in technology testing projects  
- Job opportunities and skills development  
- Stimulation of local SMMEs  
- Improved health and hygiene |
Key Lessons Learnt

Testing on a platform = greater benefits than individual field tests

REGULATOR SEES PERFORMANCE UNDER LOCAL CONDITIONS

KNOWLEDGE SHARING

TECH DEVELOPERS CAN FOCUS MORE ON TECHNOLOGY, LESS ON LOGISTICS

COMBINE TECHNOLOGIES

FASTER ESTABLISHMENT

SHARED INFRASTRUCTURE
Key Lessons learnt on social engagement (Municipal perspective)

• Invest in social acceptance – unless users adopt new technologies, products or services NSS initiatives will fail to go to scale
• Solutions need to be contextualized and user acceptance must be built by engaging and involving users, especially vulnerable groups
• Work toward social and environmental sustainability of the operation and supply chain
• Position the municipality/regulator as a local partner and nurture good relationships
• Contribute to skills upliftment and know how at every step of the process
• Adapt language and include arguments of interest for local community when talking to technology developers/private sector
What is needed to set up an EFTP?

- **Municipal will** is critical – access to testing sites, support for engagement with key stakeholders;
- **High level backing from National level**
- Good **trust** relationships with communities where testing takes place;
- BOTH technical engineering and social sciences expertise;
- Sufficient funds;
- Political will for support of innovative technology;
- Track record of innovation and commitment to research – relationships with WRC, DST, DTI, CSIR, universities;
- A **plan and commitment for the long term of sanitation** in the municipality.
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For more information please contact:
Susan Mercer
Pollution Research Group
mercer@ukzn.ac.za

Ruth Cottingham
Khanyisa Projects
ruth@khanyisapr.co.za

Website: prg.ukzn.ac.za