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Foreword

This PAS was sponsored by the Cities Standards Institute, a collaboration between Future Cities Catapult and the British Standards Institution [1)]. Its development was facilitated by BSI Standards Limited and it was published under licence from The British Standards Institution. It came into effect on 31 March 2017.

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This PAS is not to be regarded as a British Standard. It will be withdrawn upon publication of its content in, or as, a British Standard.

The PAS process enables a guide to be rapidly developed in order to fulfil an immediate need in industry. A PAS can be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

Relationship with other publications

This PAS is issued as part of a suite of BSI publications related to smart cities:

- PAS 180, *Smart cities – Vocabulary* defines terms for smart cities, including smart cities concepts, across different infrastructure and systems elements and used across all service delivery channels;

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1) See http://futurecities.catapult.org.uk/project/cities-standards-institute/

- PAS 181, *Smart city framework – Guide to establishing strategies for smart cities and communities* gives guidance on a good practice framework for decision-makers in smart cities and communities (from the public, private and voluntary sectors) to develop, agree and deliver smart city strategies that can transition their city's ability to meet future challenges and deliver future aspirations;
- PAS 182, *Smart city concept model – Guide to establishing a model for data interoperability* provides a framework that can normalize and classify information from many sources so that data sets can be discovered and combined to gain a better picture of the needs and behaviours of a city's citizens (residents and businesses);
- PAS 183, *Smart cities – Guide to establishing a decision-making framework for sharing data and information services*, gives guidance for decision-makers from the public, private and third sectors on establishing a framework which can support the sharing of city data and the creation of interoperable information services;
- PAS 185, *Smart cities – Specification for establishing and implementing a security-minded approach* will specify requirements for establishing a framework for the security-minded management of smart cities and their associated infrastructure, as well as of data, information and services used to deliver city services;[2)]
- PD 8100, *Smart cities overview – Guide* gives guidance on how to adopt and implement smart city products and services in order to facilitate the rapid development of an effective smart city;
- PD 8101, *Smart cities – Guide to the role of the planning and development process* gives guidance on how the planning and implementation of development and infrastructure projects can equip cities to benefit from the potential of smart technologies and approaches.

This PAS complements these publications by showing how the city-wide, strategic-level approach to the development of a smart city programme, as described in PAS 181 and PD 8100, should be applied at the level of an individual smart city project. PAS 180 provides the core glossary for terms used in this PAS.

Use of this document

As a guide, this PAS takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it. The guidance is voluntary. A city can decide whether and if so how it chooses to implement the recommendations presented in this PAS.

Presentational conventions

The guidance in this PAS is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Spelling conforms to *The Shorter Oxford English Dictionary.* If a word has more than one spelling, the first spelling in the dictionary is used.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a PAS cannot confer immunity from legal obligations.

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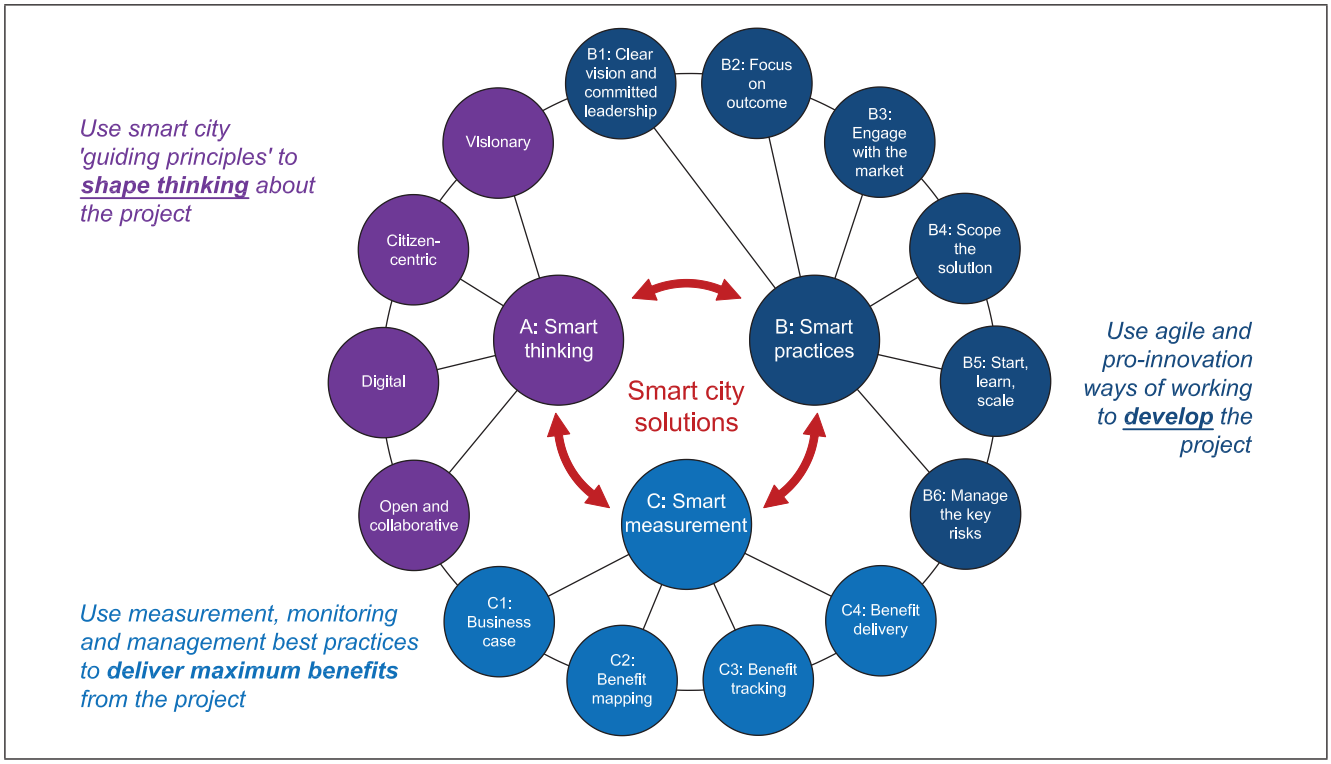
2) In preparation.

0 Introduction

This PAS provides practical, "how-to" advice, reflecting current good practice as identified by a broad range of public, private and voluntary sector practitioners engaged in developing smart city solutions. The advice is structured into three main components:

- **Component A – Smart thinking**: how to better frame opportunities to challenge traditional ways of doing things within the city, identifying where solutions could deliver transformational change in a particular area of city activity
- **Component B – Smart practices**: how to develop a project in a way that:
  a) delivers a smart city solution successfully in practice;
  b) is consistent with effective and appropriate security needs and minimizes risks to achieving the full desired impacts of the solution; and
  c) optimizes its contribution towards broader city goals for the future.
- **Component C – Smart measurement**: how to build measurement and evaluation into the project throughout its lifecycle in ways that:
  a) support successful delivery of the solution;
  b) enable effective communication to city stakeholders of the solution's impact; and
  c) provide actionable learning for future projects in the city.

Figure 1 **Overview of the components of this PAS**



These three components are described in Clauses **3**-**5** respectively, with a summary of recommendations in Annex A.

However, despite the linear nature of a publication such as this, the different components of this guide are not intended to represent a linear and sequential process. As illustrated in Figure 1, there are interactions and feedback loops between all these good practice components, and the starting point for different projects may vary.

This means that, while the content of this PAS is ordered in a broadly logical way, different projects may take different implementation paths through it depending on their city's priorities and context, and the nature of the specific project. This PAS is therefore intended for use in a modular way. To facilitate this, each individual component of the PAS is structured using a common pattern language – a consistent structure that clearly brings out linkages with other relevant components.

NOTE The pattern language used in this PAS follows that used in PAS 181, Smart City Framework. *Further information about this approach and its benefits for use in guidance such as this PAS is set out in PAS 181, Annex C.*

A more detailed mapping of the dependencies and interactions between the different components of this PAS is given in Annex B.

1 Scope

This PAS gives guidance on developing project proposals for delivering smart city solutions.

It uses case studies to illustrate good practice in smart city procurement and creating viable, financially robust business cases for smart city projects. It is relevant to projects of all sorts – not just ones that involve a procurement, and not just ones that involve a technology component.

It is for use by city leaders from the public, private and community sectors. In particular, it is targeted at project officers and commissioners of services within local and city authorities, their senior managers and the procurement specialists who support them.

The PAS is also of interest to suppliers of products and services to cities and citizens, providing them with insight into what cities regard as good practice in the development and procurement of smart city solutions.

This PAS does not cover:

- how to develop the broader vision, strategy and operating model for a smart city that provides the optimal context for any specific smart city project – this is dealt with in PAS 181 and relevant linkages are highlighted throughout this PAS; or
- how to manage the ongoing operation of a smart city solution once it has moved out of project development and into live running as part of the business-as-usual operation of the city.

2 Terms and definitions

For the purpose of this PAS, the terms and definitions given in PAS 180 and the following apply.

smart city solution
interactive asset, service, system or tool operated in a city that measurably improves the sustainability, resilience and interoperability of the city and/or transforms services and quality of life in the city in ways that are citizen-centric, digital, open and collaborative; or that enables future initiatives driven by city actors (citizens, communities, businesses, institutions) to do so

3 Component A: Smart thinking

3.1 Context

PAS 181 describes a set of guiding principles to inform development and delivery of all aspects of a city's strategy and programme for becoming a smarter city. In summary, these principles are that a smart city should be:

1) visionary;
2) citizen-centric;
3) digital; and
4) open and collaborative.

PAS 181 focuses on how these principles can be applied to the city as a whole, identifying their implications for the overall vision, strategy and operating model for the city. However, it is also important to apply these principles at the level of individual projects.

3.2 The need

City projects should ensure they fully explore the opportunities for innovation and transformation that are opened up by new technologies and new ways of working. To do this, they should systematically embrace the smart city guiding principles: visionary, citizen-centric, digital, open and collaborative.

Too often, projects, policy development and planning within cities do not fully embrace the potential for innovation and service transformation. Reasons for this include:

- lack of knowledge and understanding of where change is possible;
- public sector financial pressures being treated as a barrier to investment in innovation rather than a driver of it;
- decision-taking that is carried out within relatively narrow organizational, legacy and professional silos;
- long-term outsourcing contracts that have not been designed to enable flexibility and innovation – and more generally an unwillingness to re-examine past investment decisions in the light of changing circumstances; and
- risk aversion – or rather, a tendency to put greater weight on the risks of change as perceived by stakeholders rather than the often more significant risks that continuing with current ways of working may pose to a city's ability to deliver targeted future outcomes within available resources.

Broadly speaking, three things are needed to overcome this tendency towards inertia:

- committed leadership and a process of engagement with stakeholders that supports such leadership, by opening the project team up to ideas and information from across the city and from potential suppliers of services to the city and by effectively communicating the benefits of change;
- a willingness at all stages of project development to ask questions that challenge traditional thinking; and
- a rigorous and publicly transparent approach to measurement, which ensures that the baseline costs and benefits of current ways of working are fully understood, that the business case for change is properly articulated, that stakeholders are aware of their responsibility in the collaborative effort, that the focus is on outcomes not inputs and that risks to delivery can be effectively managed.

This PAS gives practical guidance and checklists on how "smart thinking" can be applied – i.e. ensuring that the smart city principles set out in PAS 181 are thought through for any specific project. **Checklists 1-4** look in turn at each of the guiding principles set out in PAS 181, and for each principle, set out a checklist of questions that city leaders should ask to ensure that they are fully exploring the opportunity for innovation and transformation. Not every principle will be relevant in practice to every smart city project, but applying these checklists to all projects can help ensure that the 'right' solution is scoped and that potential opportunities for innovation are not missed.

Each checklist is followed by case studies [3)] of solutions that have delivered significant benefits by asking precisely these sorts of questions – all drawn from one of the most physical and traditionally analogue (i.e. non-digital) of city functions: waste collection.

Checklist 1 – The visionary project
Does our project have a vision for the future that is clear, compelling and jointly owned by all key stakeholders?
Can we describe how life in the city will look and feel different as a result of our project?
Do we know how to measure progress towards our vision?
Is the vision for our project closely aligned with the broader socio-economic, political and environmental vision and purpose for the city's future being advocated by the city's most senior leaders?

Case study: using a top-level city vision to empower bottom-up innovation

City leaders who set out a clear and compelling vision for the future of their city find that individual organizations and projects across the city tend to align behind that vision over time. For example, the political leaders of **Brighton and Hove Council** have made sustainable management of city waste a top political priority under successive administrations since the 1990s. However, much that has been achieved has not been as the result of top-down planning. As Geoff Raw, Chief Executive at **Brighton and Hove Council**, says: "We've worked hard as a leadership team to drive forward sustainable waste management, and are proud that we are now one of the least wasteful and least land-filling cities in Britain. But the most exciting thing is the innovation and entrepreneurialism that we've seen as the city as a whole has responded to this agenda: individual employees and teams within the Council; community groups; social entrepreneurs – all bringing their own energy and enthusiasm to bear, all driving forward innovation on a broader front than we could possibly have planned from the centre [4)]."

[3)] Unless otherwise indicated, all case study data in Checklists 1-4 are drawn from the DCLG 'Bin Bible': https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/271435/BinBible-2-NT3.pdf [1]

[4)] Source: interview with CS Transform Limited, July 2016

Checklist 2 – The citizen-centric project
Do we have a detailed and segmented understanding of our customers and their needs?
What are the Council's current touch points with these customers?
Do we have evidence-based insight into the needs of stakeholder groups who are at risk of being excluded from the benefits of the project because of, for example, disability, old age, or digital exclusion?
Are we making maximum use of the data we collect and process about our customers, while ensuring that we do so in a compliant way that is secure, proportionate and consent-based?
How are our total costs allocated across the different stages of our current end-to-end delivery process – and to what extent are these currently aligned with the parts of the process that create most value from the perspective of our customers?
What are the root causes of demand for our services – can earlier action on these reduce demand?
Can small 'nudges' to customer behaviour have large impact on demand? What are the triggers that can change behaviour, and how can we adjust our delivery model to bring these into play?
What are the current bottlenecks and pain points – for our customers, and for the business?
Do we have access to customer insight not just from our own organization, but from all major city partners that engage with the same customers as us?
What trusted relationships do our customers have with other service providers in the city?
Do those organizations have channels or other assets we can leverage – achieving higher impact and/or lower cost than using our own channels and assets?
Are we correctly identifying and championing the full benefits for society from the project, even when there are different public sector bodies or silos involved in the cost side versus the benefit side?
Can we create a better solution for our customers if we re-think the commercial models and financial models that the city currently uses in this area, for example by using the innovative approaches recommended at **[B4] scope the solution** (and in particular Checklist 8 and Checklist 9)?

Case studies: reducing costs through empowering citizens to self-serve

Eastbourne has taken its own staff out of the loop for 'problem reporting' by residents, through a new smart phone app that enables residents to report problems (e.g. fly tipping) direct to the contractor. Resolution times are down, costs have gone down, and citizen satisfaction has increased.

Digital marketplaces can help citizens to reuse and repair rather than dispose of waste: **Vienna** estimates it saves 12,000 tons of waste annually; CalMAX exchange in **California** has helped make the state the lowest user of landfill in the US.

Analysis of domestic waste collection by **Lewes District Council** revealed that one element of their service added minimal additional value to citizens but created a significant proportion of costs: collecting bins from the back-door. For harder-to-reach households (about 30%), **Lewes** asked citizens to 'share the cost' of moving bins about, by shifting the collection point from the backdoor to the curtilage of the property. The result was a 20% reduction in collection costs.

Case study: reducing demand through behavioural change

A 2014 evaluation of 16 schemes in the UK to promote recycling and composting by giving residents (individually or in a community) reward points for use in local shops or to support community projects found an average 8% increase in recycling performance, 3% reduction in landfill – with lower cost schemes that form part of a broader communications strategy delivering best value for money.

Checklist 3 – The digitally-enabled project
What volume of customer engagements do we have, and how does this vary by channel?
How does the unit cost to serve a customer vary by channel?
How could we organize our cost base differently if all our customers were able and willing to access our services online? Can we use the benefits from this to fund the costs of investing to deepen digital inclusion and to ensure adequate assisted digital provision?
What new sorts of value-added services could we provide to our customers digitally?
What opportunities are there for our customers to co-create digital services (for example through giving live feedback, providing peer-to-peer advice to other customers over our channels, or integrating their own digital content and data with ours)?
Can we identify opportunities to reduce – or eliminate entirely – demand for current services through the introduction of new smart connectivity directly between city assets and digital devices?
Do any existing digital services offer capabilities that we can leverage to improve the performance or delivery of the project?
How could we organize our work and resources differently if real-time data flows and data analytics could give us near-perfect information about: • current demand for city services? • the performance of city assets? • future demand for city services?
Are we using insights driven by data analytics to shape the project?
Can we more easily embrace digital solutions if we re-think the commercial models and financial models that the city currently uses in this area, for example by using the innovative approaches recommended at **[B4] scope the solution** (and in particular Checklist 5 and Checklist 6)?

Case studies: reducing costs and improving performance through real-time matching of supply with demand

Birmingham has used data analytics, in-cab technology and new terms and conditions for staff to optimize collection rounds and crew sizes – enabling total staff costs to be reduced by 18%.

Smart street bins can monitor waste levels and wirelessly report in to fleet-routing software – case studies in US and Sweden report 40-50% savings compared with standardized collection routes.

Over a third of waste bins in **Germany** are now RFID tagged to enable a shift to "pay as you throw" models of funding municipal waste collection according to the Rand Corporation [2].

Bournemouth is using route optimization software to integrate collection from trade waste customers with its domestic collection rounds in real time. Results so far include a one-off capital saving of £300k and 4% savings in staff costs.

Checklist 4 – The open and collaborative project
How can we create spaces (both physical and digital) and opportunities for city innovators to come together across sectoral and organizational boundaries?
Do we really need to provide our current service, or could other city partners do it better if we organized differently?
What assets do we deploy in delivering our service, and could these be leveraged by other city organizations for other purposes? Could they be monetized?
Can we make our data more open, discoverable and useful for other city stakeholders, without exposing personal or other sensitive data?
Can we create new sorts of value and/or strip out costs by safely sharing our data with other city partners?
When we are investing in an asset or service to meet our local needs, is there scope to make this a platform which is re-usable for other needs in the city?
When we are investing in an asset or service to meet our local needs, is there scope to reduce costs by developing a standardized requirement and shared procurement approach with other cities that have similar needs?
How can we best incentivize private and voluntary sector partners to collaborate with us and co-invest to deliver our objectives?
Are we taking a security-minded approach that enables open and collaborative delivery of the project vision without undermining the safety and security of citizens, stakeholders and assets?
Has the project approach considered previous project results from other cities and will it publish its results in order to add to the body of know how?
Can we deliver more collaborative solutions if we re-think the commercial models and financial models that the city currently uses in this area, for example by using the innovative approaches recommended at **[B4] scope the solution** (and in particular Checklist 5 and Checklist 6)?

Case studies: collaborating to reduce costs of waste collection

Shared services between directorates: **Cornwall** has integrated its systems for refuse, recycling and street cleaning, with new multi-skilled teams reducing total staff requirement by 10% while delivering a more effective service.

Shared services across local authorities: four South Coast towns have let a joint ten-year waste collection and street cleansing service with integrated systems. **Eastbourne** alone calculates annual savings at 25%.

Joint procurement across UK local authorities: a recent DCLG report [1] finds that savings of up to 10% on vehicles and 35% on wheeled bins can be achieved through clearer, standardized specifications and joint procurements.

Case study: incentivizing the community to solve city problems

Tasmania's waste authority is successfully using prizes (£250 for student designers and £3,500 commercial prototypes and business plans) to encourage innovative product development using city waste-streams.

3.3 Recommendations

City leaders should:

a) encourage those involved in the development of any new project or policy for the city to:

   1) ground the project in customer insight and data analytics;

   2) think broadly across organizational silos about the potential for innovation and service transformation that smart solutions open up including the scope for the technology and assets created through the project to create benefits beyond the immediate scope of the local authority department that is sponsoring the project; and

   3) promote a culture which is comfortable with occasional failure, in which change and innovation are seen as having risks that need to be managed but in which these are always weighed against the strategic risks to the city posed by inertia;

b) establish business assurance processes to support managers as they seek to implement recommendation **3.3 a)**;

c) in particular, ensure that before any formal procurement and contracting process is launched, senior leaders from across all divisions of the local authority have reviewed the procurement requirement and satisfied themselves that "the right thing is being procured at the right time"– i.e. that the ***visionary***, ***citizen-centric***, ***digital***, ***open*** and ***collaborative*** questions set out in **Checklists 1-5** of this PAS have been appropriately asked and answered; and

d) ensure that the smart characteristics of the proposed solutions are communicated clearly and consistently to stakeholders throughout the project development process.

3.4 Linkages

Undertaking the sort of smart thinking described in this PAS is not a one-off event, but a process over time. **Component B**, **Smart Practices** (see Clause **4**) and **Component C, Smart Measurement** (see Clause **5**) give more guidance on how this process should be managed.

In particular:

- The project team's understanding of how the questions highlighted in **Checklists 1-4** can best be answered in a specific case will be developed and deepened through:
  - **[B1] building a clear vision and committed leadership** (see **4.1**);
  - **[B2] focus on outcomes** (see **4.2**);
  - engagement with external stakeholders as part of **[B3] engage with the market** (see **4.3**); and
  - **[B4] scope the solution** (see **4.4**).

- **[C2] benefit mapping** (see **5.2**) provides advice on how to ensure that the baseline costs and benefits of the current practices are clearly measured and understood and that there is clear line of sight between the smart solution being developed and the end outcomes being targeted by the city.
- **[B6] manage the risks** (see **4.6**) describes how the key risks in a typical smart city solution can be effectively managed.

As a consequence of the increasing use of, and dependence on, information and communications technologies to enable smart cities, there is a need to address the inherent security vulnerabilities.

4 Component B: Smart practices

Understanding how the smart thinking described in **Component A** (see Clause **3**) can be applied to a particular objective and city context in order to develop an effective smart city solution is not something that can be done rapidly or without significant stakeholder engagement. In short, smart thinking should be developed through smart practices.

Guidance notes **[B1]** to **[B6]** (see **4.1** to **4.6**) describe six key elements of smart practice that should be deployed in the development of all smart city solutions. The case study in Annex C provides a worked example of how one city – Bristol – has applied these smart practices in developing an innovative, data-driven and user-centric waste management solution.

4.1 GUIDANCE NOTE B1: BUILD A CLEAR VISION AND COMMITTED LEADERSHIP

4.1.1 Context

The first guiding principle of PAS 181 is the need for smart city leaders to develop a clear, compelling and inclusive vision for their city.

4.1.2 The need

An individual smart city solution is most effective when it is clearly aligned with an overall vision and strategy for the city as a whole, and is championed by leaders who are committed to delivering it as a key building block of that wider vision.

A project aimed at developing a smart city solution can start in many places. Some successful projects are initiated at the top, with the city's most senior political and administrative leaders seeing the need for the project and pushing it forward. Many others are initially conceived at more operational levels within the city administration, or by stakeholders external to the administration.

Whatever the genesis of a project, it is important that the project team ensures, at as early a stage as possible, that:

- the project has championship and visibility at senior leadership level within the city;
- all involved have a shared vision of what the project aims to deliver and how this can contribute to the wider strategic priorities of the city and to citizen needs; and
- citizens are engaged directly in shaping the visioning, both face-to-face and through social media and other digital tools.

4.1.3 Recommendations

When developing a smart city solution, city leaders should:

a) create a vision of how life in the city will both look and feel different as a result of the smart city solution being successfully implemented, focusing on the tangible benefits to citizens;

b) ensure that this vision:

   1) is developed in an iterative and collaborative manner that is, inclusive of all relevant stakeholder groups and informed by user research and engagement, with social media and other technologies used to enable wider public participation in the process;

   2) embraces the opportunities opened up by smart technologies, smart data and smart collaboration - and does so in a way that integrates these with the core socio-economic, political and environmental vision and purpose for the city's future, rather than seeing them as somehow separate from the city's core strategic objectives;

   3) is measurable.

c) establish leadership and governance arrangements for the project that ensure:

   1) a clear focus of accountability for the project at senior level within the city authority;

   2) arrangements are made that enable costs to be accrued and benefits attributed across different cost centres;

   3) deployment of formal project management disciplines;

   4) the right skills mix in the leadership team;

   5) the need for security and resilience across all elements of the project is managed from the outset;

   6) an open and transparent governance and delivery process, engaging directly with citizens to co-create the solution and using digitally-enabled models of wider civil participation.

4.1.4 Linkages

Advice on setting smart city vision and leadership at a whole-of-city level in order to provide the optimum context for any individual project is given in PAS 181 (see guidance notes **PAS 181 [B1] city vision** and **PAS 181 [B3] leadership and governance**).

When developing the vision for an individual smart city solution, the project team should:

- ensure that this is informed by **[A] smart thinking** (see Clause **3**);
- maintain a strong **[B2] focus on outcomes** (see **4.2**);
- develop the project vision in an open and inclusive way as part of **[B3] engage with the market** (see **4.3**), including involvement of external stakeholders and partners within the project team, where possible; and
- use **[C] smart measurement** (see Clause **5**) to ensure that the vision for the solution is measurable, that there is clear line of sight between the outputs it aims to deliver and the end outcomes being targeted by the city, and that effective governance is in place to ensure accountability for delivering these benefits.

4.2 GUIDANCE NOTE B2: FOCUS ON OUTCOMES

4.2.1 Context

[B1] building a clear vision and committed leadership for a smart city solution (see **4.1**) covers the need to define the outcomes that the solution aims to deliver for the city. These outcomes, not cost, should be the driving force behind city procurements.

4.2.2 The need

The key focus in the early stages of a smart city project should be to define the outcomes and service levels that the project aims to achieve, and to avoid rushing into specifying particular ways of delivering these.

A smart city solution is defined by the outcomes it delivers. A key task at the start of any smart city project should therefore be to understand and document the user needs that the project aims to meet, the outcomes that are to be delivered, and how these will be measured.

Stakeholders involved in developing smart city projects should look not just at the immediate outputs the project aims to deliver and how these feed through directly into social and economic outcomes, but also at the positive externalities that the project can deliver through the way it is managed. In the UK, the Public Services (Social Value) Act of 2012 [3] requires city authorities to take account of social value in all services contracts with a value over the EU threshold.

This can include, for example:

a) strengthening of local economic ecosystems and supply chains;

b) creation of jobs and training opportunities in the city;

c) regeneration and the development of local infrastructure;

d) improvements to urban sustainability.

In procurements, the focus of city authorities should be on specifying *what* the city needs suppliers to achieve, not *how* they should achieve it. By using outcome-based specifications that focus on the problem that needs to be solved, cities can tap into potential solutions from innovative suppliers and technologies that might offer a transformational way of dealing with that problem.

Of course, there is also a risk of under-specifying projects. At some point, a project should be clear about what it is actually doing and the nature of the solution that it is developing. Doing this too early however, ahead of effective engagement with users and suppliers, risks locking the city into overly costly and ineffective approaches.

4.2.3 Recommendations

When developing a smart city solution, city leaders should:

a) focus on procuring outcomes, not specifying inputs [5)];

b) take a broad view considering the social, economic, and environmental nature of those outcomes;

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5) This is a core principle of UK, EU and international law on public procurement – see for example the WTO Agreement on Government Procurement. See https://www.wto.org/english/docs_e/legal_e/rev-gpr-94_01_e.htm [4]

c) take procurement decisions that are based not on initial project cost but on long-term value for money in the delivery of these outcomes, including:

   1) total cost of ownership (including costs of exit);

   2) the suppliers' ability to innovate; and

   3) confidence in delivering the expected outcomes.

d) review their local arrangements for procurement (for example, standing orders) to assure themselves the necessary flexibility to achieve this outcome focus.

4.2.4 Linkages

Other key Guidance Notes to help ensure a strong **[B2] focus on outcomes** are:

- **[C2] benefits mapping** (see **5.2**), which provides advice on how to define and measure outcomes for a smart city solution.
- **[A] smart thinking** (see Clause **3**), which provides a systematic approach for ensuring that a city does not default into 'business as usual' ways of thinking about how best to deliver those outcomes.
- **[B3] engage the market** (see **4.3**), which recommends good practices in ensuring that this thinking is not done in isolation, but taps into the best ideas from across the city and across the global smart city marketplace.

4.3 GUIDANCE NOTE B3: ENGAGE WITH THE MARKET

4.3.1 Context

As smart city leaders **[B1] build a clear vision and committed leadership** (see **4.1**) and **[B2**] **focus on outcomes** (see **4.2**) for a smart city solution, they need to do this on an open and collaborative basis with customers and suppliers.

4.3.2 The need

Smart city projects need early, frequent and two-way engagement with the market; both with customers and a broad range of suppliers.

A city's customers – the citizens, businesses and visitors it serves – lie at the heart of any successful smart city solution. PAS 181 states that "*Smart cities seek to engage with citizens and businesses as owners of and participants in the creation and delivery of city services, not as passive recipients of services*".

Projects that engage with customers in a genuine spirit of co-creation (rather than simply consultation) can experience very significant benefits, including:

a) stakeholder ownership and engagement;

b) much deeper understanding of the drivers and root causes behind demand for city services, and how this demand can best be managed;

c) opportunities for city services to be delivered in entirely new ways, for example through direct citizen-to-citizen engagement with little or no city involvement.

Checklist 5 sets out some key "dos and don'ts" to consider when taking forward customer engagement for a smart city project.

Checklist 5 – Dos and don'ts for customer engagement	
Do	
✓	**Start early:** start the co-creation process early in the development of the project, and well in advance of scoping any procurement
✓	**Take it seriously:** ensure that senior leaders for the project personally engage with customers as part of this engagement and insight process. This helps shed new light on the project and shape thinking about its scope, direction and priorities
✓	**Embrace digital:** use social media and other digital channels to enable broad public participation
✓	**Be inclusive:** engage pro-actively with stakeholder groups who are at risk of being excluded from the benefits of the project because of, for example, disability, old age, or digital exclusion
✓	**Leverage your partners:** establish open channels for dialogue with partners, and build partner involvement into your customer insight – their customers are your customers, and they might be having different, more open conversations with them
✓	**Give feedback to participants:** present the outputs of customer engagement work back to people who participated in it, with an indication of how their input is helping to shape the 'product'
✓	**Share more widely:** publish the results of all customer insight work so that others can benefit from it and potential collaborators can identify opportunities to help use it more effectively
✓	**Iterate:** continue throughout the lifecycle of project implementation
✓	**Measure:** include performance metrics on customer engagement in the projects framework for **Component C, Smart measurement** (see Clause **5**)
Don't	
✗	**Assume to know what customers think:** instead, be obsessive about developing an evidence-based and data-rich understanding of the needs and views of customers – both internal and external – on a segmented basis
✗	**Undertake a one-off consultation:** and think that will be sufficient
✗	**Take a narrow, siloed view of who the customers are:** if customers are defined narrowly and from the perspective of 'who is using this specific current service', opportunities may be missed to get a broader understanding of real-life citizen needs and how services from multiple city organizations might be transformed to meet them

A similar process of collaboration and engagement is needed on the supply side. PAS 181 states that that smart *"city leaders should focus on nurturing and managing an innovation ecosystem"* in the city. Checklist 6 sets out some key "dos and don'ts" to consider when taking forward the PAS 181 advice on supplier management in the context of an individual smart city project.

Checklist 6 – Dos and don'ts for supplier engagement	
Do	
✓	**Start early:** give the market as much notice as possible of emerging needs, procurement plans and spending plans, including through well-publicized digital channels
✓	**Take an inclusive approach to defining the supply-side for the market:** smart city solutions can often disrupt traditional markets, bringing innovations from other sectors or disciplines
✓	**Engage with SMEs and local supply chains**: including through innovation workshops, use of competitions and placing SME-engagement requirements on large suppliers
✓	**Create opportunities for suppliers to interact with your citizens**: doing this early in the process will create valuable new thinking about how best to achieve the desired outcomes
✓	**Engage on a multi-channel basis:** use digital channels to make emerging plans and requirements as widely known as possible, including through relevant local, national and European portals. But also invest in face-to-face engagement, including through meetings, workshops and hackathons, and through visits to reference sites for products, services and suppliers.
✓	**Keep an open mind in relation to the potential need for new types of commercial model and financial model:** taking best advantage of innovations from suppliers, especially new-entrant suppliers, might require significant changes to the commercial models and financial models the city is used to. Be open to this, using the approaches recommended at **[B4] scope the solution** (see **4.4**) and in particular Checklist 8 and Checklist 9.
Don't	
✗	**Define detailed requirements** before engaging widely with potential suppliers
✗	**Just talk to the usual suspects**: be open to ideas from outside traditional suppliers to your sector, and from SMEs and new entrants as well as established players
✗	**Apply a one-size-fits all procurement process**: take full advantage of the full range of tools now available within the lighter-touch regime for EU procurement[6)] that was introduced in the UK in February 2015 with the aim of encouraging more agile and SME-friendly procurement by public authorities
✗	**Make price the sole focus of engagement**: more important is to find out how suppliers can bring innovation to bear in delivering long-term outcomes for the city
✗	**Forget that suppliers need to make a return on their investment in relationships with city**: look to facilitate this, incentivizing win-win collaborations and being prepared to invest in initial proof-of-value collaborations with innovative smaller businesses

6) See detailed guidance from the Crown Commercial Service at https://www.gov.uk/guidance/transposing-eu-procurement-directives [5]

4.3.3 Recommendations

When developing a smart city solution, city leaders should:

a) establish, and give high priority and adequate resources to, a formal, managed programme of work on market engagement as a key workstream within the project plan; and

b) ensure that this covers both customer co-creation and supplier engagement, and reflects the smart practices described in this PAS.

4.3.4 Linkages

PAS 181 addresses market engagement at a strategic, whole-of-city level, setting out an integrated strategic approach to the commissioning of services, across the city council and in partnership with other city service delivery organizations. This includes advice on ensuring that long-term contracts do not become a barrier to innovation. Of particular relevance are:

- **PAS 181 [B5] procurement and supplier management**; and
- **PAS 181 [B9] empowering stakeholder-led service transformation**.

These provide important context in which the leadership team for an individual smart city project should seek to engage with customers and suppliers. The team should use this process of market engagement to inform its work on all aspects of the project, and in particular on:

- **[B1] build a clear vision and committed leadership** (see **4.1**); and
- **[B4] scope the solution** (see **4.4**).

The project team should build performance metrics for customer and supplier engagement into **[C] smart measurement** (see Clause **5**).

4.4 GUIDANCE NOTE B4: SCOPE THE SOLUTION

4.4.1 Context

In scoping a project to deliver a smart city solution, it is important to take a holistic view of the different dimensions on which innovation may be needed. At the same time, it is important to develop that holistic view in an agile and practical way, rather than to over-plan at the outset.

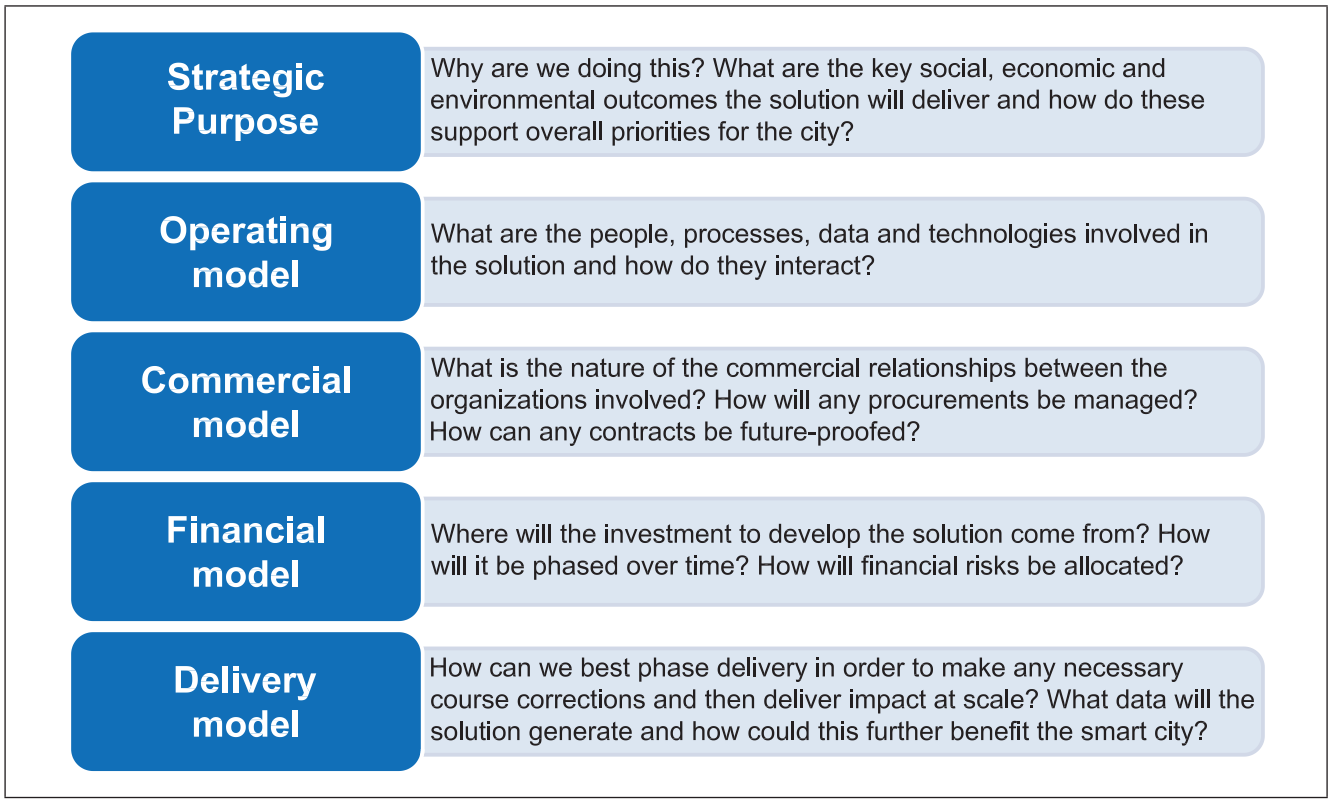
4.4.2 The need

Successful smart city solutions need to be clearly defined across five key dimensions:

- **the *strategic purpose* of the smart solution;**
- **the *operating model* for the smart solution;**
- **the *commercial model*;**
- **the *financial model*; and**
- **the *delivery model.***

Figure 2 summarizes five key dimensions that should be defined when scoping a smart city solution. There is significant scope for innovation in each dimension, and if all elements are not well aligned, the solution is likely to under-deliver.

Figure 2 **Scoping the solution**



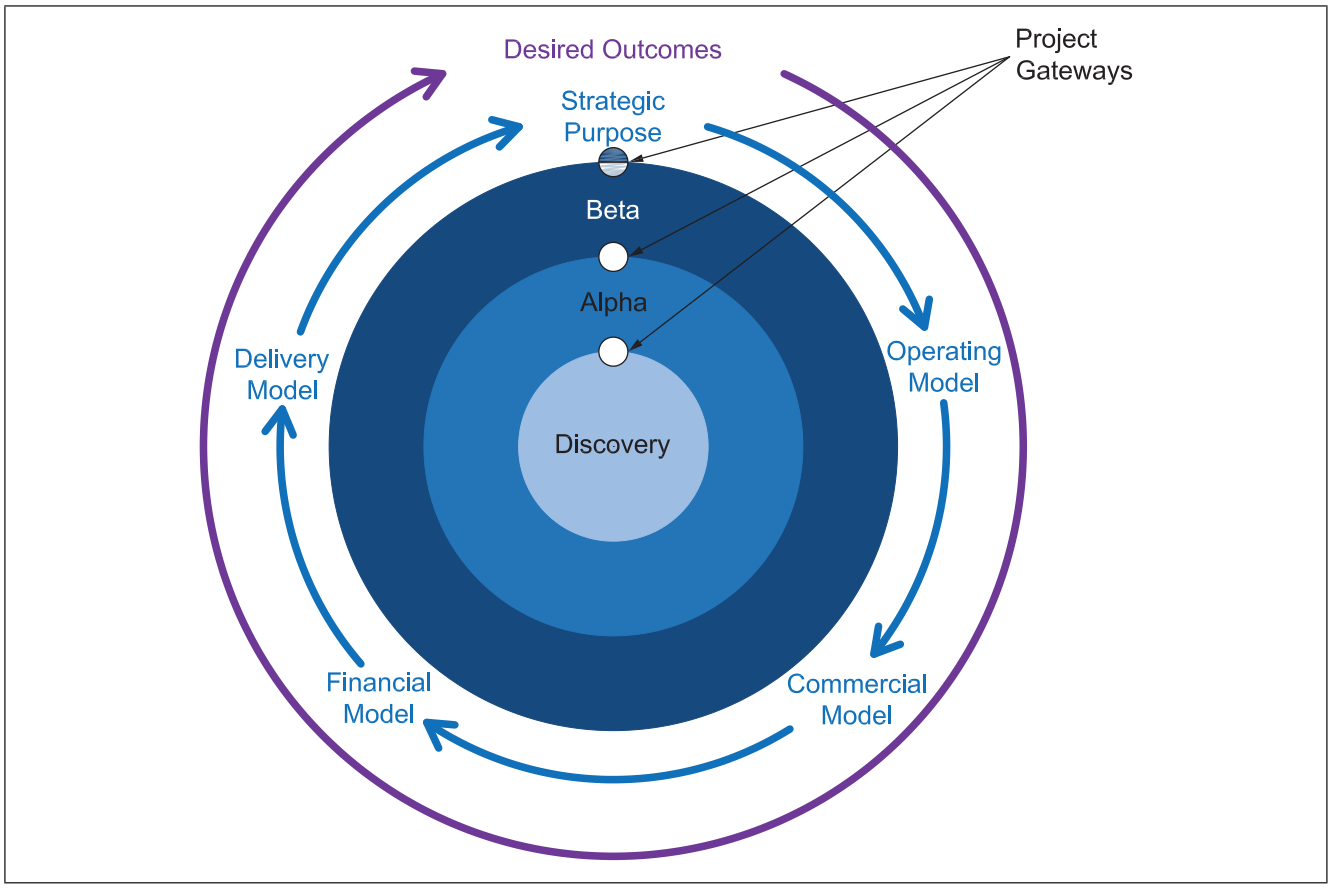
These five dimensions deliberately map on to the 'five case model' for investment appraisal set out in the Green Book [7)], which is widely used for business case development and project implementation when using tax payers' money in the UK. A wealth of guidance on deploying Green Book good practices is available, and remains valid for smart city projects.

In this PAS, the focus is on identifying specific challenges and opportunities that are of particular relevance in smart city markets. Solutions in these markets should be fluid, responding to technological developments, changing citizen needs and shifting financial landscapes. The focus of this PAS is therefore on how Green Book methodologies can be applied in the agile manner required by smart city solutions.

Smart solutions require agile delivery – as discussed in detail at **[B5] Start, Learn, Scale** (see **4.5**). However, this 'agile' approach should apply in the overall approach that the city takes to planning and designing the operating model, commercial model and financial model for the solution, not just at the delivery stage, as illustrated in Figure 3. Agile delivery includes a willingness to close a project down rather than proceeding to further phases, if initial testing shows that the proposed solution will not deliver the intended benefits.

7) See guidance on developing the strategic case, the economic case, the commercial case, the financial case and the management case for investment appraisals at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf [6]

Figure 3 **Agile scoping** [8)]



The first dimension highlighted in Figures 2 and 3 – the strategic purpose of the project – is dealt with in detail in **[B2] focus on outcomes** (see **4.2**). Checklists 7-10 look in turn at the other four dimensions, highlighting key considerations that city leaders should bear in mind as they develop a smart city solution, and stressing the need to proceed in an iterative way, using small, rapid, agile iterations to test assumptions and refine knowledge before deciding on the optimum approach for implementation at scale.

Checklist 7 – Developing the operating model for a smart city solution	
✓	**Baseline the "as is":** develop a clear and quantified understanding of how ***people***, ***processes*** and ***technology*** are currently deployed in the area of city life that the proposed smart city solution will impact.
✓	**Apply smart thinking:** use the guidance set out in Clause **5** (**Component [A]**) to help think through how people, process and technology could be combined to deliver transformational impacts – and ensure that this is informed by customer insight and data analytics.

8) The diagram demonstrates how successful smart city projects typically integrate the phased and gated approach of PRINCE2 (https://www.axelos.com/best-practice-solutions/prince2) with agile development approaches (such as those recommended by the UK government in the Government Service Design Manual. PRINCE2® is a registered trade mark of AXELOS Limited, used under permission of AXELOS Limited. All rights reserved. PRINCE2® is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by BSI of this product.

✓	**Don't do your thinking in silos:** the resulting services will not operate in a vacuum and neither should your solution. Work to consider all stakeholders, relevant services, and externalities in the project to develop an efficient operating model.
✓	**Appraise the key options for the future:** assess how the different potential operating models vary in terms of cost, time-to-market, risk and potential impact.
✓	**Consider what data is required** to develop and implement the operating model and whether the provenance of the data is sufficient for the purpose it will be used for
✓	**Don't commit too early:** where novel and untried operating models are being developed, consider trying two or more options in tandem before taking a decision on the long-term business solution.
✓	**Don't try to do everything at once:** be realistic in the scope of the project and goals that are set, and avoid the temptation to solve too many problems with one project.
✓	**Bring the preferred option to life:** work with city stakeholders to develop a clear and shared vision of how life in the city will look and feel different as a result of the smart city solution coming into operation. Explore the potential for digital modelling and digital visualization to assist in this.

Checklist 8 – Developing the commercial model for a smart city solution	
✓	**"Sanity check" the solution to ensure it can be delivered commercially:** check that the optimal mix of people, process and technology identified in the preferred operating model can be delivered through a viable, well-structured and legally-compliant deal between the parties involved. Understand how data and information is collected, processed and stored, so as to ensure that a security-minded approach is being adopted across the supply chain. Effective use of the approaches recommended in **[B3] engage the market** (see **4.3**) can help with this.
✓	**Think "commissioning" not "procurement":** it is possible that a procurement may be a sensible part of the commercial model for securing the smart city solution, but the starting point should be a much broader assessment of how different market players might best deliver the targeted outcomes [9]. Consider the range of more innovative delivery models that can be deployed, including city companies, joint ventures, mutual and social enterprises. Grants might also play a role, as may the establishment of market mechanisms to deliver services rather than traditional procurement/supplier relationships [10]. Also the SBRI [11] provides a quick, simple and well-established process that enables city authorities to support the development of innovative commercial products and services that respond to city challenges.

[9] See the NAO's "Successful Commissioning Toolkit" at https://www.nao.org.uk/successful-commissioning/

[10] See "Public Service Markets - A Practical Guide" by the Institute for Government, http://www.instituteforgovernment.org.uk/publication/public-service-markets-learning

[11] See https://sbri.innovateuk.org/sbri-for-government-departments-public-bodies

✓	**Take full advantage in any procurement of the more flexible procedures opened up by new public contracts regulations** [12]**:** procedures such as "innovation partnership", "competitive dialogue" and "competitive procedure with negotiation" allow greater interaction with the market in order to refine requirements and award a contract, compared with the "open" or "restricted procedures" that have been traditionally used. They can be particularly helpful when cities are seeking to procure smart innovation [13]. Make sure that your city's own local arrangements for procurement (for example local authority standing orders) embrace these new flexibilities.
✓	**Think local:** give full consideration to the increased powers for cities to encourage use of community-based business models such as mutuals, social enterprises and supported factories that are opened up by new public contracts regulations [14]. Make sure that the economic impact on local supply chains is addressed as an explicit consideration in procurement decisions. Consider how circular economy solutions can help reduce waste and create new value in the city [15].
✓	**Balance risk between parties:** as a general rule, liability for risks should fall to the party best able to manage that risk. Ensure that risks are evaluated and priced – don't seek to develop a commercial model that offloads risks on to a supplier that they do not have the levers to manage (such as, for example, the risks associated with internal business change by a City Council). Understand the business models of all partners (in public, private and third sectors): undertake due diligence to understand the outcomes and timeframes for partners, and ensure these are aligned. As part of this, ensure you address the risks across the supply chain associated with the collection, processing, sharing and storage of data and information.
✓	**Use smart contracting principles to future-proof any contracts:** PAS 181 recommends four principles that should inform smart city contracting: ***Focus on procuring business outcomes***: specify what the supplier should achieve, not how it should achieve it (in general, this includes procuring services not assets); ***Build open data into all procurements***: be clear that all data is to be owned by the city not the supplier, or establish clear requirements for the supplier to make data available via open standards and fair, reasonable and non-discriminatory terms [16]; ***Incentivize innovation and collaboration***: ensure that contractual arrangements encourage collaboration with others to create new value, and the sharing of common city assets; ***Avoid supplier lock-i***n, by integrating interoperability requirements into all ICT procurement, using off-the-shelf products and open standards wherever possible, and factoring in the costs of exit from the outset.

12) Such as the Public Contracts Regulations 2015 [7] and the Public Contracts (Scotland) Regulations 2015 [8].

13) See European Commission guidance for public authorities on Public Procurement of Innovation, at https://www.innovation-procurement.org/fileadmin/editor-content/Guides/PPI-Platform_Guide_new-final_download.pdf [9]

14) Such as the Public Contracts Regulations 2015 [7] and the Public Contracts (Scotland) Regulations 2015 [8].

15) Peterborough is an example of a UK city looking to develop circular economy approaches at a city-wide level: see http://www.peterboroughdna.com/circular-economy/

16) Whilst ownership of data should be as described, not all data should then be made open by the city. Access to and or publication of data should respect principles of privacy, security, consent, purpose and proportionality.

✓	**Ensure all suppliers are security-minded:** ensure that suppliers adopt a responsible attitude to cyber security (for example, through compliance with Cyber Essentials, Cyber Essentials +, or the local equivalent [17]).
✓	**Use proof of concepts:** use a smaller-scale version (pilot/proof of concept) of the smart solution to validate the viability, efficacy, and efficiency of the commercial model.

Checklist 9 – Developing the financial model for a smart city solution	
✓	**Ensure that the proposed operating model and commercial model for the solution is fundable and affordable:** Understand the lifetime capital and revenue flows associated with the solution, and ensure that this can be matched to sources of funding.
✓	**Think innovatively on how to do this:** smart city projects often do not fit neatly into traditional funding models, in which an organization makes an investment in the expectation of making a future return. In many cases, costs might need to be incurred by some players in the city in order to drive benefits for others; and those benefits might involve large externalities which do not translate easily into direct cashable savings or monetizable benefits. Yet there is a rich mix of potential funding models to draw on, ensuring that the funding profile, risk profile and benefits profile for the project can be optimally aligned. For example: a) research by the Smart City Council has identified 28 different financing mechanisms that are available for smart city projects [18]. b) the European Commission has identified the following as important innovative financing models that can help take forward smart city investments [10]: 1) models for early demonstration and deployment of innovative solutions using a grant, guarantee and loan blending mechanism; 2) project financing; 3) spread shareholding; 4) smart bonds; 5) crowdfinance; and 6) energy performance contracting for energy efficiency.
✓	**Leverage mainstream budgets:** in this relatively early stage of smart city market development, many projects still tend to be funded with one-off, time-limited research and innovation grants, often through funding competitions run by national government or the European Commission. While such investments can be helpful for demonstration purposes, they can struggle to develop sustainable, long-term impact. Commercial models which draw on mainstream operating and capital budgets in the city are likely to be more robust and sustainable.
✓	**Define practical financial KPIs:** both as an aid to setting a project scope that delivers tangible benefits, and to enable effective cost/benefit tracking.

[17] https://www.gov.uk/government/publications/cyber-essentials-scheme-overview

[18] Smart Cities Financing Guide, http://smartcitiescouncil.com/resources/smart-cities-financing-guide

Checklist 10 – Developing the delivery model for a smart city solution	
✓	**Develop a phased roadmap for implementing the solution:** plan for a delivery approach that starts small, work through important operating issues in a live working environment, and build confidence through early and incremental deliverables.
✓	**Avoid a big-bang approach:** avoid developing a model that is focused around a large deliverable towards the end of the project. This approach is inherently risky both in terms of delivery processes and also from the perspective of keeping the support of delivery partners and other stakeholders. Instead, plan for iterative development of a series of deliverables, each of a manageable size and scope, which build experience, capability and confidence, and mitigate the impact of any single delivery failure. Incorporate this phased approach into the procurement process, ensuring that suppliers use iterative development as the cornerstones of project delivery. Examples of supplier-led iterative development include: a) proof of concept (POC): the definition of a certain method or idea in order to demonstrate its feasibility, or a demonstration in principle with the aim of verifying that some **concept** or theory has practical potential; b) proof of product (POPr): The delivery of a POC as a product that can be tested with users, with the aim of verifying that **product/approach** practically delivers the intended experience/outcomes; and c) proof of service: the delivery of the POPr to operate at the scale required to deliver the required outcomes, with the aim of verifying that the **service** can practically be delivered and sustained. Typically a POC might be deployed during the "discovery" phase of a project, a POP during the "beta" phase and a POS during the "beta" phase (see **[B5] start, learn, scale** for more detail on these phases).
✓	**Plan for impact at scale:** while phased, iterative development is essential, don't use this as an excuse for a constant series of "pilots", "prototypes" and "proof of concepts". Always keep in mind that the goal is to deliver transformative and beneficial outcomes to citizens, achieving impacts at a city-wide scale. As described in **[B5] start, learn, scale** (see **4.5**) the key is to start small, learn, improve – but then implement at scale in a way that becomes part of the mainstream operating model for the city.
✓	**Apply best practice programme and project management techniques:** formal project management methodologies such as PRINCE2 [19] can help bring discipline and rigour to the delivery process. In many cases, however, a project to develop a smart city solution will find that the programme-level disciplines of Managing Successful Programmes [20] are even more helpful.

[19] https://www.axelos.com/best-practice-solutions/prince2. PRINCE2® is a registered trade mark of AXELOS Limited, used under permission of AXELOS Limited. All rights reserved. PRINCE2® is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by BSI of this product.

[20] https://www.axelos.com/best-practice-solutions/msp. MSP® is a registered trade mark of AXELOS Limited, used under permission of AXELOS Limited. All rights reserved. MSP® is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by BSI of this product.

✓	**Don't forget the data:** ensure that data generated through delivery of the solution is owned by the city rather than its suppliers, and is open for re-use by others (in ways that preserve the security and privacy of personal data and other sensitive data). Ensure that the data governance aspects of the delivery model are addressed at an early stage of the service design and that they are regularly reviewed throughout both the project lifecycle and the subsequent service delivery
✓	**Plan for privacy, security and resilience from the start:** it is vital to address these issues from the initial discovery phases of the project.
✓	**Plan for external reviews and health checks:** regular checks of projects by external reviewers provide an invaluable external perspective, helping to control direction, quality and scope. It can also provide those delivering the project with an impartial view of the different perspectives held by different delivery partners, helping to surface issues that stakeholders might find difficult to raise through normal project processes.
✓	**Capture and share learning:** ensure that the project plan explicitly caters for evaluating its progress and impact, with a view not only to improving performance but also to publishing and communicating learning from the project.

4.4.3 Recommendations

When developing a smart city solution, city leaders should ensure that, before any significant investments are made, they have clearly scoped the ***strategic purpose*** of the solution, the ***operating model*** for the solution; the ***commercial model***; the ***financial model***; and the ***delivery model***.

4.4.4 Linkages

It is important not to undertake this scoping work in isolation. The project should therefore be scoped through an inclusive and collaborative process of stakeholder engagement as described at **[B3] engage with the market** (see **4.3**).

Initial scoping work should be tested in practice, using agile delivery techniques which allow the scope to be refined and improved before being implemented at scale as described at **[B5] start, learn, scale** (see **4.5**).

The results of this work should be documented in the **[C1] business case** for the project (see **5.1**).

4.5 GUIDANCE NOTE B5: START, LEARN, SCALE

4.5.1 Context

[B4] scope the solution (see **4.4)** recommends development of a phased roadmap for delivering the project. That roadmap itself should be developed through an agile, hands-on and market-responsive approach.

4.5.2 The need

Successful projects evolve through discovery and learning. It is therefore important to *start* implementation of the solution at an early stage rather than continue with ever-more detailed planning, to *learn* from that early implementation, and then to move towards implementation at *scale* through an iterative, agile delivery process.

At the start of an ambitious smart city project, it might seem sensible to carry out detailed planning from day one all the way to the end of the project. In reality, this is not the case. At best, it is a waste of effort, and at worst, it can result in the

project team remaining emotionally committed to a planned course of action even as it begins to fail in practice.

This is because:

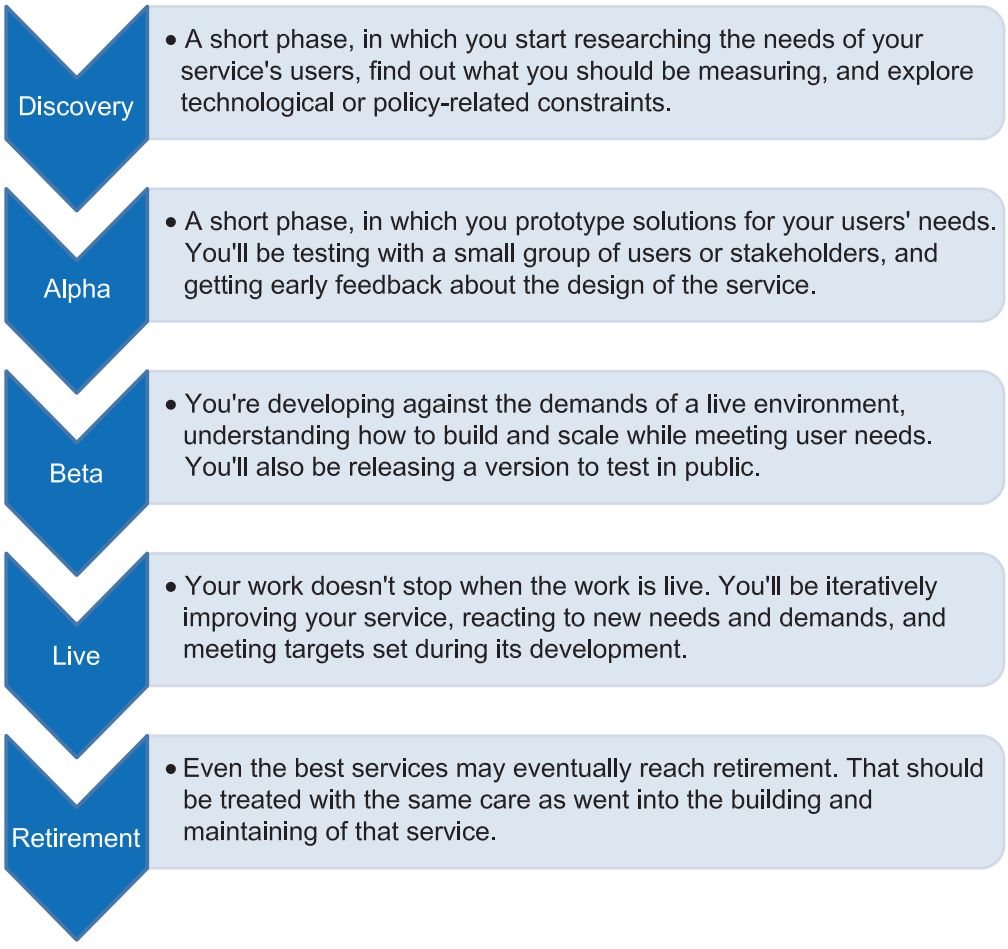
a) at the outset of any project, the project team have to make early working assumptions that may not always be correct;

b) things that are out of the project's control are likely to change during the course of delivery; and

c) new market insights and user feedback might require a different direction of travel than originally anticipated.

An agile process of "planning by learning, and learning by doing" is therefore critical. The Government Service Design Manual [21] gives an overview of agile delivery processes, recommending a five phase approach to building a digital service, as shown in Figure 4. This phased approach is also highly beneficial for smart city solutions that fall outside the scope of the Government Service Design Manual.

Figure 4 **Agile delivery** [22]



SOURCE: The Government Service Design Manual

[21] The Government Service Design Manual: https://www.gov.uk/service-manual

[22] This uses the description of agile service design phases set out in the Government Service Design Manual. See https://www.gov.uk/service-manual

4.5.3 Recommendations

Smart city project leaders should take a phased, iterative, agile approach to project delivery:

a) In the early phase of the project, focus on **safe and secure delivery**:

   1) prioritize actions which help to accelerate belief and confidence across the city stakeholder community that the project is beneficial, but which can be delivered with low levels of risk;

   2) as part of this, scope an initial deliverable to serve as an early focus for the project rather than over-planning at the start, using the agile processes recommended in the Government Service Design Manual;

   3) ensure that privacy, security and resilience considerations are taken into account from the start of the project and throughout the agile delivery: that is, they should be addressed during discovery and not left until later stages; and

   4) use the learnings from this initial deliverable to inform further work.

b) Once the early project deliverables move from the discovery and alpha phases into the beta and live phases of operation, shift the strategic focus of the project towards **building demand** for the smart city solution and creating a significant and growing number of users for the solution;

c) Once that demand starts to take off, the strategic focus can start to shift towards **benefit realization**: in other words, to start driving out the social, economic and environmental impacts for the smart city solution that are identified in **[C1] business case** (see **5.1**).

4.5.4 Linkages

The learnings from the practical experience gained through **[B5] start, learn, scale** should be used to validate and refine assumptions in the initial **[C1] business case for the solution** (see **5.1**) and to feed back into ongoing work to **[B4] scope the solution** (see **4.4**). The delivery process should be underpinned at all phases by the risk management processes described in **[B6] manage the key risks** (see **4.6**).

4.6 GUIDANCE NOTE B6: MANAGE THE KEY RISKS

4.6.1 Context

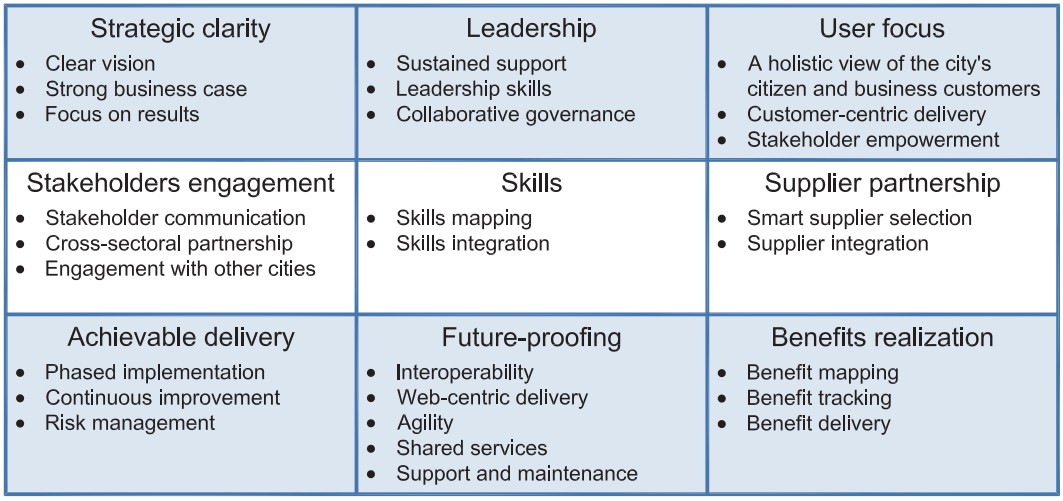
As with any delivery project, a smart city project inevitably faces significant risks throughout its duration. These risks relate to the business and cultural changes involved in delivering smart city solutions, as well as the security risks that need managing for any technology project.

4.6.2 The need

In delivering a smart city solution, city leader should ensure that they are managing the major strategic risks effectively.

There is now an increasing body of research that seeks to understand why some ICT-enabled change programmes and projects succeed and why others fail. PAS 181 describes nine critical success factors that reflect and respond to the findings of such research, validated through consultation with stakeholders in the UK smart city market and internationally (see Figure 5).

Figure 5 **Critical success factors for smart cities**



SOURCE: PAS 181:2014

PAS 181 focuses on how to manage these critical success factors at the level of a smart city programme as a whole. However, they are just as relevant at the level of an individual project to develop a specific smart city solution. At Annex D, this PAS presents a checklist for ensuring the effective management of the nine critical success factors at project level.

The principal target users of the checklist are project officers within city administrations who are developing smart city projects, and their senior managers. The checklist can be used as a health check tool to gain insights from across key project stakeholders as to where the current areas of risk lie, or simply within the project delivery team to assess areas that need specific attention.

Not all of the questions in the checklist will be answerable positively in the early phases of developing a smart city solution. However, negative answers should be viewed as 'risk triggers': i.e. highlighting that a significant risk is likely to crystallize into a real difficulty for the project. Before any significant financial commitments are made – for example, ahead of completing a competitive procurement – a healthy project should be able to answer "strongly agree" to every question.

It is important not only to understand key risks, but also to manage them effectively – recognizing that different stakeholders within the project have different levels of risk appetite. Checklist 11 gives advice on the process that smart city projects should follow to ensure effective risk management across the lifecycle of the project.

Checklist 11 – Dos and don'ts for managing key project risks	
Do	
✓	**Describe project risks and associated impacts clearly and succinctly** so that people can understand them as standalone statements; maintain this information on a formal risk register and ensure that information is always current.
✓	**Prioritise all risks** by assessing their relative likelihood and impact on the project if not addressed in a timely way, using a simple and consistent scale (often converted to a Red/Amber/Green rating).

✓	**Focus on managing the risks themselves rather than the risk register:** risk management should focus on effective mitigation, including timely escalation where necessary, rather than focusing on process issues such as the number of risks on the register. Establish an approach to active risk management so that people can understand their role and responsibility to take and support dynamic actions to address the risks identified.
✓	**Ensure clear ownership** of every risk on the register, with ownership of each risk assigned to a named individual. Be aware that ownership might have to change over time.
✓	**Clarify the risk appetite of key stakeholders:** individuals, teams, organizations, and partnerships engaged in a smart city project all have different attitudes to risk. It is vital that all those involved understand the appetite that each different stakeholder has from the outset, and that this is reflected in risk ownership and risk mitigation strategies for the project. This is particularly important where risk ownership and the impact of the risk relate to different stakeholders.
✓	**Schedule regular formal reviews of project risks** to ensure that the register is up-to-date. The status of the project, the risks it faces and their probability/impact will change over time – this should be tracked and managed.
✓	**Set clear target closure dates** for risks that are likely to impact specific key project activities, deliverables and business outcomes.
✓	**Integrate risk management within project governance**, ensuring effective processes for decision-making and escalation.
✓	**Use collaboration tools** to share the project risk register, governance and ensuing actions with project stakeholders.
Don't	
✗	**Just identify risks at the outset of the project:** ensure that there is an ongoing process to raise and review risks throughout the duration of the project to ensure that the risk register is current.
✗	**Forget that risk mitigation actions may themselves create new risks:** ensure you understand any potential new vulnerabilities and risks that are introduced through risk mitigation measures, and build these into your risk management processes
✗	**Just focus on delivery risks:** it is just as important, if not more so, is to identify and manage risks to benefit realization (see guidance note **[C4] benefit delivery** [see **5.4**]).
✗	**Ignore risks related to the security** and potential misuse of data and information
✗	**Actively hide risks from key stakeholder groups:** put in place a transparent and open risk-management process which involves all relevant parties.

4.6.3 Recommendations

To establish a robust and effective risk management strategy, the smart city project team should:

a) use the nine critical success factors (see Annex D) as an ongoing checklist in identifying issues that the project should regularly monitor to ensure they do not negatively impact on the delivery of the project; and

b) set up mechanisms that allow all key stakeholders to have visibility of and input into the current risks that are being managed, within wider project governance that allows for effective decision-making and escalation.

4.6.4 Linkages

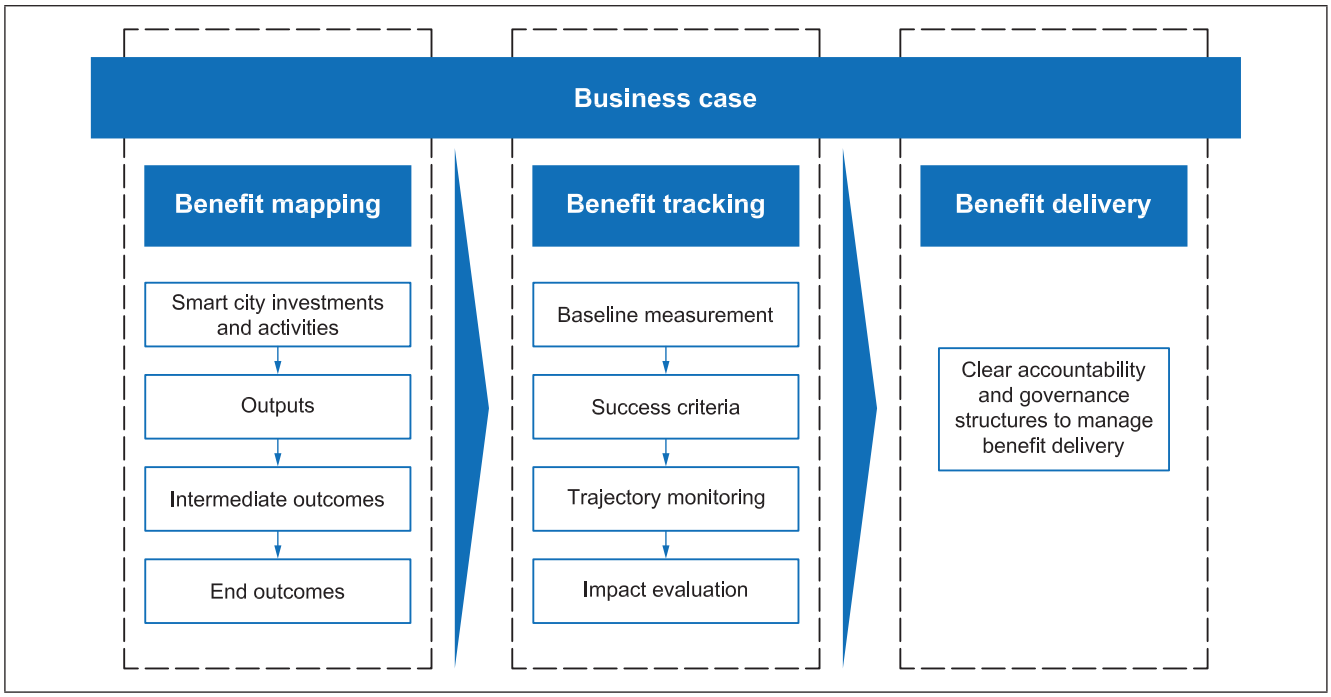
Risk management should be considered in every element of **[B4] scope the solution** (see **4.4**) (that is, scoping the ***strategic purpose*** of the solution, along with its ***operating model, commercial model, financial model***, and ***delivery model***). It should be embedded as a core element of the delivery process described in **[B5] start, learn, scale** (see **4.5**).

Many risks for an individual smart city project might be common to other projects in the city, and hence could be best mitigated at a programme level. PAS 181, and in particular guidance note **PAS 181 [B3] leadership and governance**, contains advice on the formal governance and programme management disciplines that are required to manage risks across smart city programmes.

5 Component C: Smart measurement

A project does not have any value if it does not, or cannot, deliver what has been promised. Benefits realization is therefore a core responsibility for any project delivering a smart city solution. PAS 181 sets out a best practice approach to benefit realization for smart cities, based on the framework illustrated in Figure 6.

Figure 6 **Smart city benefit realization framework**



Whereas PAS 181 gives strategic guidance on how to embed this approach in the governance of a city as a whole, guidance notes **C1-C4** in this PAS give more detail on how to apply this framework in the context of an individual smart city project.

5.1 GUIDANCE NOTE C1: BUSINESS CASE

5.1.1 Context

Teams delivering smart city projects need to document, in some form or another, the scope, delivery timetable, resourcing, benefits, cost and desired impacts that the project is setting out to achieve. The business case forms the ideal starting point for this work.

5.1.2 The need

A clear and quantified business case, agreed at the highest levels of governance, is important not only to secure initial commitment to the necessary project investments, but as a mission-critical tool for managing change throughout the period of the project and beyond.

All too often, a business case is seen as a one-off project initiation document, developed at the start of the project and then not looked at again once the go-ahead is given to proceed with delivery. This is not an effective way to develop a smart city solution. A strong business case provides a tool that can be used throughout the project lifecycle to:

a) ensure clear line-of-sight between every investment and activity in the project, the immediate outputs these produce, and the final targeted outcomes; and

b) prevent delivery teams from drifting into delivering what is easy to deliver rather than remaining focused on ensuring the successful delivery of outcomes.

It is important however not to get lost at the outset in developing an over-detailed and over-engineered business case. Given the need for smart city projects to take an inclusive approach to developing project scope (see **[B3] engage the market** [see **4.3**]) and to take an agile approach to project delivery (see **[B5], start, learn, scale** [see **4.5**]), this runs the risk of killing off a project before it can start. What is important at the outset is not to write the theoretically perfect business case, but to create something that is fit-for-purpose and can be refined over time (see **5.1.3**).

5.1.3 Recommendations

Smart city project leaders should establish a business case for the project that:

a) documents a clear and measurable strategic purpose for the project, linked to overall strategic and programme-level objectives for the city (see **[B1] clear vision and committed leadership** (see **4.1**) and **[B2] focus on outcomes** [see **4.2**]);

b) documents initial plans for the operating model, commercial model, financial model and delivery model for the project (see **[B4] scope the solution** [see **4.4**]), including key assumptions about these that need to be tested as the project moves forward;

c) identifies the major strategic risks for the project, informed by **[B6] manage the key risks** (see **4.6**);

d) underpins the project with a measurement strategy that covers the three pillars described in more detail in guidance notes **C2-C4**:

   1) **benefit mapping:** setting out all the intended outcomes from the smart city project, with clear line-of-sight showing how the immediate outputs from specific activities and investments in the project flow through to deliver those outcomes;

   2) **benefit tracking:** establishing a baseline of current performance by the city against the target output and outcomes, defining success criteria for future performance, and tracking progress against planned delivery trajectories aimed at achieving these success criteria; and

   3) **benefit delivery:** ensuring that governance arrangements are in place to ensure clear accountabilities for the delivery and ongoing monitoring of every intended outcome.

e) is then used as a living document throughout the project, with assumptions being refined as more evidence, learning and user feedback can be brought to bear.

5.1.4 Linkages

The business case has strong links with all other elements of this PAS: it is the place in which key assumptions and plans for all elements should be documented. The initial business case can be refined over time through further work on:

- **[C2] benefit mapping** (see **5.2**);
- **[C3] benefit tracking** (see **5.3**); and
- **[C4] benefit delivery** (see **5.4**).

PAS 181, and in particular guidance note **PAS 181 [C] benefit realization framework**, contains advice on development of an overall business case for a smart city programme as a whole. If a strong programme-level business case is in place within the city, this provides a good basis for individual project-level business cases to be developed in a rapid, agile and light-touch manner.

5.2 GUIDANCE NOTE C2: BENEFIT MAPPING

5.2.1 Context

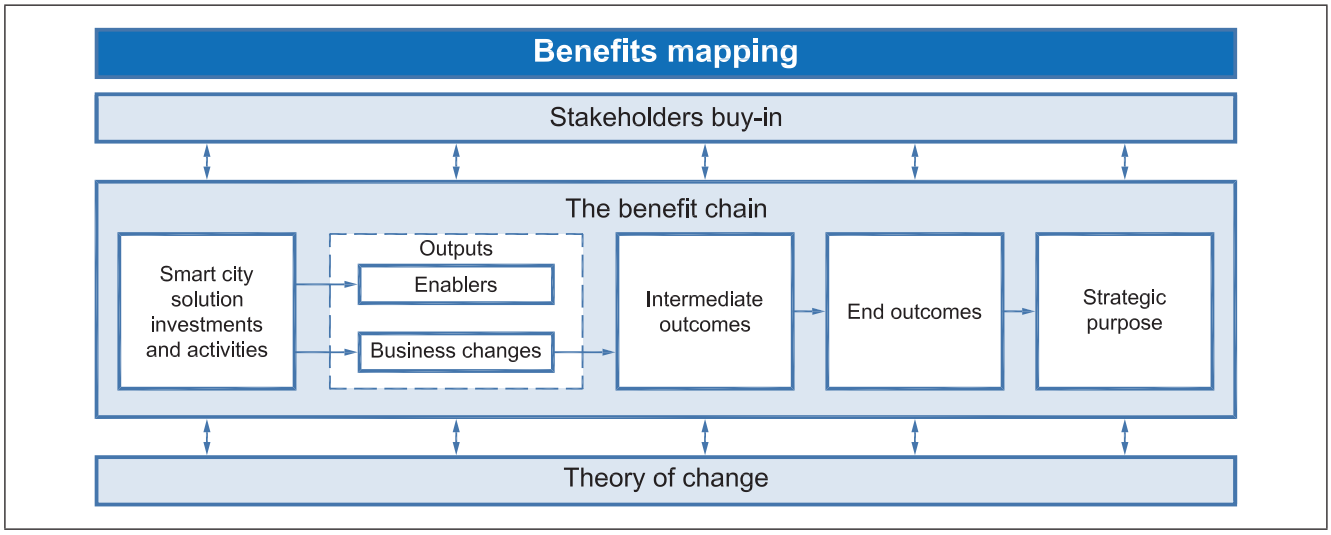
The first of three 'smart measurement' pillars, **[C2] benefit mapping** provides the impact assessment model needed to support the **[C1] business case** (see **5.1**) for a smart city project.

5.2.2 The need

The business case for a smart city project needs to be supported by a clear and measurable framework showing how project activities lead to delivery of project outcomes, underpinned by a credible theory of change to demonstrate causal relationships across all stages of the benefit chain.

Benefit mapping requires clarity about all the intended outcomes from the smart city project, with clear line-of-sight showing how the immediate outputs from specific activities and investments in the project flow through to deliver those outcomes. This flow is called the 'benefit chain' as illustrated in Figure 7 [23)].

Figure 7 **Benefit mapping**



23) This benefits mapping methodology is described in PAS 181, and in more detail in the global open standard for transformational change programmes in the public sector: the 'Transformational Government Framework' published by international standards consortium OASIS. For the latest version of the standard, see: http://docs.oasis-open.org/tgf/TGF/v2.0/csprd01/TGF-v2.0-csprd01.pdf [11]

The benefit map should:

a) **start with the strategic purpose:** real clarity on the problem the project aims to address and how doing so will impact on the vision and strategic aims for the city as a whole.

b) **map out clear line of sight between:**

   1) **smart city investments and activities:** any project action including individual tasks funding or resources that contribute towards one or more of the project's deliverables;

   2) **outputs:** the outputs of smart city investments and activities that contribute to achievement of the targeted outcomes. In general, these fall into two types: **enablers** and **business changes**. Enablers tend to be artefacts or systems of some kind (e.g. assets such as buildings, IT systems, control systems, equipment, databases etc.). Business changes include changes to processes, policies, organizational structure, and even behaviours and values. Enablers on their own – if not then followed up by any business change – cannot deliver benefits, so it is important that these changes are effectively understood and mapped. (Many projects to deliver smart city solutions suffer from a focus on delivering enablers at the expense of outcomes, and so a key purpose of the benefit map is to ensure that the required business changes are identified and given appropriate emphasis.);

   3) **intermediate outcomes:** these are the short-term benefits that the project seeks to deliver as a result of putting one or more outputs in place. City leaders should aim for a project to achieve some 'quick wins' early on so as to build change momentum and stakeholder buy-in to the next phases of work.

   4) **end outcomes:** these are the longer-term social, economic and environmental outcomes that the project seeks to achieve, in fulfilment of its **strategic purpose**.

c) **be underpinned by an evidence-based theory of change:** in developing the benefit chain, it is important to ensure that the logical flow is credible, even if causality cannot be proven at each step. This is because causal links between many smart city solutions and the full range of downstream benefits can never be fully proven on a cost-effective basis, due to:

   1) the long-term nature of the business changes involved, in which interventions now can deliver benefits (often very important ones) decades in the future; and

   2) the difficulty of isolating the impact that the project has on a particular social or economic outcome from the myriad of other factors that also impact on that outcome.

The key test of the benefit map is therefore not that it *proves* a particular set of outcomes, but that it *gives confidence* that there is a genuine and credible cause and effect flowing from activities to outputs to outcomes, and is grounded in the reality of what can practically be evaluated on a cost-effective basis.

At the same time, it is important to remember that an effective benefit map needs to provide not just a logical framework, but also an emotionally-satisfying one. The benefit map needs to seem intuitively correct, and be resonant for key project stakeholders. This means it should be developed collaboratively with stakeholders. Getting the right people together to develop the project's benefit map means that they buy into the resulting output, and are more likely to support its delivery.

5.2.3 Recommendations

Smart city project leaders should develop a benefit map for the project, giving clear line-of-sight on how all aspects of project activity flow through to the strategic outcomes being targeted by the city. This should not seek to prove cause and effect on an unequivocal basis, but demonstrate a credible logical flow underpinned by an evidence-based theory of change which has the support of key stakeholders.

5.2.4 Linkages

Benefit mapping is a key tool to support:

- **[B1] clear vision and committed leadership** (see **4.1**); and
- **[B2] focus on outcomes** (see **4.2**).

Once the benefit map has been developed, it should:

- be included within the **[C1] business case** (see **5.1**);
- be underpinned with detailed metrics and measurement processes via **[C3] benefit tracking** (see **5.3**)
- inform [**B6] manage the key risks** (see **4.6**) – in particular, it is important to ensure that risks to the delivery of key outputs and outcomes are identified and managed.

5.3 GUIDANCE NOTE C3: BENEFIT TRACKING

5.3.1 Context

The second of three pillars towards the smart city project's impact evaluation strategy, **[C3] benefit tracking** sets out the detailed metrics and measurement processes needed to track progress against the **[C2] benefit map** (see **5.2**).

5.3.2 The need

Once city leaders have fully defined and articulated the project's intended benefits, they should establish appropriate measurements and measurement processes to track progress against these benefits over the duration of the project.

Benefit tracking is about establishing a baseline of current performance against the target output and outcomes, defining success criteria for future performance, and tracking progress against planned delivery trajectories aimed at achieving these success criteria.

Key elements to address include:

a) **key performance indicators (KPIs):** measures should be identified to track progress across all stages of the benefit map, and which can be tracked with integrity across the lifecycle of the project. This should cover both outcome and leading indicators:

   1) **Outcome indicators:** Outcome indicators relate to measurement of the key benefits being targeted by the project – they focus on the intermediate outcome and end outcomes of the benefit chain shown in Figure 7.

   2) **Leading indicators:** Leading indicators focus on measures that indicate whether the smart city project is on track for successful delivery, by looking at the programme's performance on key success factors: the skills of the project delivery team; degree of user-focus; effectiveness of risk management, etc. They focus on the project investment, activities and outputs stages of the benefit chain shown in Figure 7.

b) **baseline measurement**: to be able to measure the progress, it is first important to establish what the pre-change baseline is. If this is not currently known, it needs to be established as soon as possible.

c) **success criteria and targets**: the scale and pace of change which the project is expected to deliver should be identified for each measure. Clarity is needed not just about what will be measured, but what sort of change in performance against that measure is positive and what level of change will be regarded as a successful outcome. Targets should be SMART:

   1) ***Specific*** – clear and unambiguous;

   2) ***Measurable*** – quantifiable;

   3) ***Achievable*** – realistic and attainable;

   4) ***Relevant*** – applicable and worthwhile;

   5) ***Time-bound*** – delivered within a specific timeframe.

d) **trajectory monitoring**: for all of the measures put in place, it is helpful to define the timing and profile of the expected benefit realization, so that stakeholders know when to expect to see the benefits and managers can intervene early on if progress is not on track; and

e) **impact evaluation**: a clear plan is needed for measuring each KPI. In some cases, this will be possible in real-time, in others through periodic surveys, in others perhaps only through longitudinal economic impact evaluations.

5.3.3 Recommendations

Smart city project leaders should:

a) establish clear baselines for all benefits that are targeted by the project (to ensure that the project team knows where it is starting from);

b) agree measurable success criteria and trajectories for each benefit in the business case (to ensure that the project team knows where it wants to get to);

c) establish an effective measurement framework of key performance indicators to track progress (to ensure that the project team knows how well it is doing);

5.3.4 Linkages

The benefits to be tracked are set out in the **[C1] business case** (see **5.1**), and in more detail by **benefit mapping** (see **5.2**). Accountability for delivering the benefits should be defined and managed through the process described in **[C4] benefit delivery** (see **5.4**).

5.4 GUIDANCE NOTE C4: BENEFIT DELIVERY

Context

The third of the three pillars towards the smart city project's impact evaluation strategy, **[C4] benefit delivery** establishes the benefit realization plan and puts in place the supporting governance structures and monitoring processes.

5.4.1 The need

A smart city project can successfully deliver its intended outputs without these necessarily delivering the intended benefits. For benefit delivery to work effectively, each intended benefit needs an accountable owner who is responsible for driving out and maximizing the benefits to all its stakeholder groups, and who is well-positioned within project governance structures to escalate when benefits realization is not on track against the planned targets.

Benefit delivery is about ensuring that the delivery of every intended outcome specified within the business case and associated benefit map is proactively managed and monitored, with appropriate governance arrangements in place to support this process.

To make this happen, benefit realization plans should be documented for the project, which outline the planned activities to achieve the benefits both in the short and longer-term by each of the benefit owners.

5.4.2 Recommendations

The following steps are recommended to achieve optimal benefit delivery across a smart city project:

a) **Identify benefit owners for all end outcomes targeted in the business case and associated benefit map.** A benefit owner should be a senior and empowered manager, accountable for championing the delivery of that outcome – even where that individual does not have personal responsibility for delivering all the activities and outputs that contribute to that outcome;

b) **Developing benefit realization plans for the project**, which outline for each benefit owner the activities that will be carried out to realize each benefit, including any clear dependencies and priorities across the project;

c) **Empowering benefit owners to lead on risk and issue management for "their" outcomes.** Risk and issue management often focuses on delivery risk: risks to project outputs. While this is an important area, what really matter are risks as they relate to the benefits being sought. If a threat to an outcome is identified, alternative responses and associated costs should be evaluated so that project governance can decide on the appropriate action.

d) **Providing a forum for issue escalation and resolution, and for sharing and collaboration between benefit owners.** A senior project board or stakeholder forum is a useful body to drive forward delivery of benefits, with regular visibility of any benefits that are not on track to be delivered.

e) **Make sure you capture unintended benefits.** Smart city projects often deliver unintended serendipitous impacts. It is important to recognize, measure and communicate these, and to feed them back into the evolving business case.

If benefits are not being delivered as originally envisaged by the project team, it may be that the enablers or business changes are not meeting the needs of the stakeholders so it is important that further action is taken to **[B3] engage with the market** (see **4.3**).

5.4.3 Linkages

All the 'smart practices' described in Clause **4** of this PAS have a bearing on the effectiveness of benefit delivery, and in particular **[B1] clear vision and collaborative leadership** (see **4.1**), **[B2] focus on outcomes** (see **4.2**), **[B3] engage with the market** (see **4.3**) and **[B6] manage the risks** (see **4.6**).

Annex A (informative)

Summary of recommendations

[A] Smart thinking

City leaders should:

a) encourage those involved in the development of any new project or policy for the city to:

   1) ground the project in customer insight and data analytics;

   2) think broadly across organizational silos about the potential for innovation and service transformation that smart solutions open up including the scope for the technology and assets created through the project to create benefits beyond the immediate scope of the local authority department that is sponsoring the project; and

   3) promote a culture which is comfortable with occasional failure, in which change and innovation are seen as having risks that need to be managed but in which these are always weighed against the strategic risks to the city posed by inertia;

b) establish business assurance processes to support managers as they seek to implement recommendation **3.3 a)**;

c) in particular, ensure that before any formal procurement and contracting process is launched, senior leaders from across all divisions of the local authority have reviewed the procurement requirement and satisfied themselves that "the right thing is being procured at the right time"– i.e. that the ***visionary***, ***citizen-centric***, ***digital***, ***open*** and ***collaborative*** questions set out in Checklists 1-5 of this PAS have been appropriately asked and answered; and

d) ensure that the smart characteristics of the proposed solutions are communicated clearly and consistently to stakeholders throughout the project development process.

[B1] Build a clear vision and committed leadership

When developing a smart city solution, city leaders should:

a) create a vision of how life in the city will both look and feel different as a result of the smart city solution being successfully implemented, focusing on the tangible benefits to citizens;

b) ensure that this vision:

   1) is developed in an iterative and collaborative manner that is, inclusive of all relevant stakeholder groups and informed by user research and engagement, with social media and other technologies used to enable wider public participation in the process;

   2) embraces the opportunities opened up by smart technologies, smart data and smart collaboration - and does so in a way that integrates these with the core socio-economic, political and environmental vision and purpose for the city's future, rather than seeing them as somehow separate from the city's core strategic objectives;

   3) is measurable.

c) establish leadership and governance arrangements for the project that ensure:

   1) a clear focus of accountability for the project at senior level within the city authority;

2) arrangements are made that enable costs to be accrued and benefits attributed across different cost centres;

3) deployment of formal project management disciplines;

4) the right skills mix in the leadership team;

5) the need for security and resilience across all elements of the project is managed from the outset;

6) an open and transparent governance and delivery process, engaging directly with citizens to co-create the solution and using digitally-enabled models of wider civil participation.

[B2] Focus on outcomes

City leaders should:

a) focus on procuring outcomes, not specifying inputs[24)];

b) take a broad view considering the social, economic, and environmental nature of those outcomes;

c) take procurement decisions that are based not on initial project cost but on long-term value for money in the delivery of these outcomes, including:

1) total cost of ownership (including costs of exit);

2) the suppliers' ability to innovate; and

3) confidence in delivering the expected outcomes.

d) review their local arrangements for procurement (for example, standing orders) to assure themselves the necessary flexibility to achieve this outcome focus.

[B3] Engage with the market

City leaders should:

a) establish, and give high priority and adequate resources to, a formal, managed programme of work on market engagement as a key workstream within the project plan; and

b) ensure that this covers both ***customer co-creation*** and ***supplier engagement***, and reflects the smart practices described in this PAS.

[B4] Scope the solution

City leaders should ensure that, before any significant investments are made, they have clearly scoped the ***strategic purpose*** of the solution, the ***operating model*** for the solution; the ***commercial model***; the ***financial model***; and the ***delivery model***.

[B5] Start, learn, scale

Smart city project leaders should take a phased, iterative, agile approach to project delivery:

a) In the early phase of the project, focus on **safe and secure delivery**:

1) prioritize actions which help to accelerate belief and confidence across the city stakeholder community that the project is beneficial, but which can be delivered with low levels of risk;

2) as part of this, scope an initial deliverable to serve as an early focus for the project rather than over-planning at the start, using the agile processes recommended in the Government Service Design Manual;

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24) This is a core principle of UK, EU and international law on public procurement – see for example the WTO Agreement on Government Procurement. See https://www.wto.org/english/docs_e/legal_e/rev-gpr-94_01_e.htm [4]

3) ensure that privacy, security and resilience considerations are taken into account from the start of the project and throughout the agile delivery: that is, they should be addressed during discovery and not left until later stages; and

4) use the learnings from this initial deliverable to inform further work.

b) Once the early project deliverables move from the discovery and alpha phases into the beta and live phases of operation, shift the strategic focus of the project towards **building demand** for the smart city solution and creating a significant and growing number of users for the solution;

c) Once that demand starts to take off, the strategic focus can start to shift towards **benefit realization**: in other words, to start driving out the social, economic and environmental impacts for the smart city solution that are identified in **[C1] business case** (see **5.1**).

[B6] Manage the key risks

City leaders should:

a) use the nine critical success factors (see Annex D) as an ongoing checklist in identifying issues that the project should regularly monitor to ensure they do not negatively impact on the delivery of the project; and

b) set up mechanisms that allow all key stakeholders to have visibility of and input into the current risks that are being managed, within wider project governance that allows for effective decision-making and escalation.

[C1] Business case

Smart city project leaders should establish a business case for the project that:

a) documents a clear and measurable strategic purpose for the project, linked to overall strategic and programme-level objectives for the city (see **[B1] clear vision and committed leadership** (see **4.1**) and **[B2] focus on outcomes** [see **4.2**]);

b) documents initial plans for the operating model, commercial model, financial model and delivery model for the project (see **[B4] scope the solution** [see **4.4**]), including key assumptions about these that need to be tested as the project moves forward;

c) identifies the major strategic risks for the project, informed by **[B6] manage the key risks** (see **4.6**);

d) underpins the project with a measurement strategy that covers the three pillars described in more detail in guidance notes **C2-C4**:

1) **benefit mapping:** setting out all the intended outcomes from the smart city project, with clear line-of-sight showing how the immediate outputs from specific activities and investments in the project flow through to deliver those outcomes;

2) **benefit tracking:** establishing a baseline of current performance by the city against the target output and outcomes, defining success criteria for future performance, and tracking progress against planned delivery trajectories aimed at achieving these success criteria; and

3) **benefit delivery:** ensuring that governance arrangements are in place to ensure clear accountabilities for the delivery and ongoing monitoring of every intended outcome.

e) is then used as a living document throughout the project, with assumptions being refined as more evidence, learning and user feedback can be brought to bear.

[C2] Benefit mapping

City leaders should develop a benefit map for the project, giving clear line-of-sight on how all aspects of project activity flow through to the strategic outcomes being targeted by the city. This should not seek to prove cause and effect on an unequivocal basis, but demonstrate a credible logical flow underpinned by an evidence-based theory of change which has the support of key stakeholders.

[C3] Benefit tracking

City leaders should:

a) establish clear baselines for all benefits that are targeted by the project (to ensure that the project team knows where it is starting from);

b) agree measurable success criteria and trajectories for each benefit in the business case (to ensure that the project team knows where it wants to get to);

c) establish an effective measurement framework of key performance indicators to track progress (to ensure that the project team knows how well it is doing);

[C4] Benefit delivery

City leaders should:

a) identify benefit owners for all end outcomes targeted in the business case and associated benefit map;

b) develop benefit realization plans for the project;

c) empower benefit owners to lead on risk and issue management for "their" outcomes;

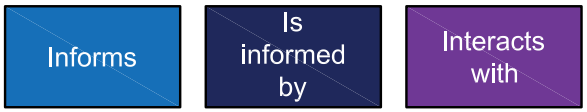
d) provide a forum for issue escalation and resolution, and for sharing and collaboration between benefit owners; and

e) make sure they capture unintended benefits.

Annex B
(informative)

Dependencies and interactions between the components of this PAS

Note: colour coding shows dependency between PAS components listed in rows and those listed in columns		A	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4
A: Smart thinking												
B: Smart practices	B1: Clear vision and committed leadership (see **4.1**)											
	B2: Focus on outcomes (see **4.2**)											
	B3: Engage with the market (see **4.3**)											
	B4: Scope the solution (see **4.4**)											
	B5: Start, learn, scale (see **4.5**)											
	B6: Manage the key risks (see **4.6**)											
C: Smart measurement	C1: Business case (see **5.1**)											
	C2: Benefit mapping (see **5.2**)											
	C3: Benefit tracking (see **5.3**)											



Annex C
(informative)

Case study – developing a smart waste proof of concept (POC) in Bristol

The case study below provides a worked example of how one city – Bristol – undertook a proof of concept (POC) for a Smart Waste Project. Many of the practices used by Bristol Waste Company (BWC) are also recommended best practices within this guide.

The sidebar to the right of the case study highlights principles within the guide, with the narrative on the left hand side explaining how the POC was constructed and applied.

The project

Bristol Waste Company (BWC) is a wholly owned council company with a mandate to undertake a 10-year strategic plan, aligned to a clearly defined vision of "a cleaner, greener Bristol, in which residents, communities and businesses feel involved, informed and empowered to create a better place for future generations".

B1: Clear vision and committed leadership

In 2016, BWC collaborated with Bristol Is Open (BIO – a joint venture between the city's council and university), NEC, Bristol City Council and User Centric (a Bristol-based SME) to undertake a POC with the outcome of demonstrating the potential for connectivity and smart technology to deliver (waste) services more efficiently and effectively in Bristol, enhancing the quality of services to residents. The collaboration focused on the value each party could bring, to see how they might benefit from working together towards the outcome, as well as understanding and agreeing clear interfaces and ways of working together.

B2: Focus on outcomes

"*What we really needed to understand was why we wanted to work together in the first place and what we could all bring to the party*", says Steve Ostler, BWC, Finance Director and Project Sponsor. "*BWC knew that we wanted to become more data-led to deliver our vision, and we were aware of the conceptual benefits of smart cities, but we needed to get down into the nitty-gritty of how exploiting these new technologies would contribute towards a cleaner, greener city for Bristol residents. We also knew that resources were limited, so needed to work with people who didn't necessarily see the benefits of initial collaboration in purely financial terms*".

B3: Engage with the market

Through workshops and open dialogue, the group understood BWC's value proposition and the real-life problem they wanted to solve, and this enabled the onward development of a smart city target architecture and comprehensive Statement of Work.

Mark Ives from User Centric, said; "*With all these things it's really important to think big but start small and explicitly understand what real-world problems technology can contribute towards solving, and then get into the basics on how you make successful change happen. An approach like this tends to create great momentum going forwards, increases confidence in the overall solution and encourages greater uptake*".

B4 Scope the solution

Realizing the value of starting small, the initial commitment was to deploy sensors to bins in a controlled environment (consequently not impacting on residents or any privacy issues) to enable near real-time monitoring of fill levels. Through this, BWC could validate the value of the data in terms of informing collection services and engagement with local communities.

Issues of data security, intellectual property, data and asset ownership were addressed at the outset. The group held workshops to agree working and design principles (based on data protection, open standards and interoperability) which were then used to guide activity.

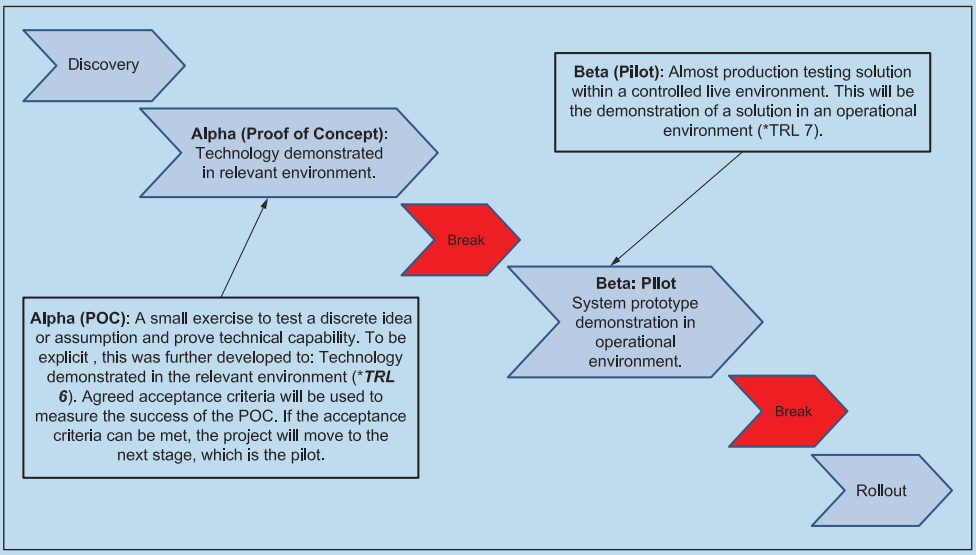
Workshops were also used to ensure everyone was clear on the role they would play in contributing towards the outcome, with NEC providing the sensors and platform, BIO the infrastructure, BWC the bins, and User Centric working with BWC to identify the value proposition and also drive the change forward in a people-centric way. Each partner also developed their own specific objectives for the collaboration that the whole group signed up to. These helped form acceptance criteria that were used to guide and inform decisions as the work progressed.

B4 Scope the solution

The approach also meant careful consideration of funding models. Pre-existing partnerships – notably a Horizon 2020 consortium between NEC, Bristol Is Open and Bristol City Council – enabled the partners to move rapidly to POC without procurement. Each of the group members committed resources in kind, justified by a belief in the value of the knowledge and relationship benefits that would accrue – and in the knowledge that the transition to pilot would require use of more traditional procurement routes.

The work was not without its challenges. In particular, it meant having to think differently about relationships with commercial partners, which became apparent as the group refined their agile delivery model (see Figure C.1). *"We always knew that the relationships would need to change and mature as the work progressed, not least because BIO's funding constrains use of their infrastructure to research and development"* says Kerry Greig (Bristol City Council Architectural Services and Lead Architect for Smart Waste). *"But as we progressed we soon realized the importance of a shared understanding of the different phases of activity – from proof of concept, to pilot, to the future. This also meant a clear grasp of how we would transition between the stages and who would need to be involved to deliver environmental, social and economic benefits."*

Figure C.1 **Agile design and delivery of the project**



B5: Start, learn, scale

The group wanted to move fast – the sooner the sensors were installed safely and securely, the sooner they'd be able to validate the actual technology, learn and adapt. The challenge was that the legal models within respective organizations didn't always align.

Eventually a Statement of Work was agreed, produced, developed and agreed by the group.

This proved an essential document for all parties, and represented a shift from the legal templates traditionally deployed. Following completion of the POC, options analysis follows to inform the decision making process for the next stage.

C1: Business case

Although the partners were committed to agile delivery, they also wanted clear structures and robust management practices in place. The key risks to the project were identified in cross-partner workshops and throughout POC delivery and were proactively managed in a structured way, with ownership of each risk allocated to the relevant partner best placed to mitigate.

B6: Manage the key risks

Lessons learned

The importance of:

- strong governance;
- stakeholder buy in;
- understanding the problem(s) technology could help solve;
- understanding the overall value of solving the problem; and
- regular face to face interaction and dedicated resources.

Annex D (informative) Checklist of critical success factors

The checklist set out in Table D.1 is for use by teams delivering smart city projects when assessing the project's status against the nine smart city critical success factors identified in PAS 181.

Table D.1 **Checklist of critical success factors** *(1 of 7)*

	Strongly disagree	Tend to disagree	Tend to agree	Strongly agree
a) Strategic clarity				
1) Clear vision • I personally have a clear understanding of what our smart city project is seeking to achieve and how this links to the overall priorities for our city. • All project stakeholders have a clear and common understanding of what our smart city project is seeking to achieve and how this links to the overall priorities for our city. • The scope of the smart city project is unambiguous – it is entirely clear what the project will and will not seek to deliver. • The relationship and dependencies between this project and other related smart city projects and programmes is clear.				
2) Strong business case • We know what outcomes we want to achieve. • We have established clear, evidence-based measures of success. • We have a clear and quantified baseline of the costs and performance of current service delivery systems across the city, against which we can compare the impact of the project.				
3) Focus on results • The project is set up to take concrete, practical steps in the short to medium term. • The project is set up to deliver early benefits ("quick wins") to stakeholders. • We will not spend money on technology before having identified the key organizational and business changes needed for it to help deliver our vision.				

Table D.1 **Checklist of critical success factors** *(2 of 7)*

	Strongly disagree	Tend to disagree	Tend to agree	Strongly agree
b) Leadership				
1) Sustained support • Political leaders and senior management from key city stakeholders are committed to the project for the long term. • There is a single person in charge of the project. • This person is pro-actively involved in leading the project, empowered to take decisions, and seen as having authority by all the organizations involved with the project. • The wider project team has the necessary authority to proceed from all relevant internal and external decision-making bodies.				
2) Leadership skills • The responsible leader of the project has the skills and experience needed to lead a project of ICT-enabled business change of this scale and scope. • Our leadership team as a whole has the skills and experience needed to deliver a project of ICT-enabled business change of this scale and scope. • Our leadership team understand the potential safety and security issues inherent in the proposed project and associated business case, and have sought appropriate professional advice • Our leadership team has access to external support, including engagement with leaders of smart city initiatives elsewhere in the UK and internationally.				
3) Collaborative governance • Leaders from the city authority and all major city partners are motivated for the project to succeed. • Clear and collaborative governance arrangements are in place for the project, involving representatives of all key organizations at a senior level who are empowered to take decisions and manage risks and issues which involve their organizations. • There is unambiguous accountability as to which person and/or organization has the lead role on each aspect of project delivery.				

Table D.1 **Checklist of critical success factors** *(3 of 7)*

	Strongly disagree	Tend to disagree	Tend to agree	Strongly agree
• There are clear and effective processes in place for resolving disagreements between different parties involved in the project. • The reporting processes between the multiple parties involved in this project give timely and accurate views of progress and key risks.				
c) User focus				
1) A holistic view of the city's citizen and business customers • The project is informed by a detailed and segmented understanding of the needs of its customers. • Customer insight for the project is informed by both market research and analysis of city data. • The project has access to customer insight not just from our own organization, but from all major city partners that engage with our customer group(s).				
2) Customer-centric delivery • There is a clear strategy to ensure that customer-facing services delivered by the project are integrated with other city services for the same customer groups, for example through one-stop multi-channel services. • There is an effective strategy to encourage take up of services through digital channels, and to help those who are currently digitally excluded to benefit from the project.				
3) Stakeholder empowerment • We engage customers directly in any service design and delivery relevant to this project. • We provide all stakeholders with access to project-related data to maximize engagement and empowerment in taking project decisions and participating in delivery activity, using open data wherever possible and appropriate secure channels where not.				
d) Stakeholder engagement				
1) Stakeholder communication • We have a clear and documented understanding of who the key stakeholders for our project are. • Our stakeholders have a clear understanding of our project, how they can engage with it and how they will benefit from it.				

Table D.1 **Checklist of critical success factors** *(4 of 7)*

	Strongly disagree	Tend to disagree	Tend to agree	Strongly agree
• We have a clear and documented understanding of any stakeholder sensitivities or concerns regarding the collection, access to, processing, sharing and storage of data and information by this project. • The project has simple and easy-to-use processes for stakeholders to engage with. • There are sufficient project resources in place to ensure the appropriate level of engagement with stakeholders.				
2) Cross-sectoral partnership • The project is engaging effectively with stakeholders in the public, private and voluntary sectors. • The project is delivering clear benefits for all stakeholder groups across the public, private and voluntary sectors.				
3) Engagement with other cities • Our project is engaging systematically with other cities to learn lessons and exchange experience.				
e) Skills				
1) Skills mapping • I personally have all the skills I need to successfully fulfil my own role in relation to the project. • The project team as a whole has all the skills needed to deliver this project successfully. • We have mapped out the skills we need to deliver this smart city project, and have established clear plans for acquiring and maintaining them.				
2) Skills integration • The roles, responsibilities and lines of accountability for all people involved in delivering the project are clear. • We have effective mechanisms in place to maximize value from all the skills available across the partners involved in delivery of the smart city project.				

Table D.1 **Checklist of critical success factors** *(5 of 7)*

		Strongly disagree	Tend to disagree	Tend to agree	Strongly agree
f)	**Supplier partnership**				
	1) Smart supplier selection • We have engaged collaboratively with potential suppliers in scoping the requirements for this project. • The project adopts procurement and contracting policies that are aligned with smart city procurement principles (focus on outcomes, open data, incentives for innovation and collaboration, avoidance of lock-in). • The project selects suppliers based on long-term value for money rather than price, and in particular based on our degree of confidence that the chosen suppliers will secure delivery of the expected business benefits.				
	2) Supplier integration • Senior management for the project is directly involved in managing the relationship with key suppliers. • There is effective project/supplier integration: both sides operate as an integrated delivery team with shared management information systems. • There are incentives in place for our suppliers to innovate and to cut costs, with the benefits being shared between the project and the suppliers.				
g)	**Future-proofing**				
	1) Interoperability • Wherever possible we use interoperable, open standards that are well supported in the market-place.				
	2) Web-centric delivery • We use SOA principles in order to support all of our customer interactions, from face-to-face interactions by frontline staff to online self-service interactions.				
	3) Agility and resilience • Our service delivery is resilient by design, with no critical single points of failure. • We take a security-minded approach to ensure the project will not jeopardise the safety and/or security of citizens or city assets.				

Table D.1 **Checklist of critical success factors** *(6 of 7)*

	Strongly disagree	Tend to disagree	Tend to agree	Strongly agree
• We deploy technology using common building blocks that can be reused to enable flexibility, resilience and adaptiveness.				
4) Shared services				
• We manage key building blocks as city-wide resources (in particular common customer data sets; common applications and application interfaces; and core ICT infrastructure).				
5) Support and maintenance				
• Our support and maintenance arrangements are designed to achieve trustworthy operation of the smart city systems and to apply appropriate security-mindedness to the handling and use of data and information.				
• Our support and maintenance arrangements can take over responsibility for assets developed and/or managed by stakeholders who leave the smart city's ecosystem for whatever reason.				
• We have a process in place that can engage with replacement stakeholders when existing stakeholders deemed to provide value leave the smart city's ecosystem or become disengaged.				
h) Achievable delivery				
1) Phased implementation				
• The project has a phased approach to delivery which minimizes risk at each stage, and avoids significant levels of simultaneous technological and organizational change.				
• The delivery plan for the project covers all key tasks needed to deliver success, set out in stages that are logical and achievable.				
• There are clear criteria, agreed with stakeholders, which must be met at the end of each delivery stage before the project can move to the next stage.				
• The project has the staff and financial resources it needs to ensure effective delivery.				
2) Continuous improvement				
• Our delivery plan assumes we will not get everything right first time, but establishes systems that enable us to understand the current position, plan, move quickly and learn from experience.				

Table D.1 **Checklist of critical success factors** *(7 of 7)*

	Strongly disagree	Tend to disagree	Tend to agree	Strongly agree
3) Risk management • We understand and have documented the key risks faced by the project. • Each risk is owned by a named leader, empowered to manage that risk and escalate as necessary. • We understand the need for the ongoing proactive management of safety and security risks. • Effective Risk and Issue reporting processes are in place, with no ability for suppliers and delivery teams to "hide bad news". • Our project benefits from regular external healthchecks.				
i) Benefits realization				
1) Benefit mapping • Every aspect of work on the project has clear line-of-sight through to the strategic outcomes being targeted by the city. • Every major delivery partner involved in the project has a clear and quantified view of the benefits that the project will deliver specifically for that partner. • The benefits that the project is seeking to achieve are documented in a business case that has been agreed with city partners. • The project team is fully focused on delivering the intended benefits, not on "delivering what is easy to deliver".				
2) Benefit tracking • Clear baselines for all benefits have been established (that is, we know where we are starting from). • Measurable success criteria have been agreed for each benefit in the business case (that is, we know where we want to get to). • An effective measurement framework of key performance indicators is in place to track progress in delivering each benefit (that is, we know how well we are doing).				
3) Benefit delivery • For each intended benefit of the project, a "benefit owner" has been identified. A benefit owner is a senior manager who will be responsible for the business changes needed to deliver that benefit. • Benefit owners have established clear benefit realisation plans.				

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