Effect of System-Scale on Multi-Objective Sanitation Planning

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Universal Sanitation

Sanitation Solution Continuum

Centralized

Decentralized

Onsite
Use

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>10%</td>
</tr>
<tr>
<td>East Asia &amp; Pacific</td>
<td>50%</td>
</tr>
<tr>
<td>Latin America &amp; Caribbean</td>
<td>31%</td>
</tr>
<tr>
<td>North America</td>
<td>25%</td>
</tr>
</tbody>
</table>

1 Banerjee, Sudeshna and Morella 2011
2 United Nations 2004
3 World Bank & Australian Aid 2013
4 EPA 2002
Objective

Improve understanding of the factors affecting the performance of onsite sanitation solutions (OWTS) to:

i. Improve reliability of *existing* systems

ii. Guide decisions about *future* OWTS implementation
Systemic Components of OWTS Performance

- OWTS Technology
Systemic Components of OWTS Performance

- OWTS Technology
- OWTS User Interface
Systemic Components of OWTS Performance

Model Approach

Independent:
Technology & User Interface

Dependent:
Estimated financial consequence

Data:
Local documented data
Data Characteristics

Boulder County, CO

- **14,300** OWTS
- **4,700** OWTS are NOT permitted
- **215** repair permits applications indicating that they “Found out the system failed”
- Similar to the total population, ~**30%** of the sample systems are NOT permitted
Dependent Variable Identification

Repair Severity

• No. of Repairs
  • Repair Types
    – Minor
    – Moderate
    – Major
• Financial consequence of poor performance
Independent Variable Categories

Physical State
Organization
User Motivation
Knowledge
Economic
Other
Multinomial Logistic Regression

Model Skill:
RPSS specifies the extent by which, relative to constant climatology forecasts, the actual predictions are successful in discerning among different outcomes

- Models choices
- Response variable is categorically distributed

Model Skill:
RPSS specifies the extent by which, relative to constant climatology forecasts, the actual predictions are successful in discerning among different outcomes
## Significant Predictors of OWTS Performance

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Age</td>
<td>TECH</td>
<td>+</td>
</tr>
<tr>
<td>Regulated Inspection (Property Transfers)</td>
<td>ORG</td>
<td>−</td>
</tr>
<tr>
<td>Sales</td>
<td>UM/KNOW</td>
<td>+</td>
</tr>
<tr>
<td>Other Documented Inspections (Loan)</td>
<td>ORG</td>
<td>−</td>
</tr>
<tr>
<td>Water Supply</td>
<td>UM/OTHER</td>
<td>.</td>
</tr>
<tr>
<td>Structural Value/Living Area</td>
<td>ECON/TECH</td>
<td>.</td>
</tr>
</tbody>
</table>
Expected Risk (thousands of dollars)

Observed Risk

Estimated Risk

Properties requesting OWTS repair permits with failed systems

- Category 1: Less than $13,000
- Category 2: Between $13,000 and $17,000
- Category 3: Greater than $17,000
Conclusions

• Importance of mandatory inspections
• Education campaigns at the point of sale
• Set standards for post-purchase operations into regulations

Future Research

• Hierarchical modeling
• Extreme values
• Improving severity index
• Linking economic to environmental and health consequence
Acknowledgements

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