

## **Keynote: Campuses as Living & Lived-in Laboratories for Smart City Development**

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University campuses must take a leadership position in helping cities and nations address the challenges and opportunities of climate change, urban population growth in developing countries, as well as aging populations in developed countries. To turn these challenges into opportunities require systems integration approaches to providing regional, urban and local energy, connectivity, water, mobility, and food while improving environmental quality, human health, biodiversity, and employment through future oriented community and building practices.

Carnegie Mellon University, for example, has undertaken four major initiatives with significance to the smart and sustainable cities objectives. Traffic21 introduced sensors, actuators and controllers to improve urban connectivity within existing infrastructure. It accomplished this by translating intersection congestion and flows into innovative traffic light management to reduce waiting time, pollution and energy consumption.

This led to the MetroLab Network, extracting wisdom from an emerging network of sensor data related to air, water, transportation, building energy, and more. MetroLab is a recently-launched network of more than 20 city-university partnerships focused on “smart cities“ with the mission is to bring together university researchers with city decision-makers to research, develop, and deploy research, development and deployment of technologically- and analytically-based solutions to improve our infrastructure, services, and other public sector priorities.

CMU and Pittsburgh are also a member of President Obama’s “Smart Cities“ Initiative that will invest over \$160 million in federal research, and “leverage more than 25 new technology collaborations to help local communities tackle key challenges such as reducing traffic congestion, fighting crime, fostering economic growth, managing the effects of a changing climate, and improving the delivery of city services“. The Smart Cities initiative will create test beds for “Internet of Things“ applications and developing new multi-sector collaborative models.

The fourth major initiative is grassroots, the actions taken by building portfolio owners across the Pittsburgh region in collaboration with faculty and students in the university.

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Building owners with major portfolios of older buildings and infrastructures are exploring the power of the Internet of Things and Big Data to improve the quality of indoor environments, energy and water conservation, and organizational effectiveness. These building sector leaders include: the Green Building Alliance's launch of the 2030 Challenge across the City of Pittsburgh; the Energy Innovation Center (EIC) for technical training of the next generation of trades to address critical retrofits; PNC Bank re-imagining a portfolio of 4000 buildings, Phipps Conservatory's Center for Sustainable Landscapes living building; and the world-renowned Intelligent Workplace (IW), the first Lived-in (experienced, measured, evaluated and verified performance) and Living (continuously updated and improved) Lab in the building industry. In collaboration with the Institute for Informatics at Technical University Munich (TUM), Carnegie Mellon's Center for Building Performance and Diagnostics has utilized this unmatched living laboratory for innovations in sensors, controllers, user interfaces and data analytics that engage the end user as a partner in deep energy conservation and improved indoor environmental quality, with significant applicability for the future of smart cities.