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# Waste-to-Energy Decision Support System (WTEDSS) for Sustainable Waste Management System (WMS) Planning

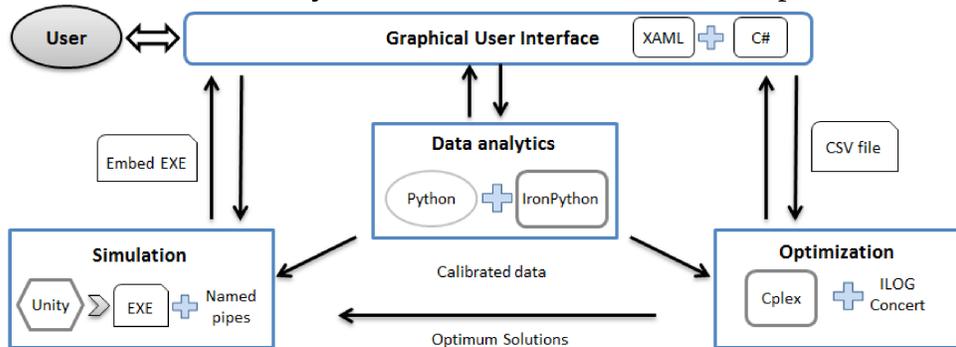
Elizaveta Kuznetsova and Michel-Alexandre Cardin

## ABSTRACT

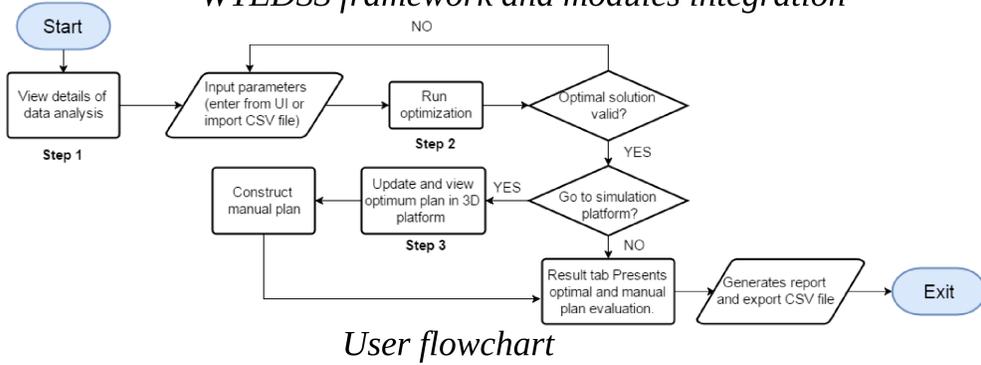
For sustainable Waste Management System (WMS) planning, a decision support system must provide not only optimal deployment solutions, but also address city challenges, e.g., land scarcity and traffic congestion. It must support a creation of flexible interactive scenarios for WMS deployment and their realistic representation in an urban context. The developed Waste-to-Energy Decision Support System (WTEDSS) i) provides waste generation overview across urban territory, ii) identifies optimal long-term deployment strategies for WMS under future uncertain operational conditions and iii) evaluates WMS performance and integration into an urban environment with 3D visualization and multi-criteria assessment.

## WTEDSS FRAMEWORK AND USER FLOWCHART

WTEDSS consists of four main modules: data analytics, optimization, simulation and graphical user interface. Input data, gathered from the user interface (UI) is sent to other modules. The data analytics performs statistical analysis and transfers the calibrated data to the optimization module and simulation platform. The optimization calculates the optimum strategy, and sends it for visualization and analysis in 2D UI and 3D simulation platform.



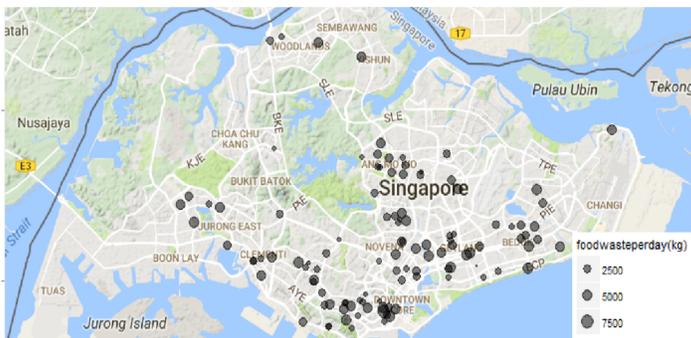
WTEDSS framework and modules integration



User flowchart

## Step 1: Data analytics

With a combination of geographic and socioeconomic data, the WTEDSS produces dynamic graphs to assist municipal planners in understanding of waste generation patterns.



Example of food waste generation sources (e.g., food courts) distribution across Singapore

## Step 2: Optimization

MILP model minimizes WMS expenses, composed of CAPEX and OPEX minus revenues, over a long-term planning horizon (e.g., 20 years).

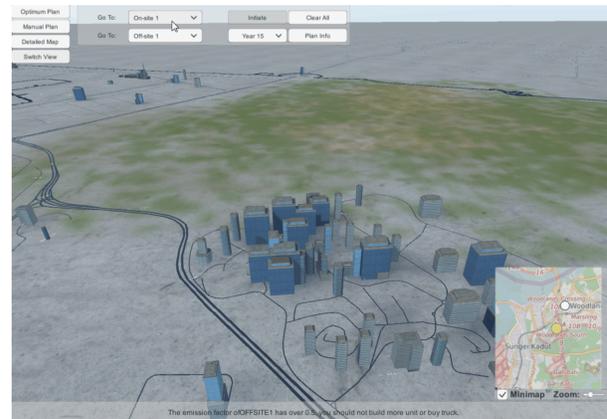
The decisions are made on:

- decentralized and centralized locations of waste treatment sites;
- technologies types and number of units to be deployed;
- time schedule for waste treatment capacities deployment;
- waste assignment for different time periods.

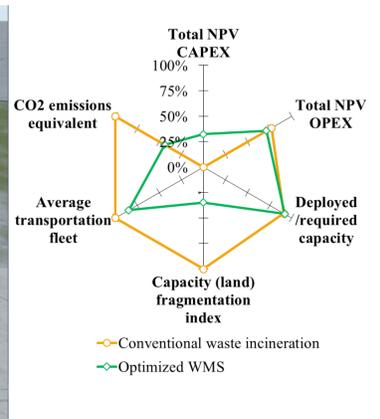
The deployment respects the urban planning constraints of transportation flows minimization (waste can be transported only to one treatment site) and land space occupation limitations.

## Step 3: Simulation and solution assessment

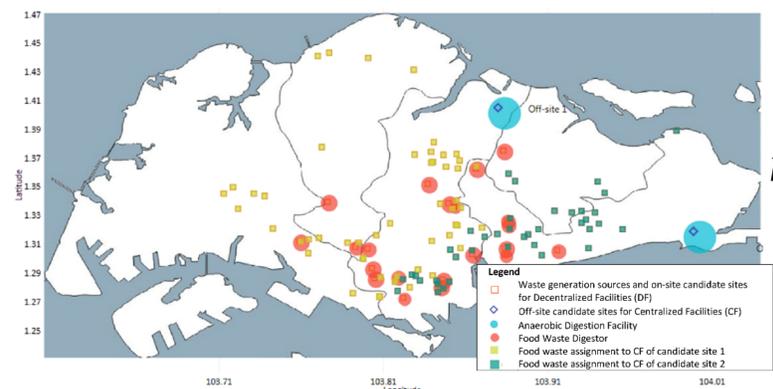
The 2D UI and 3D platform visualize the progressive WMS deployment including waste facilities and transportation flows. The performance of deployment strategies can be evaluated using a multi-criteria assessment framework.



3D simulation platform



Multi-criteria assessment



Example of WMS deployment for food waste treatment at t=15 years

## FUTURE WORK

Future developments include methodological improvements of WTEDSS modules, i.e., data analytics, optimization, visualization and assessment.

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