Sanitation

Santiago software supports sustainable sanitation planning

It is particularly challenging to reach SDG 6.2 – access to safe sanitation for all – in fast-growing, high-density urban areas when conventional centralised solutions are not viable because they rely on costly sewer networks, large quantities of water, stable institutions, and long planning horizons.

Sector stakeholders, including development banks and policy-makers, have recognised the urgent need for innovation. This had led to an increased demand for non-sewered sanitation (NSS) and faecal sludge management (FSM), and massive investments in technology innovation. Such innovations are more appropriate because they are self-contained, zero-energy, and independent of sewers. Lower water requirements, adaptability to demographic or environmental changes, and resource recovery also enhance their resilience and sustainability.

The task of combining the growing number of technologies in appropriate and sustainable systems for a given planning context is becoming increasingly complex. How compatible are different technologies? How can all waste streams be considered? How can the appropriateness for a given application be evaluated?

Structured decision-making (SDM) procedures, such as CLUES, Sanitation21 or City Sanitation Planning (CSP), are part of the answer. However, the final decision is only as good as the initial options investigated. Typically, identification of sanitation system options is left to engineers, who lack systematic methods and data to cover the broad range of available technologies and systems.

To assist engineers and enhance the transparency of the selection process, our team at EAWAG has developed Santiago (SANitation sysTem Alternative GeneratOr), software that proposes a diverse range of sanitation system options appropriate for the case at hand.

The required user inputs are given by the planning process, covering a list of objective criteria, such as environmental factors, that describe the case profiles (for example, settlement density, water availability), and the desired number of sanitation options, depending on the capacity of the following SDM process (for example, 3 to 30).

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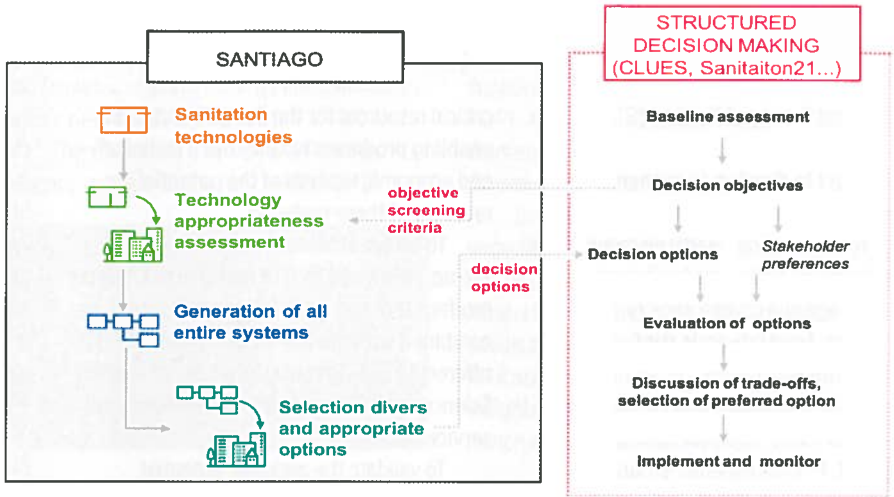

Integration of Santiago in the sanitation structured decision-making process

Internally, the software implements several steps. First, all appropriate technologies are identified by comparing the technology profiles to the application case profiles. Second, all possible system configurations, from the toilet to final reuse or disposal, are generated (typically more than 100,000). Third, the desired number of systems from all appropriate options are selected. The selection covers the full diversity defined by the system templates (Tilley *et al*, 2014). It is then passed to the SDM process for further evaluation (for example, using multi-criteria analysis). Mass flows can also be quantified to evaluate resource recovery potential and emissions.

Over the past five years, we have built a database of around 50 technologies and their characteristics (such as water requirements and resource recovery). The database is based on a large body of international literature and expert knowledge, making this knowledge available to the local experts (Spuhler *et al*, 2019). Future technologies can easily be added.

Santiago has been field tested. In 2016/17, in an emerging small town of around 4000 inhabitants in south-western Nepal, more than 100,000 possible systems were generated from 50 technologies. We then identified a diverse set of 17 appropriate systems for further investigation. These included conventional systems (for example, double pit latrines, and pour-flush toilets with biogas production), but also potentially more appropriate novel options that would not have been identified without the tool, such as urine diversion latrines with vermi-composting of faeces.

This year, in the Ethiopian city of Arba Minch (approximately 120,000 inhabitants), we generated three sets of options for three different urban realities – city centre, slum areas, and peri-urban areas. We also quantified resource recovery potentials and emissions (phosphorus, nitrogen, total solids, water) as input into further evaluations.

Currently, we are in the process of making Santiago (model and database) available online. The aim is to provide a user-friendly application for engineering consultants, government planners, policy-makers, development agencies, academia, and training institutions. We are looking for testers and feedback.

We are witnessing great progress in sanitation technologies. To help get these into practice, this tool – among others within the City Wide Sanitation (CWIS) initiative (*The Source*, March 2019, p39), will contribute to planning sustainable sanitation systems and, thereby, contribute to SDG 6.2.

References

Spuhler D, Scheidegger A and Maurer M (2019). A generic model to quantify nutrient, water and solids flows of a broad range of sanitation systems considering uncertainties. Submitted to *Water Research*.

Tilley *et al.* 2014, *Compendium of Sanitation Systems and Technologies* – 2nd revised edition, Swiss Federal Institute of Aquatic Science and Technology (EAWAG).