Title: Communication on Smart City Evaluation and Reporting In UK cities

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Abstract

Global trends towards urbanisation are associated with wide-ranging challenges and opportunities for cities. Smart technologies create new opportunities for a range of smart city development and regeneration programmes designed to address the environmental, economic and social challenges concentrated in cities. Whilst smart city programmes have received much publicity, there has been much less discussion about the evaluation and measurement of smart city programme outcomes. Existing evaluation approaches have been criticised as non-standard and inadequate, focusing more on implementation processes and investment metrics than on city outcomes and the impacts of smart city programmes. Addressing this, the SmartDframe project aimed to examine city approaches to the evaluation of smart city projects and programmes and reporting of their impacts on city outcomes. A number of 'smarter' UK cities were invited to participate, with agreement by city authorities from Birmingham, Bristol, Manchester, Milton Keynes and Peterborough to be interviewed about their smart city work. The findings provide a series of smart city case studies that exemplify contemporary city practices, offering a timely, insightful contribution to city discourse about existing and best practice approaches to evaluation and reporting of complex smart city projects and programmes.

Keywords: smart cities, smart city evaluation, city reporting, smart city programmes, UK cities

Communication on Smart City Evaluation and Reporting in UK Cities

Introduction

This communication reports on the SmartDframe project which aims to examine city approaches to the evaluation of smart city projects and programmes and reporting of city outcomes and impacts, through a series of case studies, in smarter UK cities including Birmingham, Bristol, Manchester, Milton Keynes and Peterborough. Linked to the Open University-led MK:Smart programme (mksmart.org/), which is part of Milton Keynes' Future City programme, the SmartDframe initial findings and analysis aim to inform city approaches to smart city evaluation.

Background

Global trends towards urbanisation are associated with wide-ranging challenges for cities creating complex pressures on city environments, infrastructure, buildings, networks, resources and people. City authorities need to develop infrastructures, systems and services to help citizens live, work, play and travel - ensuring that cities can develop economically, whilst protecting the environment and quality of life for citizens. The rise of smart city thinking is a direct response to such challenges, as well as providing a means of integrating fast-evolving technologies into the living environment. Smart technologies offer cities and citizens exciting solutions for new services provision, integrated city infrastructures, as well as opportunities for innovation, digital entrepreneurship, sustainable city development and regeneration, and to capitalise on novel sources of real-time data.

While smart city programmes have received much publicity there has been less discussion about evaluation of smart city projects and programmes, and measurement of their outcomes for cities. There are several key reasons why it is important to evaluate smart city work. Nearly 90% of EU cities with over 500,000 inhabitants are smart cities already (EU Directorate-General 2014, 9). A second reason is the potential growth and value of the global smart technology industry estimated to be worth $408 billion dollars by 2020 (although there are different estimates) (Bis 2013a, 2). A third reason is the proliferation of smart city programmes and projects designed to address a broad range of city challenges, and

bring opportunities for smarter: governance, economic development, citizenship, living, environments and mobility, whilst requiring effective evaluation to prove their value and benefits delivered to cities and citizens.

Existing evaluation approaches have been criticised as non-standard and inadequate, and more focused on implementation processes and investment metrics than city outcomes and impacts (Bis 2013b, 3-47). Currently there is no standardised smart city measurement indicator framework accepted by cities to measure city performance, and to help evaluate progress against city strategies aligned with measurement indicators and Europe 2020 strategies, according to the European Innovation Partnership on Smart Cities and Communities (EIP-SCC), which observed that '…*there is presently no single, broadly-accepted indicator framework that reflects the 'smart city' approach…*'. (EIP-SCC 2013, 16). Neither is this helped by the large number of smart city definitions (Albino et al. 2015, 3-21), nor the observation that most so-called smart cities are at different phases of becoming smart cities, according to the International Data Corporation (IDC) Smart City Maturity Model, based on benchmarking cities against maturity indicators (IDC 2013, 2). Reflecting this, the British Standards Institution (BSI) defines the smart city as requiring '*effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens*' (BSI 2014b, 12).

Considerable work is currently on-going to address challenges associated with smart city evaluation. This includes work on standards by the International Standards Organization (ISO), European Committee for Standardization (CEN) and BSI. There is also significant work on evaluation driven by the European Commission (EC), including EUROCITIES CITYKeys (citykeys-project.eu) which provides EC funding for cities to develop and validate smart city measurement frameworks and measures of their Key Performance Indicators (KPIs), as well as data collection procedures to support standardized and transparent European-level monitoring, and enable comparability of smart city solutions across European cities.

Moreover, there are a number of city measurement indicator frameworks specially designed to support city approaches to smart city evaluation, including *The Smart City Reference Model* (Zygiaris, 2013), *The European Smart Cities Ranking Model*

(Giffinger et al. 2007), *The Smart City Index Master Indicators* (Cohen, 2014) and *The Smart City Maturity Model* (IDC, 2013). There is also *The Ericsson Networked Society City Index* (Ericsson, 2014); and IBM's Smarter City Assessment Tool, which focuses on assessing cities' capabilities as instrumented, interconnected and intelligent (ibm.com). General city indexes are also a major source of indicators, measures and data (See Moonen and Clark, 2013), such as *The 'Cities of Opportunity Index'* of leading cities (PricewaterhouseCoopers/Partnership for New York City, 2014). However, surprisingly few general city indexes with a published methodology open to scrutiny have identified specifically smart city indicators and metrics.

Research Methods

To support future city strategies, it is important to understand the benefits of smart city project and programme developments by examining evaluation, measurement and reporting on the outcomes for cities. The SmartDframe project aimed to examine city approaches to evaluation of smart city work and reporting of city outcomes and impacts, through a series of city case studies. Key research questions included:

- How are cities approaching evaluation of smart city projects and programmes?
- How effective are the approaches taken?
- How are cities reporting on smart city work?

A selective number of city and local authorities representing 'smarter' UK cities were invited to participate in SmartDframe case study research, including Birmingham, Bristol, Manchester, Milton Keynes and Peterborough. Representatives of Glasgow City Council and The Greater London Authority were also invited, although not included at this stage. Cities were selected because they were active in having a large number of funded smart city projects and programmes, and because they were strongly involved in smart city networks, for example EUROCITIES, EIP-SCC, Small Giants and UK Core Cities.

Selected cities also represented cities with different population sizes, a useful indicator for city stratification. According to the EC classification (EC 2012, 5): Birmingham is an XXL-sized city (over 1,000,000 inhabitants); Manchester an XL-

sized city (500,000-1,000,000 inhabitants); Bristol and Milton Keynes (as a new city) represent large-sized cities (250,000-500,000 inhabitants); and Peterborough a medium-sized city (100,000-250,000 inhabitants). Small cities with populations of 50,000-100,000; and global cities with more than five million inhabitants were not included in the SmartDframe analysis.

Local government authorities representing these cities agreed to be interviewed during 2015. The authorities understood the smart city concept in terms of their smart city and future city programmes which involve partnerships between business, universities and the public sector. Some programmes were led by Councils, for example Manchester's 'Smarter City Programme'; and Milton Keynes 'Future City Programme'. Others were led by Councils and their Directorates, for example, Birmingham's 'Smart City Commission' supported by Digital Birmingham; 'Smart City Bristol' led by Bristol Futures and delivered through Connecting Bristol; and 'Peterborough DNA' led by Peterborough City Council and Opportunity Peterborough. Birmingham was the only city with an established Smart City Commission and published 'Smart City Vision and Roadmap', although Manchester and Bristol cities were considering producing a Smart City Road Map.

The case study analysis was subsequently based on reviews of city reports, and interviews with key local government authorities. City case study data were analysed in terms of: strategy and action; approach to evaluation; effectiveness of approach; reporting on city outcomes; challenges and improvements.

Smart city evaluation practices

The case study analysis revealed a dynamic, varied and detailed picture of the cities' approaches to smart city evaluation and reporting (Caird et al. 2016).

Project-focused evaluation

The cities' approach to smart city evaluation were currently focussed at a project level, and primarily driven by the external funders' requirements. For example, EC funders were interested in clear measurement indicators applied to support data sharing across European-funded projects; whereas Innovate UK funders of Future Cities Demonstrator projects currently placed more importance on demonstration of the innovation concept, although were beginning to address evaluation issues.

Most of the cities were in the early maturity phases of smart city development (IDC 2013, 2), where demonstration of the innovation concept validity may be an appropriate initial evaluation before projects can be scaled to the city. Manchester authorities said "*Inappropriate evaluation could kill a good idea if conducted too early.*" Milton Keynes and Peterborough authorities were also cautious of premature evaluation of innovation projects, fearing it might crush opportunities arising from smart city work.

Establishing baseline measures for projects was considered a good approach to demonstrate validity and progress. Several cities, such as Birmingham, Bristol and Milton Keynes have already established KPIs and measures for projects; although only Birmingham had a formal Smart City Roadmap helping to establish actions and measures of progress towards city targets. Birmingham authorities recognised the importance of baseline measures for monitoring progress, and for identifying projects with the biggest city impacts and replication potential. Peterborough authorities intended to establish baseline measures from the outset with the Phase Two Plan for their DNA programme.

Current smart city evaluation work

The cities evaluation practices reflected an awareness of ongoing smart city evaluation work, such as the BSI work and the EUROCITIES CITYKeys programme (citykeys-project.eu). Most of the cities were aware of the BSI Smart City Framework (PAS181), which provides guidance on the articulation of smart city benefits, and mapping, tracking and baselining them against measures over time (BSI 2014, 40-49). The EC's increasing emphasis on evaluation has also influenced the cities' work to address smart city challenges, including Birmingham and Manchester's involvement with the CITYKeys project. However, the city authorities were less familiar with the details of smart city indicator frameworks and city indexes available to support evaluation.

Plans to establish a smart city evaluation framework

The local government authorities intended to undertake evaluation at the city level, and most were working in partnerships, mainly with local universities. Although most had not advanced evaluation plans, Birmingham had made significant progress in developing a city-level evaluation framework aligned with their smart city strategy

and Roadmap. They had already conducted research looking at various evaluation frameworks, models and standards; worked with Arup to trial an energy-focused smart city framework; and were planning to work on evaluation with their partner KPMG, a global professional service company. However, their priority was to get projects operational, and *"they did not want to get side-tracked on measurement"*. Nevertheless they recognised "*It is not just about delivering projects, what we want to do is identify where we are making the impacts, how we get things to change, what difference we are making to citizens and businesses.*"

Through Manchester's work on the Advisory Board for CITYKeys, they were leading smart city benchmarking work across city areas, including economic development, governance, city infrastructure, transport, energy and citizen engagement. Manchester were also developing an Impact Assessment Framework in partnership with universities, for one of their European-funded smart city projects Triangulum ([triangulum-project.eu/)](triangulum-project.eu/), where they planned to address city level impacts. They said '*Triangulum is providing the basis to get the Framework right, dealing with energy, transport, dealing with people; it's got the basic ingredients of the impact framework. Once it's working well it can be expanded in scale, geographically and thematically*'.

However, most cities had not yet adopted an effective evaluation framework to measure the impact of smart city work on city outcomes. Milton Keynes authorities had developed many measures through their MK:Smart programme which could contribute to a smart city evaluation framework, although they faced challenges proving the impact of specific projects on city outcomes. Peterborough authorities were beginning to consider impact assessment, following an initial evaluation that aimed to improve their future city 'DNA programme'; reduce the complexity of projects; and address project scalability issues. Manchester and Milton Keynes authorities regarded smart city evaluation as being at an early stage, and did not think any cities had established a full evaluation programme yet. Birmingham authorities also acknowledged that no accepted evaluation approach to smart city work had emerged as yet.

Developing data intelligence

The cities' practices reflected an interest in developing data intelligence as part of their smart city approach. New mechanisms for city data generation, collection, and

sharing, including through data hubs, were helping city authorities develop data intelligence, and beginning to inform city strategies. Birmingham authorities have started to explore how data intelligence works across their city, bringing together datasets and encouraging data sharing with other organisations. Milton Keynes authorities mentioned that the city already had significant volumes of real-time data streams and other datasets collected through the MK:Data Hub. Their focus was on enabling organisations to share data, and addressing barriers such as data ownership, bureaucracy and governance issues. Peterborough authorities have also established mechanisms for feeding data collected through their city projects to the Council's Central Intelligence Unit.

Bristol authorities identified the importance of opening up data to unlock new opportunities for the city, and were using real-time traffic data collected through the Traffic Control Centre to measure congestion in the city combined with data collected through the Bristol Open Data Portal. Manchester authorities mentioned that their smart city data has been informing city strategies, such as climate change, economic development and transport strategies. Hence, the potential to capitalize on smart data sources and data intelligence is beginning to be realised.

Formal reporting processes

All the cities established processes for reporting on city performance related to measuring progress on city objectives set out in the Community Strategies (which some cities have), or the city's Council Plan or Corporate Plans led by relevant Local Authorities. The larger cities including Birmingham, Bristol and Manchester also publish Annual State of the City Reports. However, their smart city projects and programmes did not currently feed directly into their city performance reporting process, addressing statutory reporting obligations; and were therefore not subject to a formal political reporting process.

Whilst the cities had established a variety of formal and informal city reporting mechanisms, most of the formal reporting on smart city work has been driven by funding bodies; Birmingham's Smart City Commission also required quarterly reports. However, city councils typically report on hundreds of KPIs as part of formal city performance reporting, and many reported indicators have links to areas of smart city work i.e. energy, climate change, transport, waste and the liveability of the

city. Bristol authorities suggested that a mechanism was needed to report how smart city projects and programmes contributed to existing city KPIs, and formal city performance reporting processes.

Influence on city decision-making

City authorities discussed how smart city work was beginning to influence city decision-making, particularly around city investment and development. For example, smart development work around Manchester airport; and the Bristol Energy Company (bristol-energy.co.uk/) that was intended to be 'smart from the start'; and Peterborough's Smart City Leadership event for public and private sector organisations working across city areas. City decision-making would benefit from establishing effective evaluation and reporting mechanisms addressing the value and impacts of smart city work.

Conclusions and recommendations

Initial analysis of the SmartDframe findings have identified a number of challenges for evaluation and reporting of smart city work. Key evaluation challenges identified by cities centred on how to measure the causal impacts of smart city projects and programmes on city outcomes, and prove the value of such interventions. The cities already have significant project data, although faced challenges of how to make sense of data, and deciding which methodology to use to measure the impacts of their smart city work. Cities were exploring the value of data intelligence to support city strategies and actions; and were beginning to develop use of data intelligence for evaluation and reporting, supported by developments in data standards and interoperability; and to consider the opportunities afforded by smart technologies for evaluation work.

City reporting challenges centred on establishing appropriate reporting structures, so that smart city work is embedded in city management structures to support communications about the value of their projects and programmes, and to show how smart city work contributes to city performance reporting, and statutory reporting obligations. A key issue is how to make good use of data intelligence to communicate the value of smart city work generally and to report benefits for cities.

Initial analysis of the SmartDframe findings suggests the following recommendations.

Smart city evaluation approaches should:

- Be appropriate to smart city project, programme and city levels.
- Build on baseline measures established to demonstrate progress against targets.
- Develop city mechanisms to capitalize on data intelligence through evaluation and reporting at smart city project, programme and city intervention levels.
- Build on current methodologies to develop standardized frameworks applicable to cities with different challenges, strategies, and smart city programmes and projects.
- Explore opportunities to measure the impacts of smart city projects and programmes developed at city scale, against existing city Key Performance Indicators aligned with city strategies.

Design of evaluation frameworks should:

- Be flexible and relevant to different city challenges and circumstances;
- Reflect the complexity of city systems;
- Allow for evolution;
- Respond to data-driven mechanisms;
- Reflect the city's smart city vision and strategic objective;
- Include measurable indicators (quantitative and qualitative) that reflect the multi-faceted nature of smart cities rather than focus on arbitrary or easily measured indicators.

Smart city reporting approaches should:

- Develop formal and informal reporting mechanisms to communicate the value of smart city work.
- Establish management structures so that smart city work is embedded in open city structures, supporting reporting through the wider community partnership of *all* the organisations responsible for delivery of city strategies and plans, and through the wider city stakeholder partnership.
- Develop formal reporting mechanisms to use data intelligence (from smart city analytics and evaluations) more effectively to feed into city performance

reporting and formal political reporting processes, meeting statutory reporting obligations.

Further details on the SmartDframe study is available through the report 'A Tale of Evaluation and Reporting in UK Smart Cities' (Caird et al. 2016). To support future city strategies we need to understand the benefits and outcomes of smart city developments for cities and citizens. This report provides a series of contemporary smart city case studies helping to exemplify city practices, offering a timely, insightful contribution to city discourse about best practice approaches to evaluation and reporting of smart city project and programme outcomes in complex city systems.

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