Coláiste na Tríonóide, Baile Átha Cliath
Trinity College Dublin
Ollscoil Átha Cliath | The University of Dublin

Future Cities
Trinity Centre for Smart and Sustainable Cities

NSF Wireless Cities Workshop Open Research Questions

Prof. Siobhán Clarke

Trinity's Future Cities Centre

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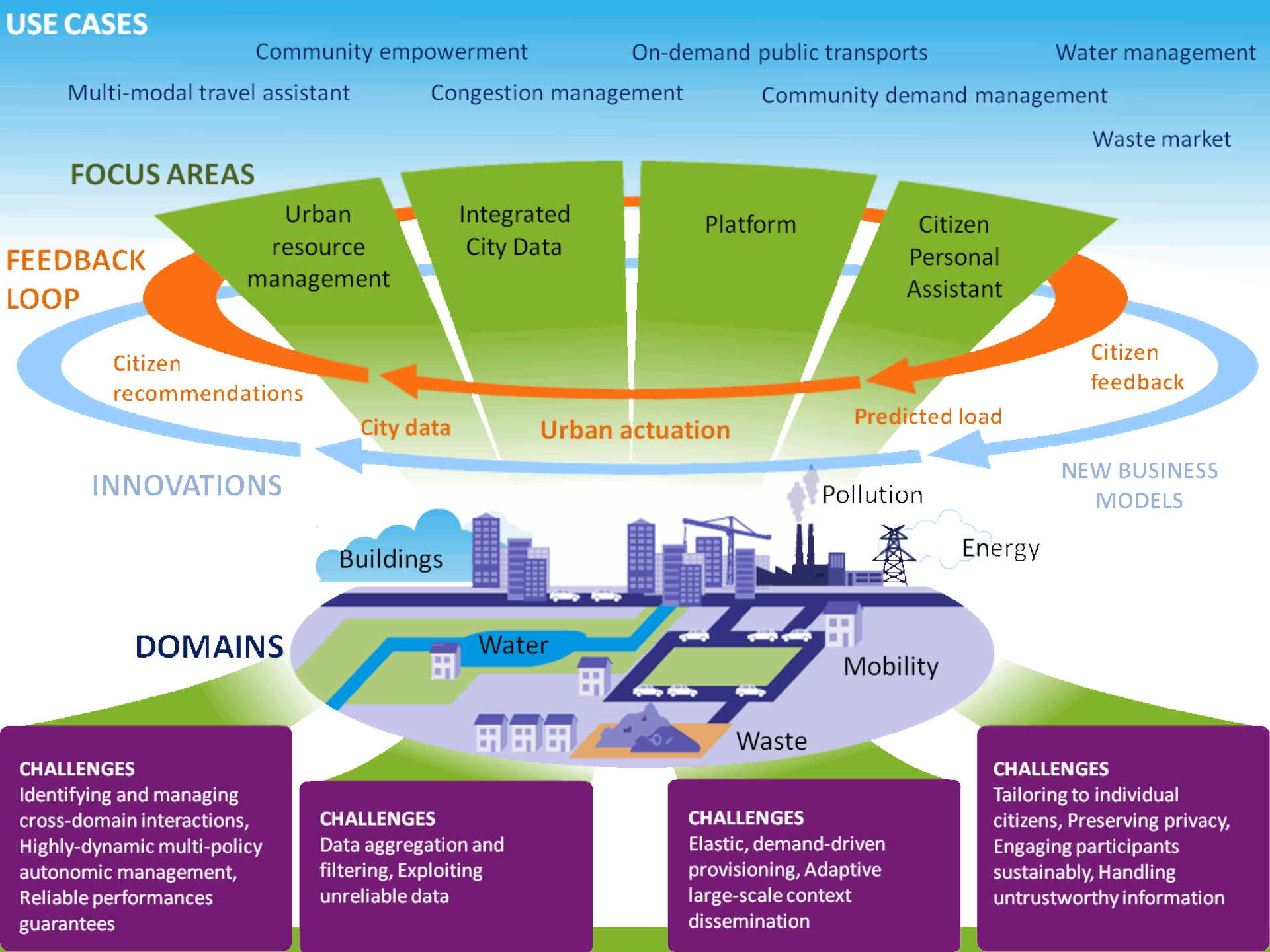
The Future Cities Research Centre undertakes **multi-disciplinary research** that enables, promotes and **facilitates behavioural change for sustainability**.

The research is supported by the application of sensor, communication and analytical technological solutions to sustainability concerns in urban infrastructure such as energy, water, waste management and transportation systems.

https://www.tcd.ie/futurecities/


USE CASES
Community empowerment
On-demand public transports
Water management
Multi-modal travel assistant
Congestion management
Community demand management
Waste market
FOCUS AREAS
Urban resource management
Integrated City Data
Platform
Citizen Personal Assistant
FEEDBACK LOOP
Citizen recommendations
City data
Urban actuation
Predicted load
Citizen feedback
INNOVATIONS
NEW BUSINESS MODELS
Pollution
Buildings
Energy
DOMAINS
Water
Mobility
Waste
CHALLENGES
Identifying and managing cross-domain interactions, Highly-dynamic multi-policy autonomic management, Reliable performances guarantees
CHALLENGES
Data aggregation and filtering, Exploiting unreliable data
CHALLENGES
Elastic, demand-driven provisioning, Adaptive large-scale context dissemination
CHALLENGES
Tailoring to individual citizens, Preserving privacy, Engaging participants sustainably, Handling untrustworthy information

Focus Area
Citizen Engagement

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Citizen engagement and participatory sensing are key to the exploitation of the internet of things for smart city services

- On-going research in the group:
  - Citizen engagement in city services co-design process
  - Participatory sensing: enabling citizens to contribute real-time data about the city resources
  - Large-scale, flexible, adaptable middleware for participatory sensing applications

- Open research questions:
  - How do we ensure sustained citizen participation?
  - How do we design privacy mechanisms to empower citizens to control their data?
  - How do we scale the real-time control actuation for provision of urban services?

- Use cases:
  - Proactive Multimodal Journey Assistant
  - Future Cities Virtual Personal Assistant
  - Community Competition
  - Energy Personal Assistant
  - Community Empowerment

Focus Area
City Resource Mgmnt

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*The complexity, scale and reliability requirements of smart city services require **autonomous** systems.*

- On-going research in the group:
  - Learning urban data patterns to support closing the control feedback for individual urban domains, in particular urban traffic control and energy demand-side management.
  - Self-organising systems and learning algorithms: dynamic, large-scale, decentralised multi-policy, multi-agent techniques, in particular, reinforcement learning, evolutionary algorithms and Monte-Carlo methods applied to urban domains
  - Security: protection of critical services

- Open research questions:
  - How do we efficiently and reliably learn optimal system behaviours in urban-scale dynamic, uncertain environments?
  - How do we predict and manage conflicts arising from goal priorities that change over space and time?
  - How do we predict and manage emergent behaviour in interacting city services?
  - How do we ensure security with pervasive urban sensing?

Focus Area

Urban Data Integration

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The independent, heterogeneous nature of existing WSNs and other city data sources requires a privacy-aware context-based approach.

- On-going research in the group :
  - Urban sensing – gather, process, analyse city-wide data from mobile devices, WSNs, open data, etc. for providing real-time city information
  - Privacy: real-time privacy-aware sensor aggregation

- Open research questions:
  - How do we manage unreliable, noisy, intermittently connected, potentially malicious sources of data?
  - How do we identify, amongst the vast amount of available data, relevant information for city services?
  - How do we balance privacy with pervasive urban sensing?

Focus Area
Urban Data Platform

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The dynamic, mobile data source environment in a city requires elastic, demand-driven network configuration and service provision

- On-going research in the group :
  - Self-adaptive systems: dynamic, run-time model-based software adaptation, including monitoring, analysis and actuation in urban domains
  - Discovery of autonomous semantic services in mobile ad hoc environments
  - Opportunistic service composition in dynamic ad hoc environments

- Open research questions:
  - How can we provide quality of service guarantees related to large-scale autonomous urban services?
  - How do we enable city-scale, reliable context dissemination?
  - How do we provide elastic, demand-driven provisioning?

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Thank you.

Prof. Siobhán Clarke

Director, Future Cities. The Trinity Centre for Smart and Sustainable Cities

Trinity College Dublin

Siobhan.Clarke@scss.tcd.ie

www.tcd.ie/FutureCities/