

The Role of Standards in Smart Cities

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Introduction

As City Authorities and their delivery partners strive to meet aspirations of citizens, they face complex choices and decisions about what type of City they are seeking to create. Different Cities will have different visions or priorities for development, reflecting the needs and circumstances of their populations and economic activities. Other issues such as resource limitations, risks and resilience may also play a part in the assessment of priorities, to enable the City Authority to take a holistic view of the City's future path.

Cities – nationally and internationally – are main drivers of economic activity: growth and, in the current context, recovery, but this output depends on a comprehensive infrastructure to deliver physical and social resources – the fuel of a City's 'economic engine'. The economic performance of a City is inextricably linked to its physical and communications infrastructures, and the delivery of resources through these infrastructures.

Cities occupy only around 2% of land mass and are occupied by 51% of the world's population and they consume an estimated 80% of its resources. The current global population is 7+ billion, and is forecast to grow to 9+ billion by 2050, by which time it has been predicted that approximately 80% of the global population will be urbanised.

The strain on traditional delivery mechanisms and supply of resources due to increasing populations poses a significant challenge to the sustainable growth of Cities. This applies not only to physical resources, such as energy, water or waste management, but also to social and economic resources, such as healthcare, traffic management and City logistics. As traditional resource delivery systems approach the limits of their capability, there is an urgent need for innovative delivery systems to effectively manage and control resource use in Cities.

Smart City¹ technologies based on digital infrastructure and digital services offer a potential way of monitoring and managing physical and social resource in the city. Digital technologies can collect sufficiently large amounts of data to support very close matching of supply availability against demand requirements. The use of historic information to correlate with actual events can also inform immediate reaction where the data sets match those of a previous historic event. The new communications potential from sensors on buildings, roads and other elements of the City and the sharing of data between service delivery channels, if integrated, will enable the City to improve services, monitor and control resource usage and react to real-time information.

To help address the issues involved in commissioning smart cities, the UK Department for Business, Innovation and Skills (BIS) has commissioned the British Standards Institution (BSI) to develop a standards strategy for Smart Cities in the UK. The strategy identifies the role of standards in accelerating the implementation of Smart Cities and providing assurance to citizens that the risks are being managed appropriately. This document provides an overview of the strategy.

¹ For the purposes of consistency, the term "Smart Cities" is used in this report, although there are a number of similar terms for overlapping concepts in general use, including "Future Cities" and "Intelligent Cities".

1 City Systems

The output of Cities depends on a comprehensive infrastructure to deliver physical and social resources, without which both the effectiveness of the City as an economic unit and its economic performance will be impaired. For example, the ease with which people communicate, travel and meet plays a key part in the City's ability to foster a thriving business community, creating requirements for development of the transport and communications infrastructure and services. The physical and social resource systems can be thought of as delivery channels, enabled by supporting information flows.

Figure 1 below shows some of the sources of information and data that are derived from infrastructure and systems (horizontal bars) and the service delivery channels (vertical bars) that depend on the information and data. At present service delivery through the vertical channels tend to operate in isolation from each other - they are "silos" of information, activity, and governance. However, there are many areas where information gathered through the City's infrastructure for one service is relevant to another service. Digital infrastructure provides a medium for delivery of digital services and taking information from citizens, offering the potential of increased service integration within and between delivery channels, enabling 'smarter' Cities – delivering improved services to citizens and businesses, and making much more efficient use of physical and social resources.

For example, tele-health delivered through applications in the Healthcare delivery channel may rely on data about a patient's daily activities generated from sensors in the home and on information from social resource management systems – integration of information across different key inputs.

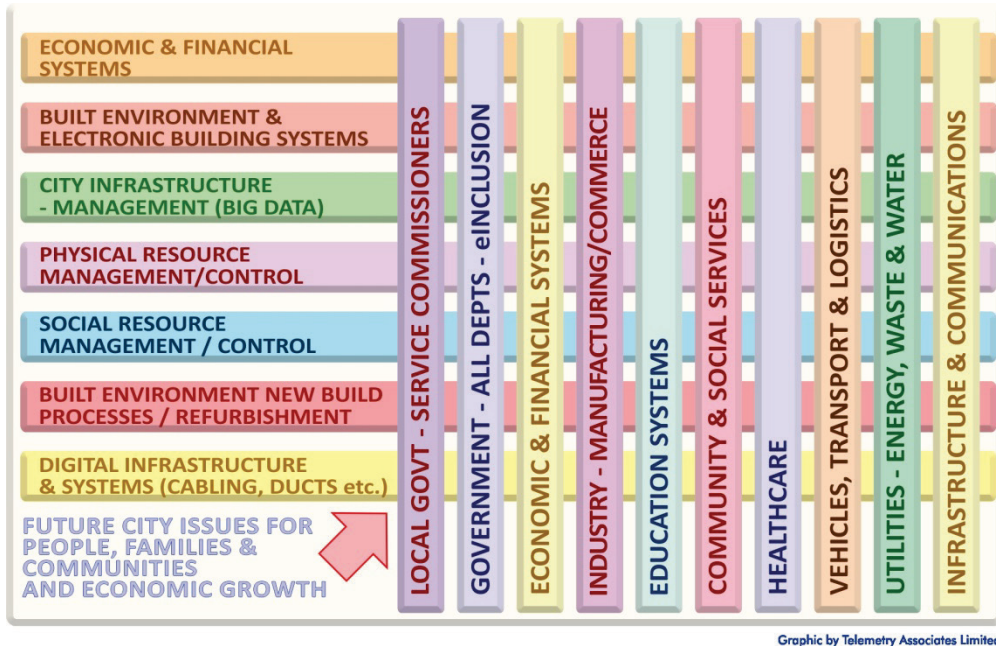


Figure 1 — Some elements of the Future City

2 Moving to a Smarter City

In the development of the standards strategy for smart cities, BSI conducted a review of existing standards and gap analysis and a wide ranging public consultation to identify the problems cities face in implementing smart city solutions. Four key issues emerged from the study:

- **How will City Authorities set their objectives for Smart Cities and measure progress?**
- **How will information be captured and shared between infrastructure and services?**
- **What risks are there in moving to Smart City services and how can these be managed?**
- **How can cities create the shared understanding to deliver the vision?**

2.1 How will City Authorities set their objectives for Smart Cities and measure progress?

2.1.1 Objectives

A key policy aim for City Authorities is to ensure that economic development is sustainable in the long-term. The City's economic performance is interlinked with issues such as the strength of the community, and the types of economic development that are possible depend upon the aspirations of the community. The availability of a pool of talented people may depend on the quality of life a City can offer, which is related to outcomes in areas such as health and justice.

Smart City objectives will need to link into these overall aims for a City. While Smart Cities clearly play a role in delivering the outcomes Cities are looking for, at present there is no clear definition of what it means to be a Smart City or how to identify the specific contributions they can make to the overall City objectives.

2.1.2 Metrics

At present it is not straightforward to assess what contribution specific infrastructure, systems and services investments can make to Cities' performance. City Authorities need reliable and broadly comparable data on the health of their City, so City-wide metrics are needed to determine the priorities for improvement and identify in which direction the City is moving. A linked set of performance metrics is required to assess the infrastructure that underpins City services, and is essential for the development of the City: these will cover the infrastructure that delivers water, electricity, gas and multimedia, removes and treats sewage, and creates physical connectivity by road, rail, canal, path and park, and informational connectivity by fibre-optic cable and copper wire.

A particular issue is how to quantify the impact of smart city initiatives in a way that can support an investment appraisal. The lack of a coherent set of metrics makes it difficult to plan investment strategies with the confidence that the planned improvements will actually be delivered. There are a number of impressive pilot projects but no standard way of assessing their impact.

2.1.3 Current Standards Programme

High-level principles-based standards can provide a framework for making choices about sustainable development of Cities. The primary standard for sustainable development is BS 8900, which advocates the use of principles as the basis for setting policy to get an organisation to think strategically about its intended course of action. It also stresses the importance of balancing economic, social and environmental development. BS 8900 is currently under revision, with the intention of both providing explicitly strategic guidance and a generic management system standard for sustainable development.

In setting policy for the City, BS 8904 *Guidance for community sustainable development* helps the responsible authorities think strategically about what sort of City it is their citizens and businesses want. The route to finding out exactly what their citizens require is through stakeholder engagement, which allows for a deep understanding of the concerns of the City. BS 8904 also allows grass-roots communities to better control their own development. An ISO standard on community sustainable development is in the early stages of development, currently proposed to be a management system standard for local authorities, embedding a similar methodology to BS 8900.

Another important part of the standards framework, in which activity is already underway, covers metrics. This work includes an ISO based on the Global City Indicators project to embrace almost every aspect of human activity, including housing, education, health services, crime and policing. One indicator of critical importance is the level of greenhouse gas emissions (GHGs), and a professional standard (PAS 2070) is under development to allow consistent assessment of GHG emissions at the City level.

Another ISO project is in development to set agreed metrics for data about this infrastructure. This project will also attempt to standardise the metrics used to specify the infrastructure itself, and any control and communication technology. Standardised data formats and communication protocols will allow services to share information and give specifiers greater confidence in the compatibility and longevity of the infrastructure equipment they purchase. UK standardisation work that will contribute to the overall picture includes work on Smart Grids and Smart Meters.

2.1.4 Future Activities

BSI is planning to hold an industry workshop to scope further standards activities in relation to performance assessment methodologies and investment appraisal in the smart city context.

This workshop will be held in Summer 2013.

2.2 How will information be captured and shared between infrastructure and services?

2.2.1 The need for common communications

A defining feature of Smart Cities is the ability of the component systems to interoperate. The optimal use of resources across a complex urban environment depends on the interaction between different city services and systems. To identify the most effective use of resources therefore requires communication between the different component systems (e.g. energy use monitored by Smart Metering combined with external temperature monitoring on the building to reduce the energy consumption of a family).

It is likely that over the next few years, Cities will have to install communications infrastructure (owned and managed by multiple vendors) that will allow information to be gathered in real time and in intervals. There will need to be strategies for optimised data collection and assimilation and documented good practice in this area would help in the creation of these strategies. In many cases the format of the information - and often the media and protocols on which it is carried - will be different and the communications environment will be highly heterogeneous. As Smart solutions are developed in different sectors, there will be a need for information captured in various infrastructure elements to be shared between service delivery channels. The information will need to be normalised (and perhaps translated), classified and stored.

2.2.2 Standards implications

The findings of the gap analysis in the standards strategy are that there are plenty of standards covering interoperability within the context of particular service delivery systems, but there is a lack of overall interoperability framework standards that work across systems.

BSI held an Interoperability scoping workshop on 1st March 2013 which identified the following potential standardisation topics:

- Providing a General Guide to cover infrastructure and data use in cities.
- Defining the requirement at the Framework Level for an Interoperability Ecosystem.
- Creating a data concept model to give a common understanding of information in the Smart City.
- Setting out a Code of Practice for Open Data covering definition and access.
- Defining the technical specifications for a Digital Consumer Unit.

BSI has set up an interoperability committee to help scope and develop an interoperability standardisation roadmap.

2.2.3 PAS 180 Standard on Terminology

An immediate need that was identified in the standards strategy was the lack of common terminology around the area of smart cities. BSI is therefore developing a new publicly available specification to establish a shared understanding of smart cities terms and definitions. This will help to build a strong foundation for future standardization and good practices.

The main aims of the standard are:

- Improve communication and understanding of the smart cities field by enabling developers, designers, manufacturers and clients to use a common language when talking about smart cities.
- Reduce the likelihood of confusion between parties in the supply chain and add clarity in cases of legal dispute.
- Create industry awareness of common smart city concepts through a rigorous, independent consensus-building process involving a wide group of UK stakeholders.

This PAS defines terms for smart cities, including smart cities concepts across different infrastructure and systems elements and used across all service delivery channels. It also covers materials, processes, methodologies and applications and is intended for city authorities and planners, buyers of smart city services and solutions as well as product and service providers.

2.3 What risks are there in moving to Smart City services and how can these be managed and minimized?

2.3.1 Sharing data between services

As data is shared between services, concerns will emerge over information security, data protection and privacy. For example, sharing data in the cloud may raise concerns over the use of data for a different purpose than that for which it was first obtained and whether personal data is being accessed, stored and processed appropriately and securely (as is required by legislation). Controls may be necessary to identify what data can be processed in which countries. Without clear safeguards in place, public confidence in the services being developed is likely to be low and this will pose a significant risk to the acceptability of Smart Cities projects to the citizens on whose behalf they are being commissioned.

Provided the data is properly classified under a taxonomy it should be possible to flag potential risks, helping to reduce them. Much of the information will be relatively anonymous since the City will need to observe the information as a whole, as people or traffic flows, derived from multiple homes and sources. As the systems reach down towards specific buildings, dwellings and people, the privacy risk becomes greater as does the need for trust and security.

2.3.2 Resilience of Smart City service delivery channels

The success of a Smart City will be critically dependent on a digital infrastructure that is robust . If critical services become dependent on Smart infrastructure and systems, service interruptions and failures of equipment are likely to have an important impact. Issues ...making excellence a habit.™

relating to resilience and planning for failure of critical systems are also likely to emerge. Any Smart City system must have built in redundancy and because of the expected massive number of data points in the Smart City there will be elements of this inherent in any City. The communications infrastructure must be designed to avoid common failure points such as electricity outage across a whole area of the City.

2.3.3 Accessibility of Smart City services

The prospect of a City sensing and acting on real-time information about daily activities to deliver services holds out the promise of more responsive services that better meet the needs of its citizens. Yet as the City moves towards the digital delivery of public services, there is also a risk of unwittingly excluding people who may have difficulty accessing services because of infirmity or impaired learning ability. This issue may be particularly pertinent for Cities facing resource constraints as they provide for an aging population. These issues will need to be addressed when service delivery channels are designed and commissioned.

2.3.4 Standards implications

There are already established standards for information security management and data protection. The BS ISO 27000 series of standards embrace best practice in information security. It includes ISO/IEC 27001 which is a specification for an information security management system (ISMS) which aims to ensure that information security management is established and maintained through continual improvement.

For Smart Cities to function effectively vast quantities of data need to be captured, stored, transferred and destroyed on a timely basis. If such data is defined as personal information, then the organization responsible for collecting it (whether directly or via an outsourced partner) is obliged to comply with the UK Data Protection Act. This stipulates that fair processing and retention take place and appropriate security, transfer and destruction be carried out. In 2009, BSI published BS 10012 which helps organizations establish and maintain a best practice personal information management system so that they can better comply with this legislation.

The newly-published ISO/IEC 29100 approaches privacy risk management issues from a framework-level perspective. Such initiatives require an ongoing and close collaboration between standards makers and policy makers, of increasing importance in the context of the new EU Privacy Directive and the growing use of identity management technologies (such as biometrics).

Existing standards can also be applied to improve the resilience of Smart Cities. Business Continuity Management (BCM) is a process that helps manage risks to the smooth running of an organization or delivery of a service or services, ensuring continuity of critical functions in the event of a disruption, and effective recovery afterwards. The Civil Contingencies Act requires local authorities to work together with major businesses, utility companies and transport providers and address BCM needs via business impact analysis and risk assessment. Standards can provide a structure for BCM allowing organisations to demonstrate that they have taken the necessary measures. These standards include BS 25999-1, a code of practice which establishes BCM process, principles and terminology to assist with furthering the understanding and implementation of business continuity within an organization, and BS ISO 22301, which specifies how to design and build an effective (and auditable) business continuity management system to meet regulatory, customer and business requirements, thereby enhancing confidence.

There may also be a need for a new standard setting requirements for resilience of the systems of the Smart City that will need to be complied with to ensure the

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continued functioning of the City under all but the most extreme circumstances, e.g. no electricity anywhere for longer than a week.

2.3.5 Future Activities

BSI is planning to hold an industry workshop to assess the issue relating to smart data risk and resilience. The focus will be on data risk management in a smart city context.

This workshop will be held in Autumn of 2013.

2.4 How can cities create the shared understanding to deliver the vision?

2.4.1 The need for a shared understanding

Success of any smart cities initiative depends on creating a common understanding and shared goals between all stakeholders, inside and outside the city boundary:

- City authority
- Public and private sector delivery partners
- National service providers and commissioning authorities
- Businesses
- Residents of the city and the surrounding area

To address this key area, BSI is developing PAS 181, Smart city framework – Guidance for decision-makers in smart cities and communities.

2.4.2 PAS 181 Smart City Framework Standard

This PAS establishes a good practice framework for city leaders (from the public, private and voluntary sectors) to develop, agree and deliver smart city strategies that can transform their city's ability to meet its future challenges and deliver its future aspirations.

The smart city framework (SCF) distils current good practices into a set of consistent and repeatable patterns that city leaders can use to help them develop and deliver their own smart city strategies.

The PAS does not intend to describe a one-size-fits-all model for the future of UK cities. Rather, the focus is on the enabling processes by which new technologies coupled with organizational change can help deliver the diverse visions for future UK cities in more efficient, effective and sustainable ways.

This means, in particular, a focus on enabling cities to:

- make current and future citizen needs the driving force behind all city systems;
- anticipate and respond to emerging challenges in a systematic, agile and sustainable way;

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- create a step-change in the capacity for joined-up delivery and innovation across organizational boundaries within the city.

Although many of the principles and methodologies recommended by the SCF are relevant within specific vertical sectors of cities - smart grids, smart mobility, smart health etc – the focus is very much on the issues and challenges involved in joining all of these up into a whole-city approach. Central to the SCF is therefore a strong emphasis on leadership and governance, business model innovation, and the active role played by all stakeholders in the creation, delivery and use of city services.

PAS 181 is aimed at city leaders (from public, voluntary and private sectors), although the emphasis will be on policy developers within city authorities, both those responsible for the authority's service design, commissioning and delivery role and those responsible for its community leadership role. The document will make clear the relevance to other sectors. The PAS will be UK focused, though the principles should be generally applicable to allow use beyond the UK.

2.4.3 High-level structure of „Smart City Framework“

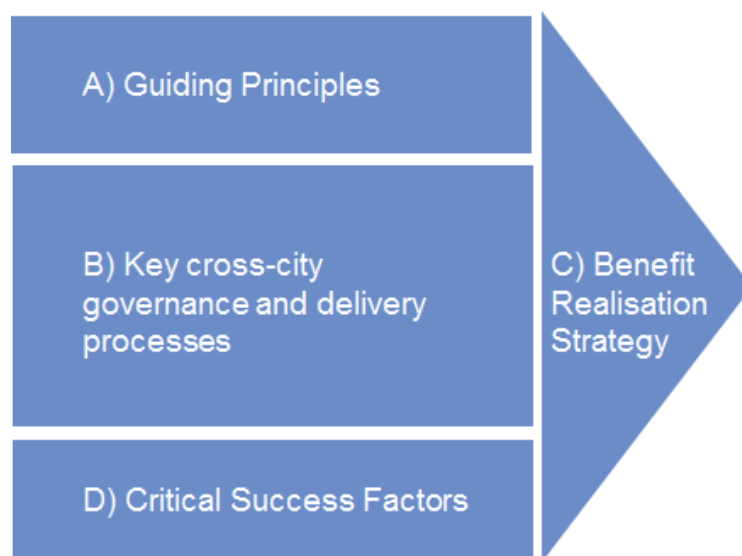


Figure 2 — Structure of SCF

Figure 2 shows the key building blocks of the Smart City Framework:

- a) **Guiding Principles:** an agreed and enduring statement of values which can be used on a consistent basis to steer business decision-making by multiple city stakeholders over the long term;
- b) **Key city-wide governance and delivery processes:** 'how-to' guidance on the key processes that need to be managed in establishing and delivering a successful smart city strategy;

- c) Benefit Realisation Framework: aimed at ensuring that all elements of a smart city strategy are effectively focused on delivering the desired outcomes;
- d) Critical Success Factors: a checklist of issues cities should regularly monitor to ensure that they are on track in the successful delivery of their smart city programmes, and that they are managing the major strategic risks effectively.

Guidance will be developed as a set of modular and inter-related 'patterns' that follow a common structure: context; the need being addressed; the recommended approach or solution; linkages to other patterns in the guide.

3 A standards framework for Smart Cities

To ensure Smart City technology fulfils its potential, a range of standards are needed to address issues faced at different levels, from the decision-making at the city level to the interoperability of particular devices. Principles-based standards can provide guidance to help the City Authority define its targets. Performance standards can help the City Authority procure the infrastructure and services that will help achieve these targets. And interoperability standards can ensure that the data captured in the City's infrastructure and systems is suitable for use in a range of service delivery channels.

Figure 3 shows the current standards hierarchy with associated standardisation work.

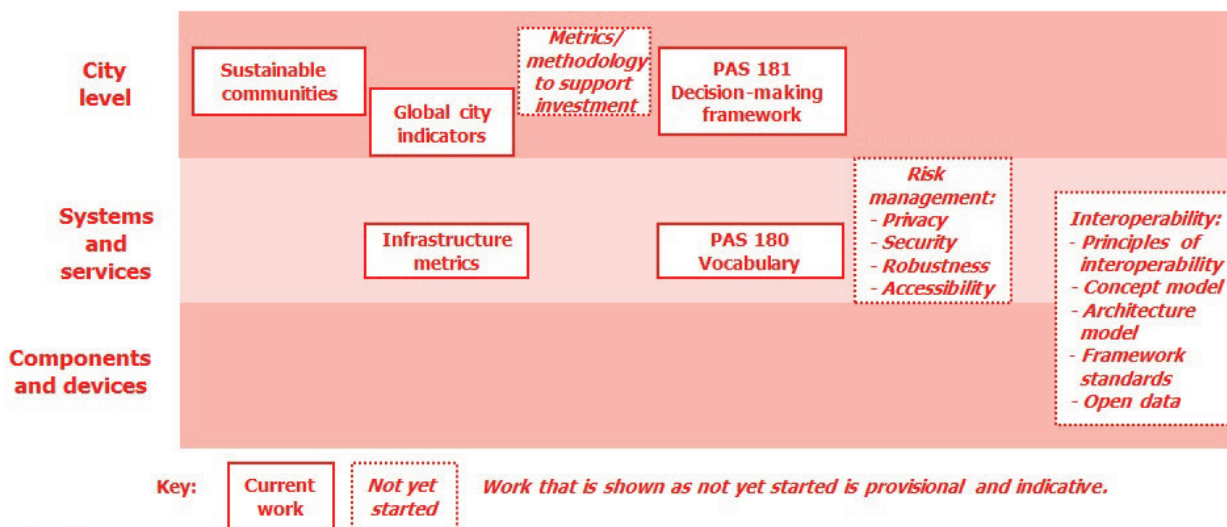


Figure 3 — Hierarchy of standards

4 Coordination and other activities

Standards coordination groups have been created as shown in Figure 4 to address 3 aspects:

- An advisory group covering the overall strategic vision for the BSI standards programme and the standards needs of City Authorities in particular.

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- An interoperability Technical committee for the standards activities relating to the information and technology aspects of Smart Cities.
- A horizontal committee for coordinating work within numerous existing standards committees

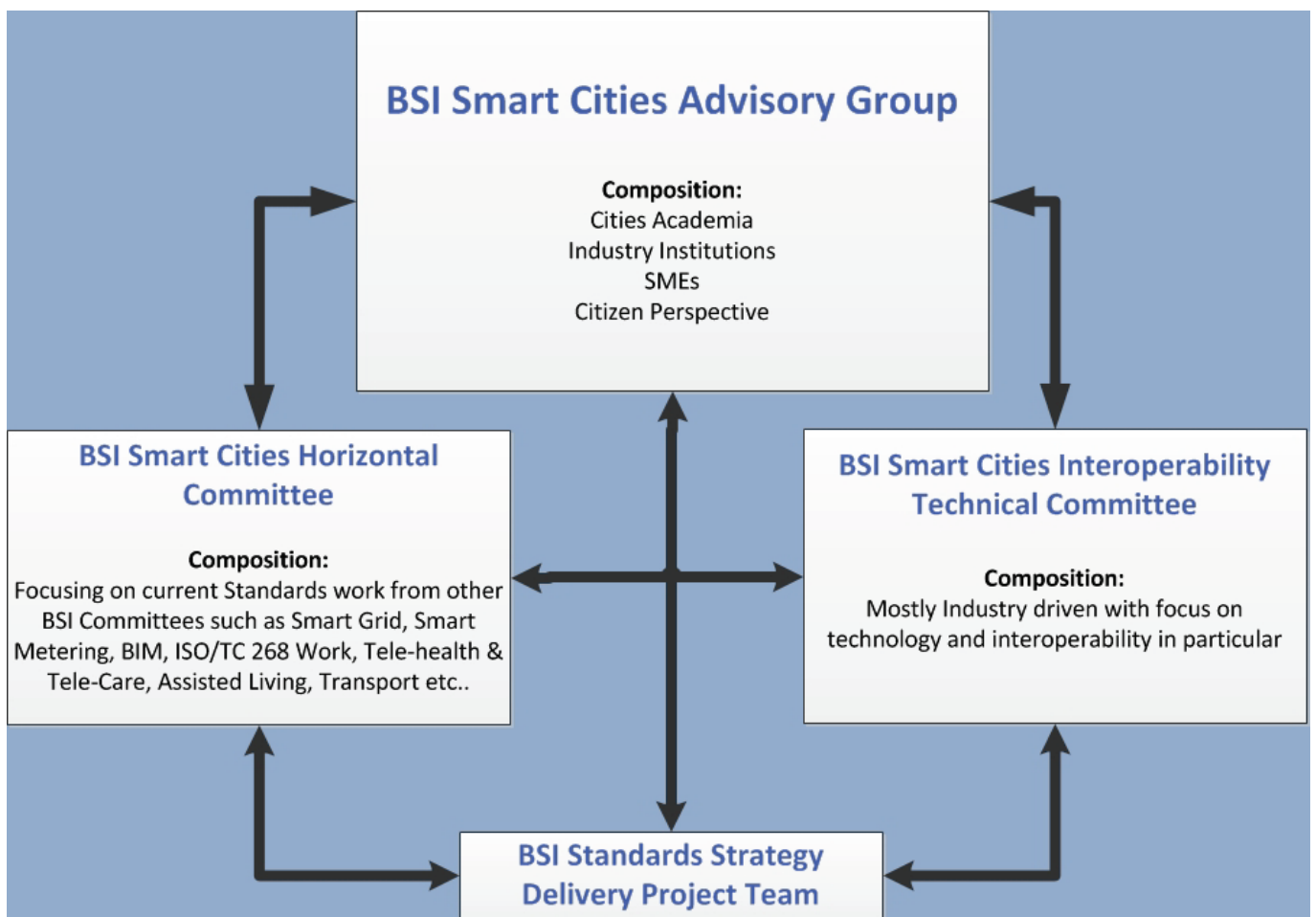


Figure 4 — Standards coordination groups

A number of other activities are currently being undertaken which include the following:

- Engagement with other standards bodies in order to coordinate and align relevant activities.
- Involvement in various smart city initiative in the UK such as the TSB funded demonstrator projects in order to bring learning into the standards programme.
- Building links with UK industry and academic centres of expertise.

5 Key Standards Programme Milestones

Table 1 below shows some of the key standards programme milestones for 2013.

Table 1 – Key Standards Programme Milestones	
Performance assessment methodologies and investment appraisal industry workshop	Summer 2013
Risk management in a smart city context industry workshop	Autumn 2013
PAS 180 Terminology Draft available for Public Comments	Autumn 2013
PAS 181 Smart City Framework Draft available for Public Comments	Autumn 2013

For further information and to get involved in our standards development initiatives, please contact:

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