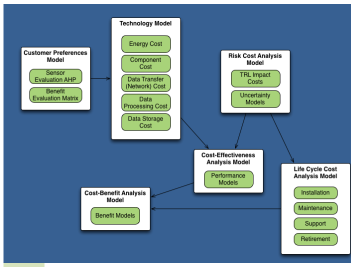

Smart Cities Decision Aid (SCDA)

A framework for smarter Smart Cities decisions

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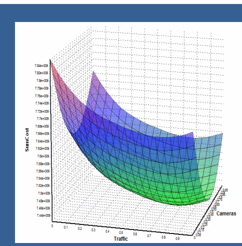

Abstract

The potential benefits of Internet of Things (IoT) technology solutions for smart cities are appealing to municipalities looking to increase revenue.

Smart Cities (SC) can drive revenue streams through both infrastructure cost savings and the increase in income that comes with a safer, more desirable city, that provides residents a higher Quality of Life (QoL). However, realization of the potential benefits of a smart city project is fraught with challenges for municipalities, due in part to the lack of a consistent and comprehensive methodology to evaluate IoT project proposals based on a deeper understanding of costs and benefits.

The Smart Cities Decision Aid (SCDA) framework provides a new methodology for municipalities to pursue and evaluate SC projects, in lieu of the current ad-hoc and limited cost-focused process for project evaluation.

Introduction

The SCDA framework is based upon an adapted version of Hazelrigg's Rational Design Framework[2], presented by Lee and Paredis as a Value-driven Design Framework[3]. Initial efforts to focus technology solutions around the objectives, constraints, and preferences of the municipality serve as inputs to models as seen in Figure 1.

Models in the framework are organized as layers, with each layer optimized individually, and the results of inner layers feed into the optimization of outer layers. This layered approach in Figure 2 allows smaller, more focused models of specific solutions to aggregate into larger models that include more complex configurations and combinations of specific technical solutions to more effectively simulate large IoT project deployments.

Methods

Optimizations at the Benefit, Solution Design, and Configuration modeling levels are performed through simulations that explore the trade space and account for uncertainty elements in the various models. Regression analyses are performed to determine equations for the full lifecycle costs of the solution, as well as the financial value of benefits to society offered by the solution.

The optimized solution is then evaluated to understand the overall utility gained, which provides the benefit a municipality will receive for the project, with respect to cost to achieve that project. Maximizing utility gained will allow the municipality to identify the best projects and configuration options for selection.

Discussion

Exploration of customer objectives, constraints, and preferences lead to an evaluation of four technology solutions: crime cameras, gunshot detectors, LED lights, and emergency vehicle traffic management. Using ModelCenter to integrate each cost factor, the tool returned an exact number of each sensor types needed to optimize utility for the municipality, as compared to the current baseline.

The charts in Figure 3 show the point where additional sensors are not worth their cost. While additional gunshot detectors per block may marginally reduce crime, the society benefit integrated with the sensor cost shows the diminishing economic returns. The final numbers were compared to third party data for validation.

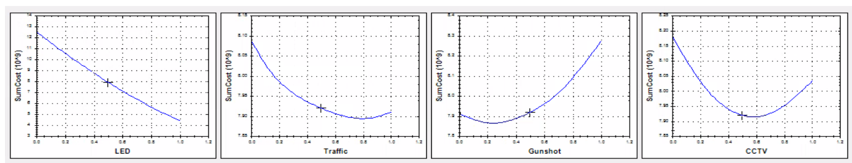

Figure 3: Sensor Sum Costs Compared to Highest Utility

Results

A modeler can evaluate solutions by comparing total cost. This process evaluates the cost advantages of societal benefits, as well as exposes additional values that can help justify new projects.

The SCDA team found that a gunshot detection system would cost $3.2M to install and $3.4M a year to maintain, yet it was possible for the municipality to save $56M annually if other societal costs and benefits were considered.

The additional revenue associated with the system was realized not only through cost reductions associated with fewer crimes and less demand for emergency healthcare, but also through an increase in the public perception of safety, which lead to population growth and increased tourism.

Conclusions

No methodology currently exists for the transparent and quantitative evaluation of IoT implementations for SC other than non-standard, qualitative assessments and decisions based on simple cost and subjective evaluations. This methodology gap leads to short term policy solutions, sub-optimal financial benefits, and decreased public perception.

The ability to consistently and accurately measure the complete benefits of a project, including societal and QoL benefits provides a yardstick to evaluate multiple, dissimilar, potential deployments. The chosen technology solutions provide visibility into recommendations for further study and demonstrates how complex technology solutions can be evaluated to make better informed decisions about SC IoT design and deployment.

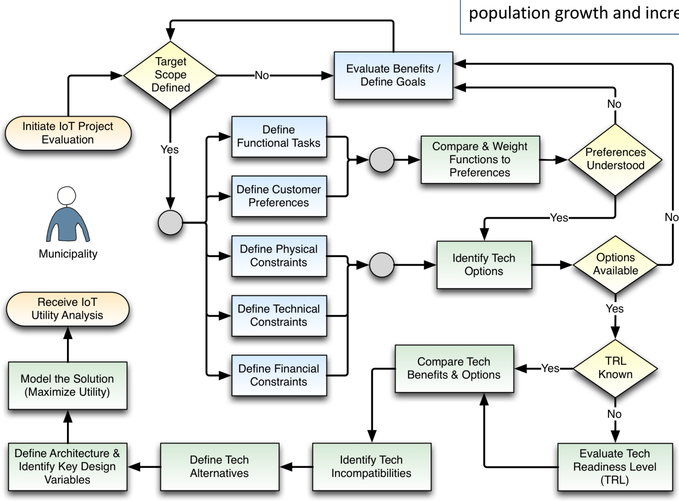

Figure 1: Model Derivation

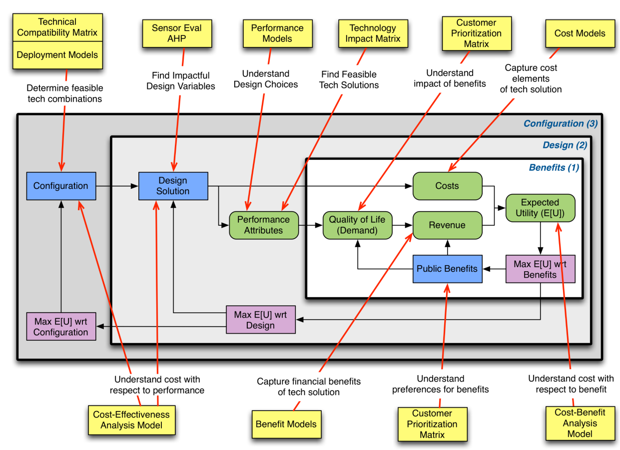

Figure 2: Model Layering

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Resources

GitHub Repository
https://github.com/cdbyrd/pmase-smartcities

Sensors Magazine Article
http://www.sensorsmag.com/internet-things/scda-framework-accelerates-large-iot-projects-smart-cities-24871

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