May 2024

# Evaluation of the Greater Cambridge Investment Fund

## Progress Plus Evidence Paper: Smart Cambridge

# Contents

1. Introduction ..... 1
2. Research approach ..... 4
3. Context, rationale and objectives ..... 7
4. Project delivery ..... 16
5. Evidence of emerging outcomes ..... 29
6. Conclusions ..... 39

Annex A: Case studies ..... A-1
Annex B: Overview of programme activities ..... B-1

# 1. Introduction

**1.1** This Evidence Paper sets out the method and findings of the progress plus evaluation of Smart Cambridge supported by the Greater Cambridge Investment Fund, delivered as part of the evaluation of the Fund to inform the second Gateway Review. The progress plus evaluation was conducted by SQW over November 2023 to February 2024.

**1.2** Throughout this Evidence Paper the programme is referred to as 'Smart Cambridge'.

## The 'Progress Plus' Concept

**1.3** The focus of the Performance Indicators for the Gateway Review of the Investment Fund is to provide evidence on the impact of the Fund in delivering local economic growth outcomes by the point of the Gateway Review. However, as discussed in the National Evaluation Framework (NEF), in some cases it may be too early to robustly evidence impacts by that date.

**1.4** A separate evaluation category was therefore included in the NEF for interventions which do not fit within the 'impact evaluation' category but, because of their scale, progress with implementation, novel delivery approaches etc., are suitable for more detailed research and reporting.

**1.5** This 'progress plus' category builds on the findings of the separate Progress Evidence Paper. It is intended to identify emerging outcomes and consider anticipated future beneficial impacts from Smart Cambridge. It is not, however, a formal impact evaluation.

**1.6** The contents of this Evidence Paper are expected to be particularly useful for the Performance Indicators shown in the table below.

**Table 1-1: Performance Indicators for the second Gateway Review relevant to this Evidence Paper**

| # | Performance Indicator |
|---|---|
| | **Intervention progress and process** |
| A2 | Explanation of the delivery process to date, including:<br>• (a) intervention milestones agreed at Board level that are likely to result in successful delivery of the intervention<br>• (b) delivery of the intervention against agreed intervention milestones with evidence of adjusting project/programme plans to mitigate the impact and to ensure value for money and successful delivery<br>• (c) an agreed spending profile for the intervention<br>• (d) evidence of keeping to the spending profile, mitigating overspend or delays and the effective reallocation of underspends; including evidence of adjusting spending and |

| # | Performance Indicator |
|---|---|
| | project/programme plans to mitigate the impact and to ensure value for money and successful delivery<br>• (e) outputs generated to date by intervention activities<br>• (f) evidence of how areas have adapted to changing circumstances and managed any necessary change – including in response to Covid-19. |
| | **Intervention impact** |
| 2B1 | Description and evidence that all evaluation activities set out in an area's evaluation plan have been completed. This includes the transfer of the results of any survey, interview transcripts, any data collected, and the code used to perform any statistical analysis. Further advice and engagement should be available to ensure that an independent evaluator can replicate any empirical work. |
| 2B2 | Evidence that each element of an intervention's logic model (i.e., inputs, activities, outputs and outcomes) has been delivered or materialised.<br>As noted in Section 4 of the NEF, whilst the default assumption is that all interventions should be subject to impact evaluation, this is not always possible (e.g., as interventions vary in terms of scale, time to deliver and time to generate impact). The Area will propose which projects are to be considered "in-scope" and agree this with the IEP. Evidence can be quantitative or qualitative, but preference should be given to providing robust, quantitative evidence where possible. |
| 2B3 | Empirical evidence that the logic model has functioned as expected (i.e., that increases in the desired outcomes and impacts can be causally attributed to the intervention). At minimum this will include the use of baselines to compare outputs and outcomes pre and post intervention. Ideally it will include an experimental or quasi-experimental approach to estimate the intervention's impact, with a clear explanation of how a counterfactual was developed and why it is credible.<br>Where practical, efforts should be made to return to projects from GR 1 which were not fully evaluated. These projects should be evaluated as set out here using similar principles as to projects in GR 2. |
| 2B4 | The rationale for the majority of Investment Funds is to generate local economic growth – the two core metrics for measuring the impact, of interventions supported by the Funds are 1) Net additional Gross Value Added (GVA), and 2) Net additional output (GVA) per hour. If it is not possible to measure either of these, then alternative metrics are acceptable provided their appropriateness can be demonstrated (a list of illustrative, alternative economic growth metrics is provided in the NEF). |

*Source: DLUHC (2023) National Evaluation Framework for Investment Funds*

# The intervention

**1.7** The Smart Cambridge programme was initially approved by the Greater Cambridge Partnership (GCP) Executive Board in August 2015. The core underpinning rationale for Smart Cambridge is to pilot and use technology to help address some of the most significant challenges faced by the area including reducing transport congestion, tackling air pollution,

and in turn delivering against the imperative for climate change mitigation and the move towards net zero. Specifically, the current objectives of the programme (2023-2025) are:

- leading projects and workstreams where they have a strong technology component
- observing and engaging with developments in the market and developments in other organisations to be able to provide thought leadership to the wider GCP programme
- catalysing and supporting innovation by engagement with the commercial markets and other partners
- carrying out trials and evaluations and using the learnings to feed into existing or future GCP projects
- bidding for external funding where there is clear alignment to GCP's objectives.

**1.8** The programme identifies and tests 'smart' ways to tackle city challenges and considers how existing and emerging technologies and data can help to support the overall objectives of the City Deal, and to progress initiatives to implementation. A range of bespoke and targeted research and innovation activity is supported across five themes: 'better data', 'making sustainable transport easier', 'better operation of the highway', 'enabling the next generation of public transport', and 'enabling smart communities'.

**1.9** Smart Cambridge is delivered by the GCP, and is a GCP workstream. In delivery, it also draws on support from individuals from the 'Connecting Cambridgeshire' programme, which covers Cambridgeshire and Peterborough and is hosted by Cambridgeshire County Council. Smart Cambridge also involves a range of public and private sector partners, and leverages funding from other sources to support with the practical delivery.

## Structure

**1.10** The remainder of this evidence paper is structured as follows:

- Section 2: research approach
- Section 3: context, rationale and objectives
- Section 4: project delivery
- Section 5: evidence of emerging outcomes
- Section 6: conclusions.

**1.11** The following annexes are provided: Annex A provides the four case study write-ups; Annex B provides an overview of programme activities.

# 2. Research approach

## Method

2.1 As set out in the Local Evaluation Framework (LEF) the focus of the evaluation was on assessing progress towards the following 'outcomes of interest' set out in the logic model:

- improved integration of the transport system
- enhanced understanding of transport planning conditions, challenges, and opportunities
- improved scheme development, appraisal, implementation, and monitoring, and
- funding secured/leveraged.

2.2 These are outcomes which are expected to start to emerge within the activity period.

2.3 The evaluation included four key elements:

- **consultations (x8) with representatives involved in the management and governance** of the Smart programme including from the Programme Board and Smart Working Group; this included representatives from a mix of private sector, academic, and public sector organisations.
- **consultations (x10) with partner organisations involved directly with the programme;** this included Cambridgeshire and Peterborough Combined Authority (CPCA), research centres at Cambridge University, Innovate UK, Centre for Connected and Autonomous Vehicles, and businesses engaged in collaborative innovation projects.
- **consultations (x6) with stakeholder organisations involved in the 'smart city' research and innovation landscape** across Greater Cambridge and the UK; this included BSI, England's Economic Heartland, Cambridge Wireless and other relevant representatives groups with an interest in/knowledge of the programme.
- **project case studies (x4)** of selected programme activities, to provide detailed insight into the nature of activities delivered, emerging benefits, and the potential longer-term contribution to economic growth across Greater Cambridge.

2.4 The four case studies were identified in the LEF and agreed at the launch of the evaluation: Sensor Network, Autonomous Vehicles, SMART Panels, and Networks Management Interventions (Vivacity Smart Signals pilot and Starling Intelligent Crossing trial). The case studies involved:

- consultations with the relevant project lead and delivery staff at Smart Cambridge

- consultations with relevant delivery partners/organisations involved with the case study
- a focused review of relevant activity data and documents, including funding applications, project initiation documents, and monitoring/quarterly review documentation.

**2.5** The evaluation also involved:

- a desk-based review of the underpinning context and rationale for the programme (including the current delivery plan and agenda packs from GCP Executive Board Meetings)
- a high-level review of relevant underpinning information available on the outputs set out in the logic model (including details of the strategies, plans and research reports produced, data on the take-up of technology platforms, and an overview of the bespoke original datasets established/collated and disseminated/released).

**2.6** This progress plus evaluation covers the Smart Cambridge programme as a whole (which started in 2015/16) reflecting that most activities overlap the first and second Gateway Review periods. However, the qualitative reflections on delivery primarily focus on the latter years of delivery (i.e. leading up to GR#2).

## Sources of evidence

**2.7** The sources of evidence for the progress plus evaluation of Smart Cambridge are summarised in Table 2-1, this is as planned within the LEF.

**Table 2-1: Sources of evidence for the evaluation**

| Source of evidence | Approach |
|---|---|
| Primary evidence | Consultations (x8) with representatives involved in the management and governance of the Smart Cambridge programme<br>• Consultations (x10) with partner organisations involved directly with the programme<br>• Consultations (x6) with stakeholder organisations involved in the 'smart city' research and innovation landscape<br>• Additional consultations (x9) with delivery staff and project partners as part of the case study research. To note, four of the delivery partner organisations consulted above were also nominated for the case study research, however, one consultation was completed covering both aspects. |
| Monitoring data and information | • Monitoring data related to the outputs set out in the logic model<br>• Outcome data on funding secured/leveraged for investment in transport systems/projects from public and private sources |

| Source of evidence | Approach |
|---|---|
| Secondary data | • Documentation associated with the programme development and delivery<br>• Documentation associated with project development and delivery across the four case study projects |

## Analysis and interpretation

**2.8** Each consultation was written up by the interviewer from the SQW evaluation team using a standard template. All interview notes were then uploaded to specialist qualitative data analysis software (MaxQDA) and analysed thematically for consistency of key messages or any differences across all interviewees.

**2.9** For the case studies, the evidence from the documentation and primary research was synthesised and written up in concise case study summary boxes (provided in Annex A). The evidence from the case study research is also drawn on throughout the Evidence Paper.

**2.10** The analysis process also included an internal workshop attended by all team members to share and discuss the key findings from the evaluation.

**2.11** Quality and assurance have been ensured throughout the evaluation process. SQW is an independent research consultancy, and the research team which conducted the evaluation is wholly independent of the GCP. Conducting quality research is the responsibility of every researcher in the team. The research team was led by a Project Director who oversaw the quality of the research processes undertaken and quality assured the outputs produced.

**2.12** As set out above and detailed in the LEF, the evaluation focused on four 'outcomes of interest'. The longer-term theme specific outcomes (e.g. related to reduced congestion and modal shift) and broader economic outcomes have *not* been considered, reflecting the time-paths to impact. These outcomes would be subject to subsequent impact evaluation.

# 3. Context, rationale and objectives

## Context

**3.1** Digital technology now underpins almost all aspects of modern living across work, travel, leisure and health domains. Emerging "smart cities" technology builds on the combination and convergence of technologies to utilise digital connectivity, sensors and data in innovative ways to support: efficient resource and environmental management; addressing traffic congestion and other city management challenges; and engage more directly with citizens.

**3.2** In this context, in late-2011, in line with national government thinking, the leadership at Cambridgeshire County Council (CCC) recognised that the digital connectivity infrastructure in the county was inadequate and risked damaging the long term economic success of the area. A multi-agency programme - Connecting Cambridgeshire - was established to address the digital connectivity infrastructure shortfall and support better exploitation of digital technology across all sectors. The initiative covers Cambridgeshire and Peterborough.

**3.3** The Connecting Cambridgeshire Programme included several workstreams including enhanced infrastructure and capacity for broadband, mobile and public access Wifi coverage to ensure the county is connected and can benefit from future facing 21st century digital infrastructure and services. One of the strands included the investigation of "smart" technologies and its relevance for Cambridgeshire.

**3.4** Subsequently in 2015, and drawing on this initial work and wider inputs from local experts and stakeholders, a proposal was submitted to the GCP Board to incorporate a 'smart cities' approach within the City Deal programme. The purpose was to explore the role of data and emerging technologies to support the delivery of improved transport, skills and housing and unlock further sustainable economic growth within Greater Cambridge. The Executive Board approved the establishment of a workstream which became the 'Smart Cambridge' interventions covered by this progress plus evaluation.

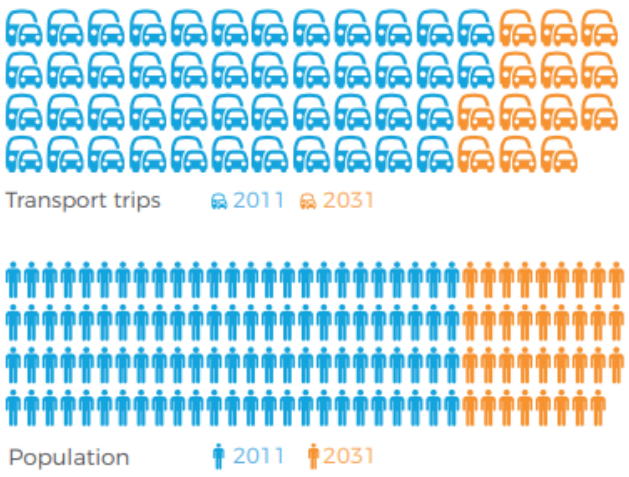
**3.5** The proposal for Smart Cambridge drew on a range of related contextual factors:

- the developing and evolving technologies and concepts related to smart cities that represent an opportunity for all areas
- the unique opportunity for Greater Cambridge specifically to become a leading "digital test bed" for smart technology given its academic and business strengths in relevant technology-rich sectors and the strong supporting infrastructure for innovation (e.g. business networks, access to finance, sites and premises)
- the opportunity to align with and contribute to the wider City Deal programme

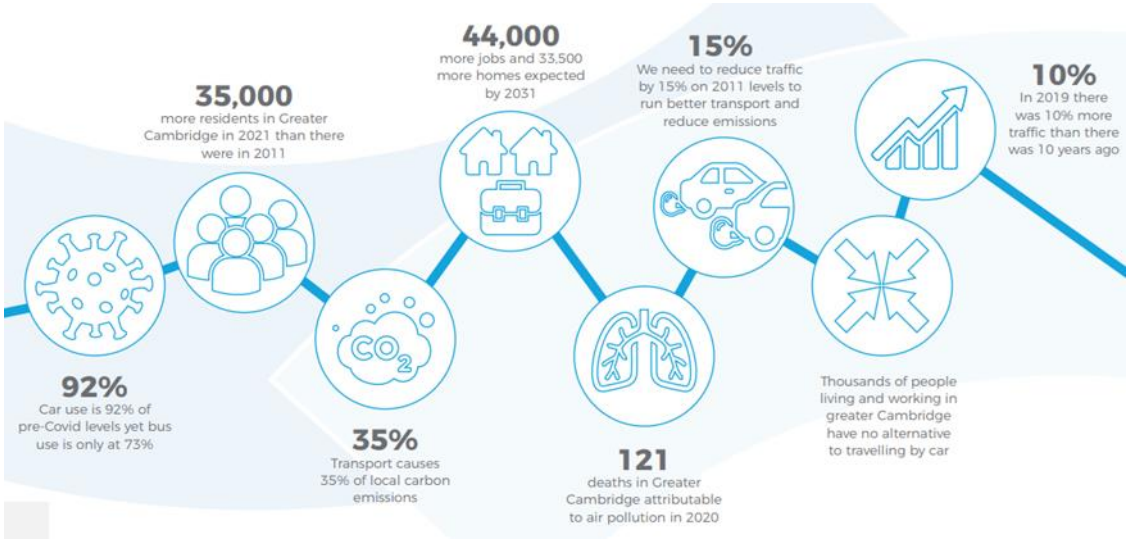
- the considerable challenges faced by the Greater Cambridge in relation to congestion, which provided an important local imperative for seeking to better leverage the opportunities for technology and innovation to address local challenges.

**3.6** The scale of this challenge related to population growth and the resulting increased demand on the transport network is summarised in the Figure below (taken from Smart Cambridge's recent Innovation Prospectus).

**Figure 3-1: The transport and wider challenge for GCP**




*The strain on roads and public transport is the result of decades of economic success, a rapid increase in population and the city's status as a top travel and tourism destination. The Greater Cambridge area is set to grow by up to 30% between the years 2011 and 2031 – with the population rising by 65,000 to 338,000 (from 273,000 in 2011). Population growth means trips on the transport network will increase by 25,000 during that period (from 101,000 in 2011 to 126,000).*




*Source: Based on Innovate in Greater Cambridge: a call for collaboration Innovation Prospectus*

**3.7** The spatial development policy context at the point of the approval of Smart Cambridge in 2015 is also important. At this time, jointly prepared but separate, local plans existed for South Cambridgeshire and Cambridge City. These plans identified areas for housing growth outside the city including Cambourne and Bourn Airfield to the west, and Northstowe and Waterbeach to the north. They also identified the new and growing employment areas in Cambridge, most notably the University of Cambridge's West Cambridge site and the

Biomedical Campus towards the south of the city. Other growing employment areas in the Greater Cambridge area were to the south of the city in the science and business parks in the South Cambridgeshire district. In spatial terms, therefore, housing growth was expected to be focussed to the north and west of Cambridge, whilst employment growth was, to a large extent, expected to be focussed towards the south of the city. This created some challenges in ensuring that Greater Cambridge had the infrastructure required to link the different growth points, whilst also recognising that in-commuters to the area also come from a broader area.[1]

**3.8** Subsequently, key statements that provide the strategic context for Smart Cambridge include:

- **Cambridge Local Plan (2018):** covers the period of 2018-2031 and identifies the need for 14,000 additional homes and 22,000 new jobs. The plan references specifically the congestion challenge faced by the city, with a need to push for further modal shift seen as a key imperative.

- **South Cambridgeshire Local Plan (2018):** Chapter 10 of the Local Plan addresses transport, outlining the aim to 'promote and deliver sustainable transport and infrastructure'.

- **Emerging New Joint Greater Cambridge Local Plan:** aims to effectively plan and allocate sites over both Cambridge and South Cambridgeshire. It outlines that new developments should reduce carbon emissions and reliance on private cars.

- **Local Transport and Connectivity Plan (2023):** the Combined Authority's long-term strategy to improve transport in Cambridgeshire and Peterborough. All future transport projects in the area will be guided by the plan. This plan will guide the work of Smart Cambridge ensuring that projects help to deliver its aims and objectives.

- **Bus Strategy (2023):** aims to improve the bus network to the benefit of residents and businesses in the region. There are a number of areas in which Smart Cambridge will work alongside the Combined Authority to deliver behaviour change and encourage travellers to use more sustainable modes.

- **Climate Change and Environment Strategy (2022):** the county council is committed to putting climate change and biodiversity at the heart of their work. Their strategy has 9 priorities, including low carbon transport. Smart Cambridge will put the policy aim of mitigating climate change at the core of each project.

- **Cambridge Air Quality Action Plan (2018-2023)** sets out the city councils' priorities for maintaining and improving air quality as Cambridge continues to grow. The proposed actions involve working closely with partners, including the county council and the GCP.

[1] Based on SQW (2019), Independent Evaluation of Local Growth Interventions: Greater Cambridge Partnership Overview Report

## Rationale

**3.9** Consistent with the context above, the core underpinning rationale for Smart Cambridge is to pilot and use technology to help address some of the most significant challenges faced by the area including reducing transport congestion, tackling air pollution, and in turn delivering against the imperative for climate change mitigation and the move towards net zero.

**3.10** The programme also seeks to exploit the opportunity to leverage the innovation and technology capacity of Greater Cambridge to become a leading "digital test bed" for smart technology and support the implementation of the wider City Deal programme with its focus on enhancing transport infrastructure, through a suite of interventions designed to address blockages to growth resulting from congestion and the impacts this has on the economy.

**3.11** As such, the rationale for the programme is to both draw on the strengths of Greater Cambridge to facilitate delivery of the City Deal objectives, and to address local challenges and barriers to sustainable growth. This is described more fully in the current Smart Cambridge Delivery Plan:

*"The Smart Cambridge programme explores the use of technology and innovative approaches to support the implementation of fast and reliable public transport, the use of sustainable modes and the behaviour change required to achieve mode shift. Local councils, technology businesses, university researchers and other organisation are working with the Smart Cambridge workstream to find smart ways to tackle city challenges like transport and air quality."*

**Greater Cambridge Partnership – Smart Cambridge – Delivery Plan 2023-2025**

**3.12** The programme seeks to address a range of barriers and challenges to the use of technology to enhance transport connectivity. This includes:

- technical and technology barriers to the use of different "smart city" approaches which require further development, piloting and testing before they can be rolled out more fully
- barriers related to the effective collation, sharing and exploitation of data on the local transport network
- address information gaps on the operation of the local transport network and how this can be enhanced
- co-ordination barriers, with different partners and organisations responsible for different elements of the local transport network, and between the private sector and local transport authorities and agencies including how to more fully engage the local technology-rich SME base in Cambridge to deliver against local priorities and solve challenges.

**3.13** These co-ordination barriers reflect both the project-level and strategic rationale of the programme, including to use technology to better support decision making and project appraisal and evaluation activities.

## Objectives

**3.14** The establishment of Smart Cambridge was approved by the GCP Executive Board in August 2015. A budget of £20,000 per year for two years (2015/16 and 2016/17) was allocated to the programme. The initial objectives for the programme were to:

- Generate an outline "smart architecture" blueprint which will facilitate the delivery of a test bed/demonstrator programme.
- Establish and deliver an initial one year test bed/demonstrator programme of work packages which implement small scale "smart" solutions, with a focus on transport related opportunities.
- Establish/participate in a wider forum for collaboration with and information exchange between complementary work programmes (e.g. the Mobilising Local Energy Initiative – MLEI) and other initiatives across the wider Cambridge research and development communities to develop and showcase the "smart" credentials and profile of the area.
- Investigate government, EU and other funding opportunities and co-ordinate funding bids to develop the Smart Cambridge programme in both the short and medium term.
- Investigate and develop collaboration opportunities with other nearby cities, including Peterborough and Milton Keynes.
- Develop a longer term smart cities approach which reflects the level of ambition for Greater Cambridge. This will complement and influence the emerging City Deal programme to ensure that "smart" characteristics are incorporated within the overall approach to housing, transport and skills as part of the delivery of the City Deal.

**3.15** The current objectives of the programme (as set out in the Delivery Plan 2023-2025) are:

- leading projects and workstreams on behalf of GCP where they have a strong technology component
- observing and engaging with developments in the market and developments in other organisations to be able to provide thought leadership to GCP
- catalysing and supporting innovation by engagement with the commercial markets and other partners

- carrying out trials and evaluations and using the learnings to feed into existing or future GCP projects

- bidding for external funding where there is clear alignment to GCP's objectives.

**3.16** The overarching scope and aim of the programme is to deliver new and emerging technology projects that support the overall objective of the City Deal to enhance and improve the transport network and infrastructure across Greater Cambridge. Smart Cambridge will also complement and help to inform the on-going development and delivery of wider transport interventions and outcomes across Greater Cambridge through the City Deal. The programme may also occasionally have involvement with innovation/technology programmes that deliver non-digital aspects as part of their output.

**3.17** In addition to the overarching programme level objectives there are also objectives at a project level (for example, see case studies in Annex A).

## Logic model

**3.18** In evaluating publicly-funded interventions, it is good practice to develop a 'logic model' which articulates explicitly the relationship between inputs, activities, outputs, and outcomes:

- inputs are the resources used by the intervention, including the Investment Fund resource

- activities are those tasks undertaken by the intervention

- outputs are the readily measurable results of those activities

- outcomes are the benefits attributable to the intervention including 'intermediate outcomes; for the direct beneficiaries of the intervention, and 'final outcomes' for the wider economy/society.

**3.19** Logic models are useful devices to inform impact evaluation, because they encourage thinking about the steps required for an intervention to have its desired effects, and the nature of effects that can be covered in evaluation. Therefore, to be effective, a logic model should represent the causal theory about why and how an intervention might work over time, that is, the 'theory of change'.

**3.20** The logic model for Smart Cambridge is presented below. This was included as part of the Local Evaluation Framework to inform the research methods adopted.

**Table 3-1: Smart Cambridge logic model**

| | |
|---|---|
| **Logic model title** | Smart Cambridge |
| **Logic Model Type** | 1C – Transport Systems (data systems) |
| **Interventions / projects covered by logic model** | Smart Cambridge |

Theory of change

As transport systems become more complex and as challenges including addressing congestion and environmental quality become more acute and potentially limiting to growth in Greater Cambridge, there is an increasing need to harness the opportunities provided by the use of technology and integrated and data-driven transport planning. The Smart Cambridge programme will identify and test smart ways to tackle city challenges, and consider how existing and emerging technologies and data can help to support the overall objectives of the City Deal, and to progress initiatives to implementation. Leveraging Greater Cambridge's position as one of Europe's leading tech hubs and home to a world-leading research intensive university, the Smart programme will support a range of bespoke and targeted research and innovation activity across the themes of 'Better Data', 'Making Sustainable Transport Easier', 'Better operation of the Highway', 'Enabling the next generation of public transport', and 'Enabling Smart Communities'. This will include projects involving the set-up, collection and analysis of real-time transport data, considering how data can be better stored, shared and used; the delivery and evaluation of trials, pilot initiatives and test-beds including projects to encourage active travel and greater use of sustainable public transport, and the use of autonomous vehicles; and the development of funding bids for external funding where there is clear alignment to GCP's objectives. The Smart Cambridge programme will also provide thought leadership to inform the on-going development and delivery of transport interventions across Greater Cambridge through the City Deal, and strategic engagement with the private sector and other partners involved in transport planning and implementation.

Key assumptions: new and emerging technologies are being developed that can support the delivery of the GCP programme; external funding is available to support the trialling of new technologies; GCP decision makers have an appetite for risk profile of innovation projects.

Other factors: a range of other City Deal interventions are seeking to address issues of congestion and supporting modal shift (e.g., cycle schemes, bus priority measures, radial route improvements and enhancements, City Access programme etc.); collaboration in the delivery of the Smart Cambridge programme with Connecting Cambridgeshire and the University of Cambridge.

| Inputs | Activities | Outputs | Outcomes |
|---|---|---|---|
| Investment Fund inputs £4.82m<br>• Other inputs (including staffing and in-kind)<br>• £100,000 from Vivacity | • Core Smart Cambridge Team at GCP (1 FTE), with additional capacity through a collaboration agreement with Connecting Cambridgeshire<br>• Delivery of research and innovation projects across five workstreams<br>➢ Better Data<br>➢ Making Sustainable Transport Easier<br>➢ Better operation of the Highway | • Technology platforms and applications developed<br>• Take-up of technology platforms (e.g., downloads, registered users) | **Theme-specific outcomes**<br>• Improved integration of transport system<br>• Enhanced understanding of transport planning conditions, challenges, and opportunities<br>• Improved scheme development, appraisal, implementation, and monitoring<br>• Funding secured / leveraged for investment in transport systems/projects – public (£) |

- £50,000 from Starling
- £100,000 from the University of Cambridge

- Enabling the next generation of public transport
- Enabling Smart Communities

- Development of funding bids
- Engagement with academic partners, including collaboration on funding bids and project delivery
- Engagement with private sector partners, including support for funding bids, advice on engagement with public sector and product development, and collaborative innovation projects
- Engagement with public and community / voluntary sector partners, including development of collaborative projects, partnership arrangements, strategic planning and integration of activities (e.g. integration of ICT infrastructure in transport projects)
- Management / delivery of established Smart systems (e.g. Smart Panels, Totem, Motion Map, Smart Cambridge Data Platform and data into travel apps)

- Trial / pilot / test-bed initiatives delivered
- Bespoke / original data-sets established / collated
- Bespoke / original data-sets disseminated / released
- Smart transport infrastructure / facilities created
- ICT infrastructure created (via integration of activities with partners)
- Strategies, plans and research reports produced
- Innovation prospectus developed
- Funding bids submitted
- Businesses engaged in collaborative innovation projects

- Funding secured / leveraged for investment in transport systems/projects – private (£)
- Long-term, positive effects on transport conditions, including
  - reduced congestion
  - modal shift via increased use of sustainable and active travel
  - enhanced local environment (incl. air quality)
  - CO2 savings

**Broader economic outcomes**

- Improved ICT connectivity for local residents and businesses (via integration of activities with partners)
- Enhancement of local innovation ecosystem and networks
- Long-term, positive economic effects including
  - enhanced attractiveness as a place to invest (e.g. employment sites, housing development)
  - improved business productivity via travel time savings, agglomeration effects
  - entrepreneurship and job creation in technology sector
  - R&D investment and spillovers

| Expected timescales for inputs / activities / delivery of outputs and outcomes | | | |
|---|---|---|---|
| Investment Fund inputs<br>• Phase 1 expenditure from 2016/17 – 2019/20 in Gateway Review 1 period<br>• Phase 2 expenditure from 2020/21 – 2024/25 in Gateway Review 2 period<br>• Programme expected to be delivered to 2030<br><br>Other inputs (including staffing and in-kind)<br>• Over the period of investment from 2016/17 to 2024/25 | • Over the period of investment from 2016/17 to 2024/25 | • Over the period of investment from 2016/17 to 2024/25 | • Theme-specific outcomes relating to integration, understanding, scheme improvement, and funding realised within the activity period<br>• Longer-term theme-specific outcomes may start to be realised within the activity period, but will emerge more fully over the 3-5 years post-Gateway Review 2 as the programme informs strategic planning and interventions<br>• Broader outcomes related to improved ICT connectivity and enhancement of local innovation ecosystem and networks realised within the activity period<br>• Longer-term broader outcomes may start to be realised within the activity period, but will emerge more fully over the 3-5 years post-Gateway Review 2 as the programme informs strategic planning and interventions |

***Relationship to other interventions***

Other Investment Fund logic models:

All logic models under Theme 1 – Transport are relevant to the Smart Cambridge programme, including the City Access and Making Connections, and schemes focused on enhancing use of sustainable and active travel across the GCP area to support modal shift, reduce congestion and enhance the integration and accessibility of the transport network

Other non-Investment Fund activities:

- Wider Connecting Cambridgeshire programme, supporting enhanced infrastructure and capacity for broadband, mobile and public access Wifi coverage

*Source: GCP*

# 4. Project delivery

**4.1** This Evidence Paper focuses specifically on the evidence for the progress towards impact of Smart Cambridge. Progress evaluation issues are considered in the Progress Evaluation Evidence paper, and recapped here to frame the evidence of emerging impacts which follows.

## Project expenditure

**4.2** Up to March 2024, Investment Fund expenditure on Smart Cambridge totalled £3.87m, equivalent to 99% of forecast expenditure by that point (see Table 4-1). By Gateway 2, a further £0.65m in Investment Fund monies is expected to be spent on the programme, along with £0.25m in private match funding.

**Table 4-1: Project expenditure to Q4, 2023/24**

| Funding source | Planned spend by intervention close (£m) | Planned spend by Q4 2023-24 (£m) | Actual spend by Q4 2023-24 (£m) | Difference between planned & actual by Q4 2023-24(£m) | % planned spend realised by Q4 2023-24 |
|---|---|---|---|---|---|
| Devolved funds | 4,820,000 | 3,930,000 | 3,878,000 | -£52,000 | 99% |
| Public match | - | - | - | - | - |
| Private match | 250,000 | 0 | 0 | - | - |
| Total | 5,070,000 | 3,930,000 | 3,878,000 | -£52,000 | 99% |

*Source: GCP*

## Activities

**4.3** The programme supports a range of bespoke and targeted research and innovation activity across five themes, as shown in Figure 4-1. The projects being delivered under Smart Cambridge have evolved over time as initial projects have completed and others have commenced. Furthermore, given the exploratory and responsive nature of the programme, opportunities continuously arise during programme delivery to explore the use of technology and innovative approaches to support the implementation of fast and reliable public transport, the use of sustainable modes, and the behaviour change required to achieve mode shift.

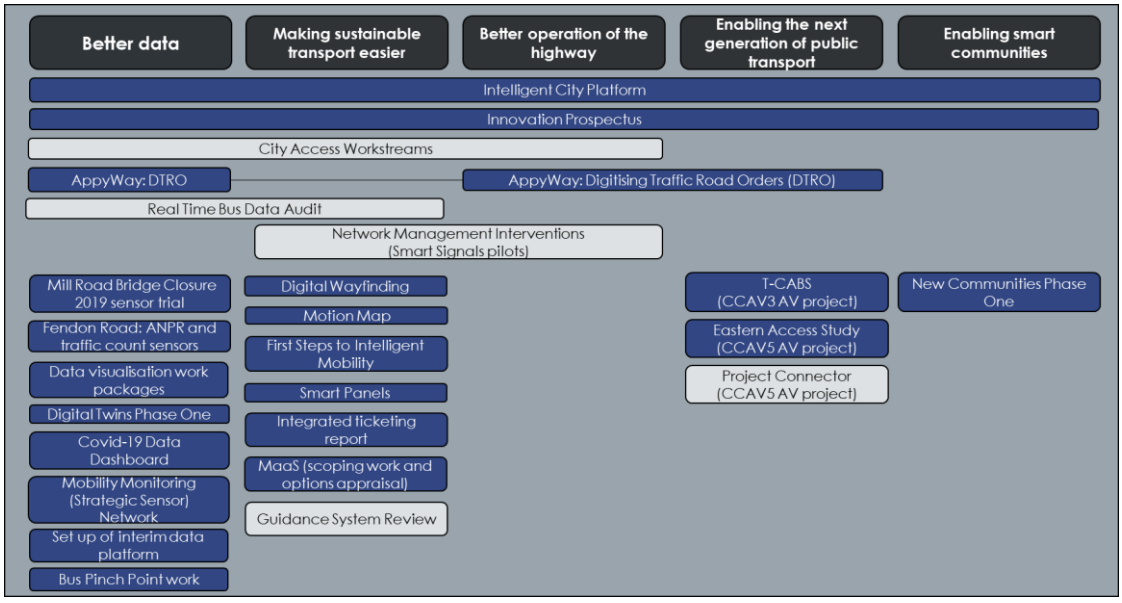
**Figure 4-1: Smart Cambridge themes**




*Source: SQW*

**4.4** Figure 4-2 provides a graphical depiction of the breadth and scope of activities delivered by Smart Cambridge since its launch (see Annex B for an overview of each project). As illustrated, activities are wide-ranging and span all five core themes, with over 25 individual projects progressed. However, to date there has been a particular focus (in terms of the volume of projects supported) on projects focused on the 'better data' theme and the 'making sustainable transport easier' theme. Projects have involved a range of partners including public sector organisations, technology providers, bus operators, public funding bodies, and universities.

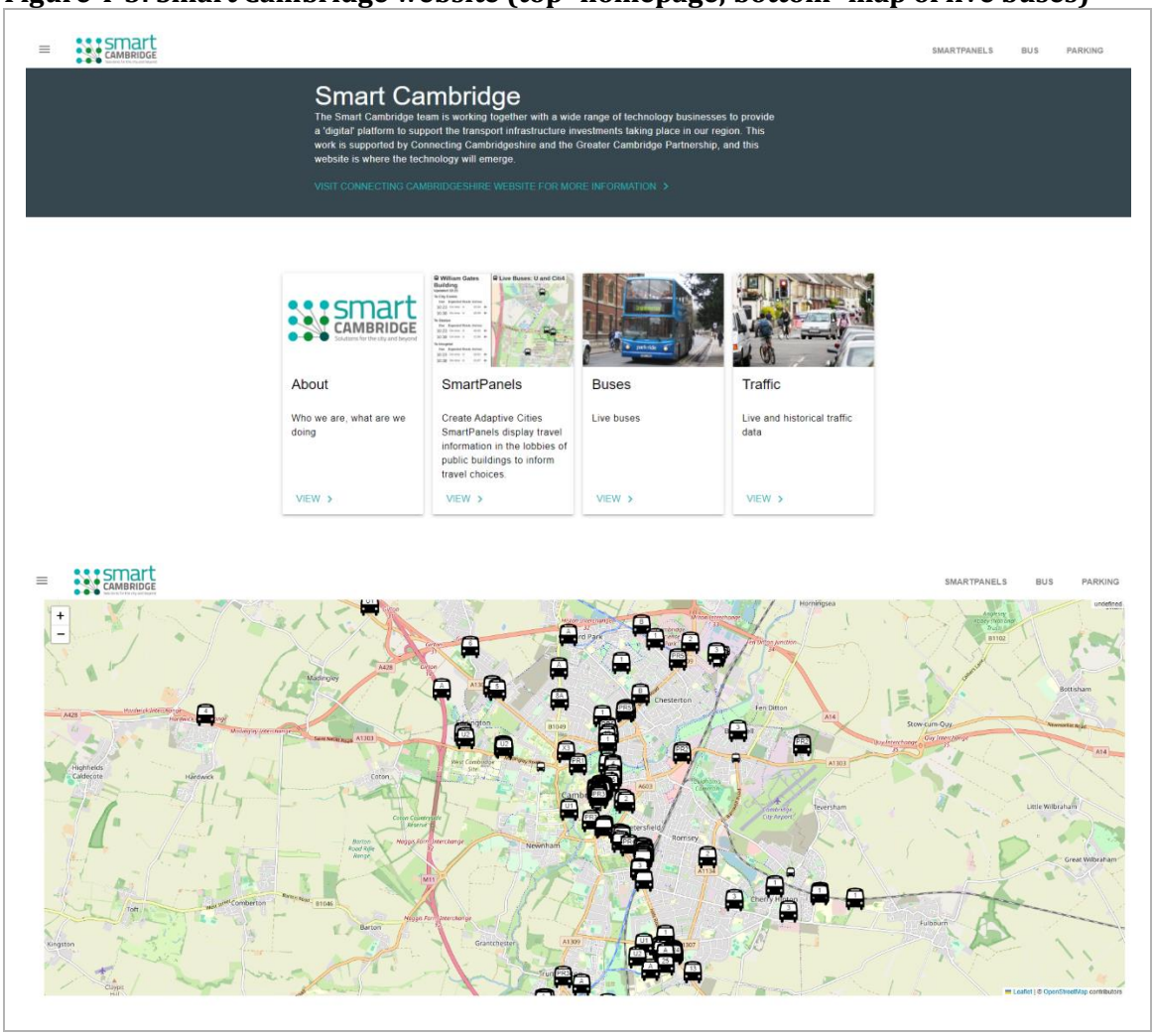
**Figure 4-2: Smart Cambridge projects by theme (blue=complete, grey=ongoing)**




*Source: SQW review of GCP Executive Board Papers up to 4th January 2024. Progress reported up to 30th September 2023.*

**4.5** The Smart Cambridge website (https://smartcambridge.org/) provides information on the various strands of activities as illustrated in the screenshots below.

**Figure 4-3: Smart Cambridge website (top=homepage; bottom=map of live buses)**




*Source: https://smartcambridge.org/*

**4.6** At the outset of the programme, establishing a digital platform to collect and analyse data was a core activity. The Smart Cambridge team worked with the University of Cambridge to develop the **'Intelligent City Platform'** (iCP)[2]. The main components of the iCP are:

- a data network to support 'Internet of Things' technology, allowing products to 'talk' to each other
- a data hub to collate, combine and process a range of data sets
- the city-wide sensor network, which is gathering data from existing systems such as traffic lights, bus movements, and car parks, together with new traffic monitoring cameras and air quality sensors.

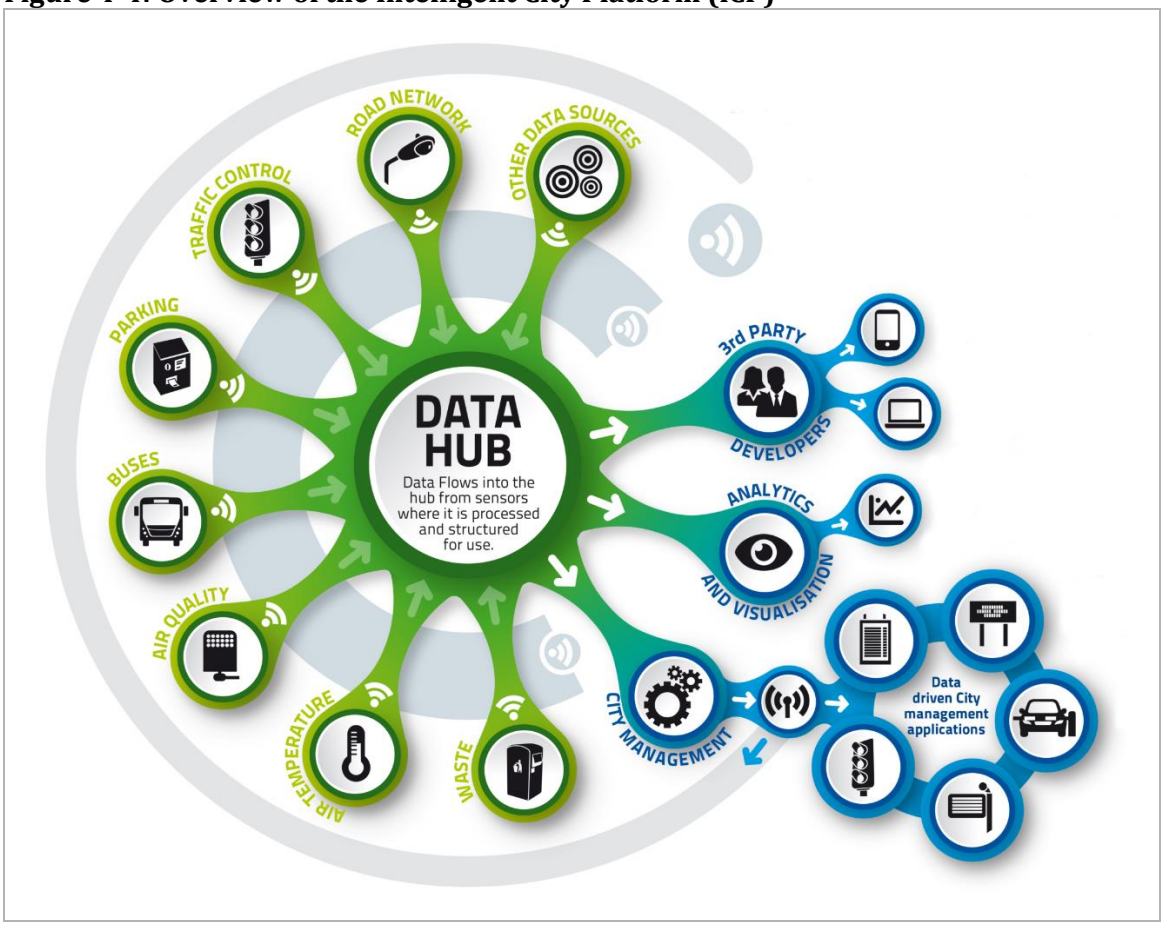
**4.7** The iCP has been used to provide real time information for a variety of applications, including the MotionMap travel app. The MotionMap was launched by the Smart Cambridge team in

[2] Initially called the 'Smart City Technology Platform'

2018 to help people plan their journeys. However, in June 2023 it was discontinued following improvements to other journey planning tools (e.g. GoogleMaps, CityMapper, Stagecoach Bus App).

**4.8** The coverage of the iCP is summarised in Figure 4-4 below.

**Figure 4-4: Overview of the Intelligent City Platform (iCP)**




*Source: Intelligent City Platform – Connecting Cambridgeshire*

**4.9** Other notable complete and ongoing programme activities include:

- **MaaS** (Mobility as a Service) aims to enable the provision of an integrated digital solution that provides travellers with equitable and seamless journey planning, information, booking, ticketing, and payment functionality for a variety of relevant modes and services within a given geography. An options appraisal has been finalised, setting out the options for delivery. The next step is to invest approximately £50k of the Smart Cambridge budget on the development of a full business case before a procurement is scheduled for 2024/25.

- Work on **'New Communities'** which focused on embedding 'smart' principles into place-making. This involved working with planners and developers to understand the opportunities for 'smart' technologies to support the planning system and help develop

better places. The programme team also engaged with other cities and organisations across the Oxford-Cambridge Arc to share learning and knowledge.

- Supporting GCP's **City Access** team in technical and behaviour change aspects of the work. For example, there is a proposal to invest £50k from the Smart Cambridge budget, match funded by Cambridge Ahead in a collaborative study into how sustainable transport behaviours can be encouraged among local residents at times when they are making significant life changes (e.g. new jobs, moving home or having a child).

- Developing an **Innovation Prospectus** to support with actively engaging with the market. It sets out the challenges that the GCP is working to address and invites the market to trial new and innovative technologies. The Prospectus was launched in June 2023.[3]

**4.10** Four projects have been subject to a more detailed review for the progress plus evaluation, reflecting their profile, progress and potential contribution to the outcomes of interest in scope at this stage:

- Research and trials into the use of **autonomous vehicles** in Cambridge, including an autonomous shuttle trial ('T-CABS') and the ongoing 'Project Connector'

- **Network Management Interventions**, specifically an intelligent crossings pilot and smart traffic signals pilot

- Establishing a **Sensor Network**, comprising 96 sensors which provide detailed data on the movement of traffic across Cambridge

- Installation of **Smart Panels** which display real-time travel and weather information to commuters in businesses and public spaces across Cambridge. There are currently 43 panels across the city.

**4.11** Case study write-ups are set out in Annex A.

## Project outputs

**4.12** Actual outputs achieved by March 2024 are presented in Table 4-2. The programme did not identify anticipated outputs at the outset given that trialling innovative technologies, and being responsive to funding and collaboration opportunities, is core to programme activity making it hard to be set prescriptive output targets. However, delivery against ten outputs had been achieved by this point, including the engagement of 24 businesses in collaborative innovation projects, the submission of 27 funding bids, and the production of 20 strategies, plans and research reports.

[3] https://www.greatercambridge.org.uk/asset-library/Smart/Innovation-Prospectus.pdf

**Table 4-2: Project outputs to Q4, 2023/24**

| | Actual outputs by Q4 2023-24 |
|---|---|
| Technology platforms and applications developed | 2 |
| Take-up of technology platforms (e.g. downloads, registered users) | 15 |
| Trial / pilot / test-bed initiatives delivered | 9 |
| Bespoke / original datasets established / collated | 8 |
| Bespoke / original datasets disseminated / released | 8 |
| ICT infrastructure created (via integration of activities with partners) | 1 |
| Strategies, plans and research reports produced | 20 |
| Innovation prospectus developed | 1 |
| Funding bids submitted | 27 |
| Businesses engaged in collaborative innovation projects | 24 |

*Source: GCP*

## Stakeholder perspectives on programme delivery

**4.13** This sub-section summarises the feedback from consultees on programme delivery, including challenges faced by the intervention and response to these, plus other factors that have gone well and less well in programme delivery and key delivery lessons. This section also considers stakeholder perspectives on activity additionality.

### Factors that have enabled programme delivery…

**4.14** Overall, there was consistent positive feedback from the consultations that programme delivery has been effective to date. In particular, several key enabling factors emerged relating to the programme team, governance structures, the level of engagement and interest in Smart Cambridge, and programme alignment with the City Deal; these are discussed in turn below.

**4.15** First, the programme rationale is logical, and it is well-aligned with the challenges and opportunities of Cambridge and the other investments being delivered through the Investment Fund. Feedback emphasised that Smart Cambridge is a complementary programme within GCP's suite of projects / programmes, with Smart Cambridge's linkages with the City Access programme highlighted in particular. Delivery of a large infrastructure programme alongside Smart Cambridge means that the programme has a test bed for trialling new technologies. This overarching strategic alignment with the City Deal was viewed as important in ensuring both internal and external stakeholders are invested in the programme, and in enabling effective delivery overall.

**4.16** This strategic alignment has also enabled Smart Cambridge to leverage the knowledge and innovation assets and endowments of the area, and avoiding adding further complexity to what is recognised by stakeholders as a complex local innovation ecosystem. Further, strategic alignment has helped to demonstrate in principle the value and purpose of pilot and trial activities (such as the Smart Panels) which can be seen as part of a broader set of investments and initiatives to drive improved transport connectivity and integration across the area.

**4.17** Second, there was consistently positive feedback regarding the **strength of the Smart Cambridge programme team**. The Head of Innovation and Technology at GCP leads the programme, and commissions support from two individuals[4] within the Connecting Cambridgeshire team at Cambridgeshire County Council. The individuals involved were regarded as the 'right people' for the programme, striking an effective balance between strategic oversight and practical delivery. Consultee feedback suggested that stakeholder communication and engagement has been effective and an important strength of the programme team. In particular, a key enabler has been the team's ability to build on and leverage their existing networks to engage and collaborate with a range of public and private sector partners in programme delivery. For example, one stakeholder commented:

*The team is very good at working across everything … the Smart programme is a very good example of not working in silos. It is a very horizontal workstream across the City Deal programme (other workstreams are more vertical) and broader activity across the region.*

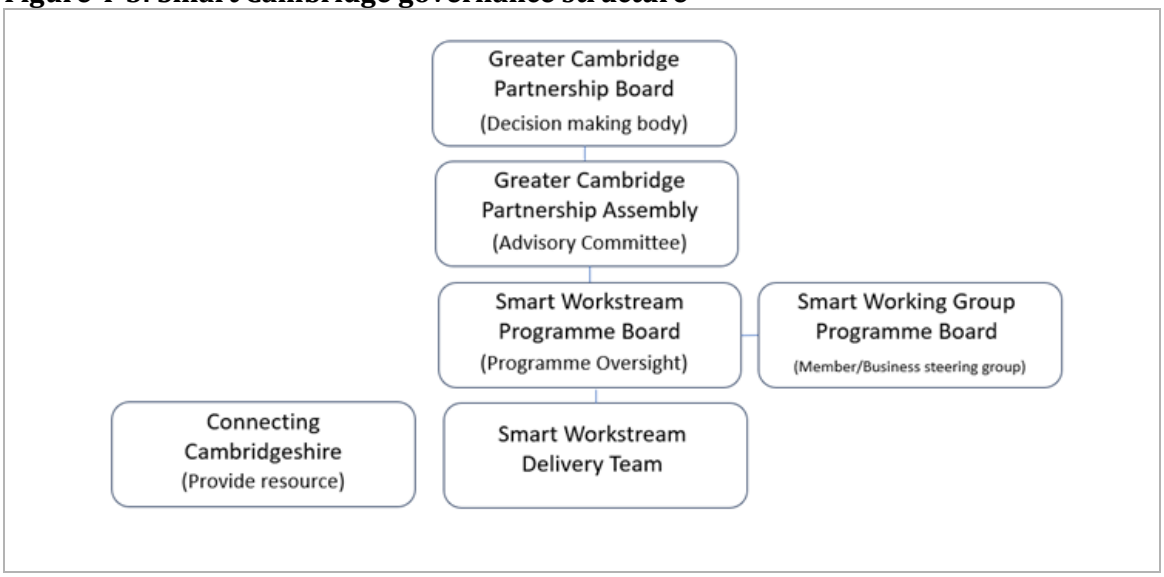
**Stakeholder consultee**

**4.18** Stakeholders also highlighted the importance of providing adequate resource for programme management and the wider programme activities, which is seen as an important learning lesson in how to deliver effective economic development interventions. Several stakeholders commented that arguably further capacity in the team would be helpful to scale-up activity and engagement with businesses, local partners and the wider community.

**4.19** Third, **programme governance structures and processes** were also considered effective by consultees. The programme is overseen by a Programme Board and Smart Working Group with each including eight to ten members (there is no cross-over in membership between the two groups) from the public and private sector (see Figure 4-5). The roles and responsibilities of both groups are summarised in the text box below. The Board and Working Group have attracted a strong calibre of representatives, with representatives from different backgrounds and specialisms, which is considered by stakeholders to have been important in facilitating effective exchange of knowledge and ideas. The two-tiered governance structure was considered appropriate and proportionate for the programme's scale and scope.

[4] One position is 0.8 FTE and the other 0.1 FTE

**Figure 4-5: Smart Cambridge governance structure**




*Source: GCP*

**4.20** Two further points are noted in this context.

- Stakeholders highlighted the importance of including individuals with genuine technical expertise and interest in "smart cities" and the evolving use and potential of technology on the Smart Working Group. Leveraging this local experience and expertise was seen as an important positive learning lesson, ensuring both the quality of the inputs by the Group, and on-going commitment and enthusiasm for the programme.

- Whilst the programme's management and governance structure and model is not simple, including related to the relationship with Connecting Cambridgeshire, this was not seen by stakeholders to be a challenge in practice. Rather, the structure and process was seen to work well overall, with benefits generated from the partnership working and knowledge sharing that this model has facilitated, and maximising the potential from existing interventions as noted above.

## Smart Working Group

The Smart Working group is a non-decision-making body that supports the implementation of the Smart Cambridge programme. Its role is to provide advice and guidance to the programme team in relation to:

- the pre-scoping of policy and interventions that may be included in the Smart Cambridge programme
- monitoring the success of individual projects supported by the Smart Cambridge programme

## Smart Programme Board

The Smart Programme Board supports the programme in the areas set out in the Terms of Reference:

- To help shape the Smart Cambridge programme, particularly where work is emerging such as the Behaviour Change workstream.
- Advise on decisions before they go to the GCP Executive Board or on major but non-key decisions.
- Guide the Head of Innovation and Technology in developing proposals to meet the objectives of the GCP.
- Acting as a sounding board for concepts and ideas.
- Support the selection of companies/organisations to work with through the Innovation Prospectus process.
- Identify opportunities for collaboration across organisations.
- Monitor the progress of the programme to ensure delivery of the stated objectives. Also, to ensure that these can be successfully embedded into business operations through effective change management.
- Support the individual projects in managing risks and resolving issues where necessary. This will be achieved by submission of bi-monthly highlight reports, which will feed into the programme board.
- To provide effective and consistent communication to all stakeholders including staff within their organisations.

*Source: GCP Smart Cambridge Programme Delivery Plan 2023-2025*

**4.21** Fourth, overall, the feedback suggested that there has been a strong level of interest and involvement in the programme both internally and externally. The has included engagement from a range of private and public sector organisations with some examples provided in

Figure 4-6. This has partially been enabled by pilots and trials demonstrating the value of the programme activities, but also demonstrates the broader strategic importance and relevance of the programme. Linked to this, the openness of GCP (and colleagues at Connecting Cambridgeshire) to trialling new innovations was reported to have been crucial in stimulating interest and enabling effective programme delivery. Consultees acknowledged that piloting new, innovative technologies is inherently uncertain and inevitably not everything will be successful, thus the willingness of the programme to trial new technologies has been critical to delivery. It was recognised that in some cases projects may fail (in technical terms) or wider technology trends may mean that the concepts are not taken forward (as was the case with the MotionMap travel app referenced above). However, this was recognised as an inherent risk and aspect of technology and innovation programmes.

**Figure 4-6: Examples of collaborative partners**




*Source: GCP*

**4.22** There was also positive feedback related to engagement with the local business community alongside the local research base which was seen as an important positive lesson for the programme at this stage. For example, one stakeholder commented in relation to the programme team:

*"They have been really good at tapping into university, business, and community relationships with tech companies in the area … major tech companies in the area have been engaged in this. That sort of public-private sector involvement that has happened really well through the Smart programme, it's a key lesson probably."*

**Stakeholder consultee**

### … and challenges to programme delivery

**4.23** The programme has also faced several challenges, but has sought, where possible, to respond, adapt and pivot accordingly to mitigate the impacts on delivery.

**4.24** As referenced above, a core part of the programme is trialling innovative technologies meaning that there are **inherent risks when testing such technologies in real world environments.** Despite risk mitigations, in some cases, this has led to unforeseen delays in project delivery. For example, due to the need to adjust and test the technology in the real world environment delivery of the Vivacity Smart Signals Pilot has been extended from one to three years (see Network Management Interventions case study).

**4.25** Initiatives delivered through the programme have, and continue to, generate large volumes of data. However, **ensuring data is collated, analysed, presented and utilised in an accessible and useful format** (e.g. to inform decision making and planning) is an ongoing challenge. For example, as set out in detail in the Sensor Network case study, work is ongoing to ensure that the data from the 96 sensors is aggregated and analysed in an accessible and useable form. The close working relationship between Cambridgeshire County Council (who is responsible for managing, aggregating, and analysing the data) and Vivacity will be important in enabling the team to maximise the potential benefits of the data over the longer-term, including to help inform policy development and scheme development and appraisal.

**4.26** The feedback from some consultees also highlighted questions around the alignment between the programme and Connecting Cambridgeshire and whether the remit and scope of the programme has been clearly communicated to stakeholders and the wider public. The majority of consultees (except those involved in management and governance) were aware of the strand or strands of activity they were specifically involved in, rather than having an understanding of the programme as a whole. Smart Cambridge is a workstream of the GCP, led by the Head of Innovation and Technology. Additional resource comes from the Connecting Cambridgeshire team who also have a Smart workstream. This arrangement allows closer collaboration, flexibility and agility between the two programmes. However, it can occasionally lead to a lack of understanding among some external stakeholders of the roles and responsibilities, which may be contributing to this perceived lack of clarity. This was seen by some consultees to be particularly important given the practical implications of some of the projects on local communities (i.e. as projects have been trialled), and to ensure a perceived alignment to other investments and initiatives in the area's transport infrastructure. A transparent, externally facing depiction of the delivery structure for the programme, and the scope of activities (i.e. what is and is not included) was identified by some consultees as a potential area for continuous improvement going forward. Some examples of this feedback included:

*They work within the context of the wider Connecting Cambridgeshire initiative, and it's sometimes difficult to tell what's coming from Connecting Cambridgeshire, which is a wider*

*initiative, and what's in GCP, and often team members overlap and combine, I'm not sure if that's an enabler or a barrier.*

**Project management and governance consultee**

*I think the team themselves always have a good understanding what the goals are, but they haven't always been able to communicate those goals in a way that a lay person could understand.*

**Project management and governance consultee**

**4.27** This said, work on clarifying this differentiation is underway with clearer messaging and work to ensure that there is better understanding of the Smart Cambridge strategy, the projects GCP deliver, as well as how all the projects come together to support the wider GCP programme. As part of this, Smart Cambridge is working with the GCP communications team to better communicate the structure and the purpose of the programme and the role of Connecting Cambridgeshire.

**4.28** Smart Cambridge has been delivered in a **challenging landscape**, and elements of the programme have been influenced by wider factors and decisions on major transport intervention in Cambridge. However, feedback suggests that the programme has not been materially adversely impacted by this, and the underpinning challenges and opportunities have remained evident.

**4.29** There have also been **specific technical and practical challenges on individual projects**. For example, on the ongoing autonomous vehicles 'Project Connector' challenges with one of the partners has delayed project delivery. Whilst the Network Management Intervention trials were both impacted by vandalism to the sensors. These challenges are explored in further detail in the case studies (see Annex A).

### Activity additionality

**4.30** The consultations also explored stakeholder perspectives on the extent to which partners would have taken forward activity without Investment Fund support ('activity additionality'). Given Smart Cambridge is comprised of multiple projects and activities, it is difficult for consultees to assess the activity additionality for the programme *overall*. Considering activity additionality is further complicated by the delivery structure for Smart Cambridge, with some uncertainty from consultees over the relationship with Connecting Cambridgeshire, as discussed above (although in practice, Smart Cambridge is a GCP workstream, with Connecting Cambridgeshire providing resource).

**4.31** This said, many consultees considered the role of GCP and Investment Fund resource for Smart Cambridge crucial in the delivery of many projects and activities, and feedback suggested that much of the activity would not have happened in the same form in their absence. For example, it was noted that sensor deployment would not have been possible

without the support from GCP. Whilst there was a recognition that some activity would have occurred without the Investment Fund given the pressures on the local transport network and opportunities from the use of new technology, consultees suggested that it would have been on a smaller scale, been more fragmented, and/or taken longer to have been delivered.

**4.32** In other cases, the programme was seen to play an important role as an early demonstrator of new technology, before the market was able/willing to invest or be deploy commercially. An example here is the MotionMap which was launched by the programme in 2018. Consistent with this demonstrator role, following improvements to other journey planning tools delivered by the market, it was timely for the MotionMap to be discontinued in 2023.

**4.33** The added value of the programme in facilitating new connections and partnerships was also emphasised. For example, one consultee commented:

*A bit of [the activity] might have been taken on by Connecting Cambridgeshire, but it wouldn't have had the same priority and deliverable requirements as it does within the GCP.*

**Project management and governance consultee**

**4.34** The alignment to the wider City Deal here was seen as important, with the Investment Fund providing a clear rationale for investment in a programme like Smart Cambridge. The continuity and long-term nature of the funding for Smart Cambridge was also identified as important by consultees. As one consultee commented:

*You need stability over time, it's not just about the overall amount, and I'd be quite sceptical of any replacement that could provide the same degree of relatively long term funding … that's been provided through the city deal. I think it's not just the funding, but it's also the sustainability of it.*

**Stakeholder consultee**

**4.35** In this sense, Smart Cambridge was seen as both a catalyst for activity to be progressed, and important in providing a funding framework and delivery infrastructure for activities focused on how existing and emerging technologies can help to support the overall aims and objectives of the City Deal, and to progress initiatives to implementation where relevant over the longer-term.

# 5. Evidence of emerging outcomes

5.1 This section considers the evidence on emerging and future outcomes, primarily focusing on the four 'outcomes of interest' for the progress plus evaluation:

- improved integration of the transport system
- enhanced understanding of transport planning conditions, challenges, and opportunities
- improved scheme development, appraisal, implementation, and monitoring
- funding secured/leveraged.

5.2 The final sub-section sets out the evidence on wider outcomes of the programme.

## Improved integration of the transport system

5.3 The Smart Cambridge programme remains on-going, with much activity at an early point or at the pilot and trial stage. The programme is also working in a complex and multi-faceted transport network landscape and against a unique set of challenges given the characteristics and growth objectives and trajectory of Greater Cambridge. In this context, as may be expected, delivery against this outcome is modest to date. However, the progress plus evaluation suggests that progress is being made, and there is some confidence locally that the programme will contribute the improved integration of the transport system in the future.

5.4 This said, there is some early, evidence that some activities are already supporting the improved integration of the transport system. For example, Smart Cambridge has installed 43 currently active Smart Panels, which feedback from the consultations suggest have increased the accessibility of transport information and are helping to inform decision making (although attribution is challenging). Further, the webpage version currently has c. 200 daily active users which is a modest number in aggregate terms (albeit no specific targets were set and no benchmark data is available), but provides quantifiable level of usage. The benefits of the digital wayfinding screens in improving transport integration were also highlighted by consultees. Consultees also noted that student bus users have increased beyond pre-Covid-19 levels, and interventions such as the provision of real time bus data were thought by consultees to have played a role here. This said, within the scope of this evaluation, attributing this reported increase in student bus use to Smart Cambridge is not possible given the range of other factors affecting bus use.

5.5 Feedback suggested that many of the ongoing projects offer significant potential to improve the integration of the transport system in future. In particular, the work on Mobility as a Service (MaaS) was considered key to delivering this outcome over the long-term. If delivered,

MaaS would provide an integrated digital solution for users to plan and book journeys using various modes of travel. Further examples cited by consultees include:

- The scope for autonomous vehicles to form part of an integrated travel system. For example, the permanent use of autonomous vehicles could significantly improve integration between the University of Cambridge's West Cambridge site and the P&R sites at Trumpington and Babraham Road. However, it was noted that effective large-scale deployment of autonomous vehicles will require smart infrastructure across the city.

- The Intelligent Crossings Pilot (part of the Networks Management Interventions) reduced crossing waiting times by 38% over the 12 month trial period and saw a reduction in near-misses between vehicles and pedestrians. Rolling out this technology has the potential to improve pedestrian corridors and support improved use of sustainable modes of travel.

*I think the Smart Panels and the work they're doing around data is definitely progress. I would see the work they're planning on mobility as a service is really the moment at which that [Improved integration of the transport system] will happen, and to reiterate that's coming down the line … it would be important to maintain the funding to actually get that done.*

**Project management and governance consultee**

**5.6** Connecting key stakeholders – for example, local authorities, Cambridgeshire and Peterborough Combined Authority (CPCA), bus operators, and technology providers – have been crucial in establishing the foundations to enhance integration of the transport system. Therefore, feedback emphasised the importance of maintaining and building on existing networks in order to realise this outcome more fully in future. Linked to this, the importance of partners (for example bus operators) sharing robust data – for example, for MaaS – is critical in enabling enhanced integration. More broadly, consultees commonly talked about adoption and the need for effective communication with end users to improve their understanding of "smart" technologies and the potential benefits.

**5.7** There are also important links between projects, with the potential to support improved integration of the transport system over the longer-term. For example, taken together, the Smart Signals project, the Smart Crossings trial, the data platform and sensors, and a move to greater automation supported by a range of other projects, are anticipated to contribute to better network management. These activities will also inform a comprehensive programme level network review.

**5.8** A number of external factors that could impact the ability of the programme to deliver against the improved integration of the transport system outcome were raised in the consultations. In particular, concerns were raised about financial viability issues currently impacting public

transport provision in Greater Cambridge[5], which over the longer-term could impact the programme's ability to improve integration. Other factors included the rapid pace of technology progression, the external funding landscape, wider improvements to connectivity across Greater Cambridge (including improvements delivered by the wider GCP programme), and possible changes to the policy and regulatory environment (e.g. in relation to micro mobility). Such external risks are beyond the GCP's control, however, they are assessed and mitigated (as far as practical) through the Smart Programme Board, the GCP governance structure and through wider consultation with partners. Where possible the programme pivots to the changing economic landscape, informed by the data the programme gathers (see section below).

## Enhanced understanding of transport planning conditions, challenges, and opportunities

**5.9** There was strong evidence from the consultations that the programme is leading to enhanced understanding of transport planning conditions, challenges, and opportunities in Greater Cambridge.

**5.10** The Sensor Network, ANPR surveys, and real time data were all considered critical in supporting this outcome. Smart Cambridge has significantly increased the coverage and frequency of data collection. For example, there are now approaching 100 (specifically, 96) sensors continually counting the number of movements by mode of transport across the city providing rich data to support enhanced understanding transport challenges and opportunities. It is noted that the majority (59, 61%) were funded by the GCP, and are directly attributable to the Investment Fund. Prior to the Sensor Network traffic data was collected biannually, making it difficult to identify patterns and trends throughout the year. Therefore, the sensor data has strengthened knowledge and understanding regarding travel patterns.

**5.11** One consultee referenced that their organisation had used Smart Cambridge's work on bus pinchpoints in the city to inform a study on the cost of congestion on public transport services; the data was "vital" in enabling the study which improved understanding of congestion challenges. Inspired by the Smart Junctions Trial, another organisation consultee has commissioned a study exploring the effectiveness of smart junctions across the Ox-Cam arc.

*The use of technology to gather data that then shines a light on the transport planning issues. I would say it's a key role that they play, I'm not aware that anyone else could [do this] within the current system.*

**Delivery partner consultee**

[5] For example, in 2022, Stagecoach East announced they were pulling out of 18 bus services completely and reducing a further five. This resulted in CPCA issuing an urgent tender to find a replacement provider to continue as many services as possible. See here for further details.

**5.12** The qualitative evidence also highlighted how the partnership working of the Smart Cambridge programme has led to enhanced understanding directly, by facilitating opportunities for knowledge exchange and learning across different perspectives (e.g. transport operators, technology companies etc).

**5.13** Linked to this, it was reported that the digital twins pilot, led by the University of Cambridge, was strengthened due to stakeholder input on the key challenges and the potential benefits of digital twins. This stakeholder engagement was facilitated by Smart Cambridge. The pilot has also informed subsequent work by the university on the development of a competency framework applicable to any digital initiative in an urban environment.

**5.14** The work on autonomous vehicles has also generated learning on the challenges and opportunities associated with implementing such technology. Specifically, the learning from the first project (T-CABS) informed the application for the follow-on Project Connector. Going forward, the aim is that Project Connector will enhance understanding of what form a commercially operated automated bus service could take and the practical steps required for implementation (see Annex A for further details).

**5.15** Looking ahead, evidence from the consultations indicates that improving the accessibility (both internally and externally) of the data (e.g. from the Sensor Network) – both practically and analytically – would be beneficial in realising this outcome more fully. This is starting to be addressed, for example by Smart Cambridge adopting the use of the Alchera data platform. This has automated the uploading, cleaning and structuring of data, and has allowed integration into dashboards such as Power BI making handling and analysis of the data more efficient. Ensuring there is sufficient capacity within the GCP / CCC teams, and drawing on relevant external expertise when required, were considered important here.

## Improved scheme development, appraisal, implementation, and monitoring

**5.16** There is evidence to suggest that the programme has supported improved scheme development, appraisal, implementation, and monitoring. The majority of qualitative feedback focused on how data from the Sensor Network is being utilised to support the delivery of the outcome. Specifically, data is being used to:

- **Inform decision-making/prioritisation on travel infrastructure investments.** For example, the data informed the Making Connections proposals (e.g. the design of the Sustainable Travel Zone). Currently, data is being provided to support with a freight strategy and action plan being led by GCP. Going forwards, the data will be used by CCC to inform the development of a new transport model (CaPCAM), and this will be used by the GCP in its future business case work which in turn will inform decision making.

- **Support with the preparation of business cases for schemes.** For example, consultants have accessed Vivacity data to inform the Greenways and Waterbeach to Cambridge business case work.

- **Support with the monitoring and evaluation of schemes.** For example, consultants have access to the data to support with an A-roads risk assessment being delivered on behalf of CCC's road safety team. Data from the Sensor Network is also used in CCC's quarterly transport data updates[6] and historic data from some sensors is available on the Cambridgeshire and Peterborough Open Data Portal[7]. Further examples of where the data is being used, or will be used, to support with monitoring and evaluation are provided in Table 5-1. It is also noted that data from the Sensor Network is being used to inform the evaluations of Chisholm Trail Phase 1 and Histon Road for the second Gateway Review.

*I like the emphasis on the data at the centre of things because I think that more than anything that can provide the most value to decision makers, politicians and the public.*

**Project management and governance consultee**

**Table 5-1: Example schemes where data from the Sensor Network is supporting monitoring and evaluation (M&E)**

| Schemes / infrastructure | | |
|---|---|---|
| **Ongoing** | | |
| GCP | CCC | GCP and CCC |
| • City Access programme<br>• Freight strategy and action plan<br>• Lensfield Road/East Road cycle works<br>• Greenways<br>• Histon Road<br>Milton Road<br>• Chisholm Trail Phase 1<br>• Robin Hood & Hills Road (Smart Signals)<br>• Low Traffic Neighbourhood's implemented during Covid-19 (Experimental Traffic Regulation Order, ETRO scheme): Nightingale Ave, Carlyle Road, Newtown, Luard Road, Nightingale Ave, Storey's Way, Silver Street | • New Developments at Waterbeach and Northstowe<br>• Dutch Roundabout | • Mill Road closure |

[6] https://cambridgeshireinsight.org.uk/roads-transport-and-active-travel/transport-data-insights/
[7] https://data.cambridgeshireinsight.org.uk/dataset/cambridge-city-smart-sensor-traffic-counts

| Schemes / infrastructure |
| --- |
| Expected in future |

GCP

- CSETS
- Madingley Road
- Cambridge Southwest Travel Hub
- Waterbeach to Cambridge
- Chisholm Trail Phase 2

*Source: GCP*

**5.17** The programme structure was considered important in facilitating this outcome. As noted above, Smart Cambridge works closely with the Connecting Cambridgeshire team accessing resource and working collaboratively with their Smart workstream. The Connecting Cambridgeshire team sit within CCC's Place and Sustainability Directorate and alongside the Highways and Transport Team who work closely with the GCP. Taken together, this close alignment and strong communication between GCP and CCC is helpful in ensuring that data/information gathered through Smart Cambridge informs scheme development, appraisal, implementation, and monitoring in practice.

**5.18** One factor which is likely to influence future progress against this outcome is future thinking on sustainable transport. Following the GCP Executive Board's decision not to progress with the Making Connections Sustainable Travel Zone proposal and pause two other schemes[8], consultees noted that the GCP will need to rethink what schemes are required to respond effectively to the travel needs of the area. The outcome of this process could have implications for Smart Cambridge, although it also provides an opportunity to inform scheme development and appraisal (and subsequently monitoring and evaluation). Further, feedback suggested a degree of risk aversion amongst transport contractors to deploy smart infrastructure as there are some negative connotations that it is challenging and costly; this could hinder scheme implementation.

## Funding secured/leveraged

**5.19** The evidence indicates very strong progress against this outcome. Total funding of £15.6m (as of March 2024) has been leveraged by the programme, of which around a third is from the private sector. This represents a ratio of funding secured to Investment Fund commitment of 5.6:1.[9]

**5.20** As shown in Table 5-2 below, in aggregate, the largest grants by value have been from the UK Government's Centre for Connected and Autonomous Vehicles (CCAV) for the three autonomous vehicle projects. As explained in more detail in the case study, the current autonomous vehicles project – 'Project Connector' – is currently being rescoped and a new

[8] See Executive Board takes decisions on key transport schemes (greatercambridge.org.uk)
[9] Total Investment Fund budget over the Gateway Review 2 period is £2.8m.

technology partner appointed. Therefore, total project costs are likely to reduce from £17.6m (comprising a grant of £8.8m and industrial contributions of £8.8m), to £6.9m (comprising a grant of £4.3m and industrial contributions of £2.5m).

**5.21** Three further points are noted in relation to Table 5-2:

- The in-kind contribution by the University of Cambridge has been in the form of usage of data centres, computer labs, and hosting amongst other things; this was reported to be highly valuable by consultees.

- Smart Cambridge contributed to the successful bid for a new Research Hub for Decarbonised Adaptable and Resilient Transport Infrastructures ('DaRe'). Led by Newcastle University, DaRe brings together the universities of Cambridge, Glasgow and Heriot-Watt as partner institutions. Funding of £10m was secured from Department for Transport (DfT), the Engineering and Physical Sciences Research Council (EPSRC), and UKRI's Building a Green Future fund to deliver the hub, of which £5m has been allocated to the University of Cambridge. Consultee feedback indicated that the Smart Cambridge programme lead was "fundamental" in securing the funding through their involvement in the application and interview process, and going forward, they will be a member of the advisory group. Delivery of DaRe is in the early stages, however, opportunities for Smart Cambridge to draw down some of the £5m allocated to the University of Cambridge are expected in future. Furthermore, DaRe is expected to develop tools which the GCP will look to integrate into the programme to support with wider delivery.

- Data from the Sensor Network has been used to support funding applications/bids. For example, the Innovate UK 'Accelerating Net Zero by Data Fusion' bid drew on the data, whilst the Decarbonised Adaptable and Resilient Transport Infrastructures Research Hub application included a funding allocation to access data from the Sensor Network.

**Table 5-2: Amount and sources of funding leveraged by the programme**

| Project | Year funding was secured | Public funding | | Private funding | |
|---|---|---|---|---|---|
| | | Amount | Source | Amount | Source |
| Trumpington to Cambridge Autonomous Busway Service ('T-CABS') | 2018 | £2,408,297 | CCAV3 | £807,202 | RDM Group |
| Commercialising Connected and Automated Mobility: Mass Transit (Eastern Access Study) | 2023 | £92,474 | CCAV5 | £61,074 | Industrial match contributions |

| Project | Year funding was secured | Public funding | | Private funding | |
|---|---|---|---|---|---|
| | | Amount | Source | Amount | Source |
| Commercialising Connected and Automated Mobility: Deployment ('Project Connector') | 2023 | £4,351,801 | CCAV5 | £2,517,872 | Industrial match contributions |
| AI for old dumb sensors | 2023 | £49,895 | Innovate UK | - | - |
| Research Hub for Decarbonised Adaptable and Resilient Transport Infrastructures ('DaRe') | 2023 | £5,000,000 | DfT, EPSRC, UKRI | - | - |
| Accelerating Net Zero by Data Fusion | 2024 | £195,128 | Innovate UK | £52,415 | Industrial match contributions |
| Smart Cities, Safe Crossings: AI-Enhanced Solutions for Data-Driven Pedestrian Optimisation | 2024 | £61,500 | Innovate UK BridgeAI | £26,500 | Starling |
| Smart Signals Trials | 2022 | - | - | £100,000 | Vivacity |
| Intelligent Crossings Pilot | 2022 | - | - | £50,000 | Starling |
| Various | 2020-2024 | - | - | £100,000 | University of Cambridge (in-kind) |
| **Total** | | **£12,159,095** | **-** | **£3,465,063** | **-** |

*Source: GCP (data up to 15/02/24)*

**5.22** A key factor that has supported the realisation of the funding leverage outcome is the wider networking activities of the programme team e.g. as members of advisory boards/groups in areas relevant to Smart Cambridge. This was seen as important in raising the profile of the programme, which is beneficial when seeking, and bidding for, funding opportunities. Linked to this, the programme team was reported to be effective at 'horizon scanning', identifying emerging 'game changers' which are of interest in Cambridge and beyond.

**5.23** The Innovation Prospectus published in June 2023 is also regarded as potentially important in leveraging funding over the longer-term, as reflected in the comment below. The work is still in a nascent stage with no specific examples provided by consultees of direct outcomes

to date. However, the programme team is involved in several on-going conversations with companies such as FLOX and Trivlee as well as academic partners that have occurred due to the prospectus It is recognised that the development of pilots and trials takes time from initial engagement with potential partners. More broadly, the feedback highlighted that the programme offers opportunities to deliver 'real-world' impacts which help attracts funding. Projects are often mutually beneficial for both GCP and partner organisations (for example, offering opportunities to trial technologies, raise their profile etc.) which incentivises partners to invest.

*The Innovation Prospectus, whilst it doesn't provide funding, has enabled conversations to happen, which opens up new funding avenues … the Prospectus has worked really well in showing that Cambridge is open to business and ideas, which in itself has opened up opportunities for funding.*

**Project management and governance consultee**

**5.24** Going forward, feedback from the consultations emphasised that leveraging further external investment will require continued Investment Fund support for the programme, as it demonstrates a commitment to this agenda in Greater Cambridge. Several consultees highlighted the critical role of individuals within the programme team in leveraging funding, thus ensuring continuity in key staff was considered a priority going forward. The ability to leverage further funding is also very dependent upon external factors such as the public funding landscape, strategic priorities, and private sector investment appetite.

## Other outcomes

**5.25** The consultations also explored evidence of other emerging outcomes to date in addition to the four 'outcomes of interest' above. Three key themes emerged:

- **Profile and awareness raising benefits.** Smart Cambridge has contributed to raising the profile of "smart city" technologies, and also providing a clear message that it is important to the local area. Through its role as part of the wider Investment Fund and links to the City Deal, this agenda has gained a higher profile. The programme has also helped to raise awareness of the opportunities for local technology companies to use Cambridge as a testbed for new technologies, and in doing so, how they can contribute to delivering local impacts. Specific projects were also identified as delivering reputational and profile benefits for the GCP, partners and the city, such as the T-CABS projects which was well publicised and attracted a Ministerial visit.

*It has a halo effect on everything else … so the way in which they're able to articulate their objectives and progress, it doesn't just reflect well on them as a programme, I think it reflects well on everyone working in that space, they can be a real driving force to portraying and making it clear that our local bodies and local authorities really care about the long term future*

*of the transport system, about decarbonisation, really view innovation as a route to solving some of these problems.*

**Project management and governance consultee**

- **Knowledge creation and dissemination,** which has the potential to contribute to regional and national debates and influence policy. For example, on completion of the Intelligent Crossing trial, Starling (i.e. the company who carried out the trial) presented the evidence to a national conference for signal engineers, which contributed to the industry wide conversation on pedestrian prioritisation.

- **Enhanced partnership working.** Overall, the feedback suggests that coordination across Greater Cambridge has strengthened in relation to the use of technology to address transport issues because of Smart Cambridge. Activity at both a programme governance and project level has helped to stimulate opportunities within, and improve the quality of, existing networks in the city. This has included engaging large corporations and SMEs, from a broad range of sectors including property development, information technology, and health. Partnership working benefits are explored in more detail in the 'project up' case study as part of the Process, Capacity Development and Partnership Working Evidence Paper.

# 6. Conclusions

6.1 This section sets out the conclusions of the progress plus evaluation of Smart Cambridge to inform the overall evaluation of the Greater Cambridge Investment Fund at the second Gateway Review stage. The conclusions are structured around three key questions consistent across all impact and progress plus evaluations.

## Is there evidence of positive economic outcomes at this stage, that would not have occurred without the intervention?

6.2 The Smart Cambridge programme remains on-going, with much activity at an early point or at the pilot and trial stage, hence it was allocated for a progress plus evaluation. Given the long term and complex 'routes to impact' associated with the programme, it is too early to draw definitive conclusions regarding economic outcomes, and whether they would have occurred without the intervention.

6.3 Therefore, the evaluation focused on progress towards four 'outcomes of interest' which were expected to start to emerge within the activity period: improved integration of the transport system, enhanced understanding of transport planning conditions, challenges, and opportunities, improved scheme development, appraisal, implementation, and monitoring, and funding secured/leveraged. Evidence of progress against the four 'outcomes of interest' is encouraging at this stage.

6.4 The programme has successfully leveraged £15.6m in funding from both public and private sources to deliver a range of activities including autonomous vehicles and smart signal trials.

6.5 There is also strong evidence from consultations with partners and stakeholders that the programme is leading to enhanced understanding of transport planning conditions, challenges, and opportunities in Greater Cambridge, and supporting improved scheme development, appraisal, implementation, and monitoring. Evidence generated by the programmes activities have been used to inform a wide range of other activity seeking to address the challenges across Greater Cambridge's transport network.

6.6 Evidence on improved integration of the transport system is more limited to date, which is not unexpected given the complex operating and strategic landscape. However, there is some early evidence that progress has been made towards this outcome. Further, there is some confidence locally that the programme will contribute to the improved integration of the transport system in the future.

6.7 Without the GCP and Investment Fund, it is likely that much of the activity would not have happened in the same form in their absence. Whilst there was a recognition that some activity

would have occurred without the Investment Fund, consultees suggested that it would have been on a smaller scale, been more fragmented, and/or taken longer to have been delivered.

## Is it reasonable to expect that positive economic outcomes will be realised in the future, that would not have occurred without the intervention?

**6.8** Smart Cambridge is expected to lead to two main groups of impacts in the future: transport specific outcomes related to reduced congestion and modal shift, and in turn (and emerging from these transport outcomes) broader economic outcomes e.g. improved business productivity.

**6.9** The programme has identified and is testing a range of 'smart' initiatives with potential to help address the city's transport challenges. Some of the activities have the potential to have a direct impact on transport provision and integration – such as the use and roll-out of autonomous vehicles – whilst the routes to impacts for some activities are more indirect, such as, the use of data from the Sensor Network to inform decision-making and the design and development of schemes based on 'hard' evidence of the transportation needs of the city.

**6.10** Overall, based on the evidence from this progress plus evaluation, it is reasonable to expect that as more initiatives are delivered and mature, the programme has the potential to contribute to long-term positive effects on transport conditions, including reduced congestion and modal shift (via increased use of sustainable and active travel). In turn, this has the potential to help to bring about broader economic outcomes related to investment, improved productivity (e.g. via travel time savings), and entrepreneurship and job creation in technology sector.

**6.11** Evidence on the counterfactual position in relation to outcomes (i.e. whether outcomes would have occurred without the intervention) is not known at this stage. Further, it needs to be recognised both that there are a wide range of other investments in Greater Cambridge that will impact on transport conditions, and that as technology evolves (including led by the market), the potential contribution of Smart Cambridge will need to adapt to market conditions. This said, as noted above, without Smart Cambridge (funded by the Investment Fund), it is likely that much of the activity would not have happened in the same form. This suggests that there is the potential for the realisation of economic outcomes in the future as a result of these activities, that would not have otherwise occurred.

## Is further evaluation evidence required in the future to provide a credible assessment of the overall contribution of the intervention to economic outcomes, and if so when should this be delivered?

**6.12** Looking forward, as more activities complete and progress implementation, it will be important to undertake further evaluation work to provide a robust assessment of the longer-term transport effects and broader economic impact of Smart Cambridge, including additionality. Assuming continued delivery, it is recommended that an impact evaluation should be delivered within 3-5 years post Gateway Review #2.

**6.13** Any future evaluation should include primary research with users (e.g., members of the public, businesses benefiting indirectly from Smart Cambridge activities), as well as follow-up research with project management and governance representatives, delivery partners, and wider stakeholders. This should complement analysis of relevant secondary and monitoring data, including any closedown / evaluation reports for specific trials and pilots such as Project Connector. GCP may also wish to consider the potential scope for applying experimental or quasi-experimental approaches for future trials and pilots. This would help to provide robust evaluation evidence and improve understanding of transport conditions and the impact and effectiveness of interventions.

# Annex A: Case studies

**A.1** Annex A provides the four case study summary boxes:

- Sensor Network
- Autonomous Vehicles
- SMART Panels
- Networks Management Interventions.

# Sensor Network Case Study

The Sensor Network monitors road usage across Greater Cambridge. It comprises 96 sensors, located across the city. The sensors provide counts of cars, pedestrians, bicycles and other vehicle types. Data is continuously collected and is available on five-minute, 15-minute, hourly and daily intervals. The Sensor Network is a joint initiative between the Greater Cambridge Partnership (GCP), Cambridgeshire County Council (CCC) and Cambridgeshire and Peterborough Combined Authority (CPCA). The aim of the network is to produce robust and up-to-date traffic data for key locations in Cambridge, including traffic volumes and modal splits.

The sensor technology was piloted by the GCP before being widely installed across key locations in Cambridge from August 2022. The sensors were procured from Vivacity, a smart traffic solutions technology company. The majority of the sensors (59) were funded by GCP, with the remaining funded by CCC and the CPCA. All partners agreed that data captured by all 96 sensors can be accessed by all partners. CCC are the body responsible for managing, aggregating, and analysing the data.

The Sensor Network project has led to the following outcomes:

- Enhanced understanding of transport planning conditions, challenges and opportunities. Previously, only biannual traffic data was collected, making it difficult to identify patterns and changes. The data provided by the Sensor Network has enabled a greater level of confidence around typical transport patterns.
- Improved scheme development, appraisal, implementation and monitoring. The Sensor Network was described as the "backbone" of this outcome for the programme overall: c
    - It is informing decision-making/prioritisation on transport investments. Most notably, the Sensor Network data is currently being used to develop CCC's new transport model (CaPCAM), which will be used by GCP to inform decision making and develop businesses case for future schemes.
    - It has supported the preparation of businesses cases for schemes, for example, the data is being used to prepare business cases for the Greenways and Waterbeach to Cambridge projects.
    - It enables the collection of data before, during and after the delivery of schemes to support monitoring and evaluation. There are a range of GCP- and CCC-funded schemes that have used Sensor Network data for monitoring and evaluation purposes, including, but not limited to, Histon Road, Milton Road and Chisholm Trail Phase 1.

- Funding leveraged/secured. The data has strengthened the evidence base, which has been used to support funding applications. For example, data from the Sensor Network formed the basis of a successful bid to Innovate UK, which is funding the *Accelerating Net Zero by Data Fusion* project.

Key learnings/reflections:

- The Sensor Network pilot was important to demonstrate the value of the traffic monitoring technology and ensured commitment from all partners involved.
- The deployment of the Sensor Network was initially difficult due to a complex procurement process. The creation of a subsequent framework agreement facilitated this process, because the steps to procure, install and operate sensors were formally documented.
- The agreement that all partners can access all of the data captured by the sensors has enabled greater coverage of data and insight on transport issues across the Greater Cambridge area.
- The quantity of data produced by the Sensor Network is vast, which could limit the overall impact the data has. Work is ongoing to ensure that the data is aggregated and analysed in an accessible and useable form. It was noted that the good working relationship between CCC and Vivacity has been crucial in efforts to maximise the impact of the data.
- A challenge going forward will be ensuring that there is capacity to maintain and update the Sensor Network. The sensor technology is constantly evolving, and the Sensor Network needs to be updated as such to maintain its relevance and utility.

## Autonomous Vehicles

Smart Cambridge has delivered research and trials into the use of autonomous vehicles in Cambridge. Autonomous vehicles ('AV') are seen as a key part of Cambridge's future public transport network, with the potential to deliver advantages over traditional services that could help increase public transport availability and use, such as expanded services, offering first-and-last mile transport and reduced operating costs.

*CCAV 3: 'T-CABS'*

T-CABS was an autonomous shuttle trial in 2021 to develop the technology and business model for an autonomous fare-paying public transport service. The project was delivered by RDM Group and Smart Cambridge, with a £2.45m grant from Innovate UK delivered through the Centre for Connected and Autonomous Vehicles (CCAV). Total project budget was £3.2 million, with the rest of the investment from the industrial partner, RDM. The service was originally intended to operate between Trumpington and Cambridge on the southern section of the Cambridge Guided Busway. This would provide access to key employment sites at the Cambridge Biomedical Campus, and trial an out-of-hours service to serve medical and research shift staff at these sites. Due to changes in operating hours for services on the busway that affected the safety of the trial, and disruptions from Covid-19, the trial site was moved to the University of Cambridge's West Cambridge site connecting to Madingley Road Park & Ride. Three autonomous shuttles were trialled with passengers on the route between May and June 2021. They ran operationally for 10 weeks out of a planned 24 due the impact of Covid-19 lockdowns.

*CCAV 5: Project Connector*

Project Connector is a trial of at-scale, on-demand self-driving vehicles on two sites in Cambridge, providing passenger services that will integrate with existing transport services: the University of Cambridge's West Cambridge Campus, and the Cambridge Biomedical Campus. The 12-month trial will initially involve on-board engineers, before moving to remote-only operators. The delivery partners include technical partners and Stagecoach, an existing bus operator, which will test commercial viability and the challenges of autonomous passenger services. £8.8m in funding was awarded to the project by Innovate UK through CCAV with match funding of £8.8m from industry. However, at the time of writing the project was being rescoped due to delays (see below), thus project costs are likely to reduce to £6.9m (comprising a grant of £4.3m and industrial contributions of £2.5m).

The project started in April 2023 with deployment planned from April 2024, running for a 12-month period. However, complications with the AV partner have caused delivery to be paused while a new partner is appointed. If a new partner can be agreed in early 2024 then the trial can continue in 2024 as planned over a 12-month period on a compressed timescale.

There have been some initial outcomes from the pilots. These are:

- The successful operation of an AV shuttle service (106 journeys, 304 passengers), testing the feasibility of the operation.
- Media coverage of the T-CABS pilot (97 local, national and international media stories, 9 TV and radio broadcasts).
- Learnings from T-CABS have provided a foundation for Project Connector, which will expand the route T-CABS used on the West Cambridge site.
- Over £10m in funding from Innovate UK and the private sector leveraged across both pilots.

Anticipated future outcomes from the trials are:

- Project Connector is expected to deliver improved understanding of whether AV can provide a better service than conventional vehicles within the region. This can only be achieved through a trial (such as this 12-month trial) which runs the service for a sufficient period to capture insights.
- Project Connector will test the commercial viability of an AV bus service.
- Broadly speaking, the trials (which build upon each other) will deliver an improved understanding of whether AV passenger services will provide a solution to congestion within the city and/or increase modal shift to public transport through an improved service.

Key learnings/reflections:

The Smart Cambridge team's ability to deal with challenges effectively was a theme in stakeholder interviews. For example, one stakeholder commented that although there had been challenges with T-CABS, these learnings had been incorporated into the bid for Project Connector. Project Connector has faced a significant challenge in the need to change its lead partner, however it was felt that it had led to the following improvements:

- Awareness of a need for greater technical expertise within the GCP team, and a technical support partner has been used to assess replacement partners.

- A reconsideration of some elements of the project, so that the pilot has been 'honed' from an original bid with three different vehicle types on two routes, to focus on one vehicle type (buses) and the right number of vehicles for a service.

Interaction between the CCAV funded projects across the UK is beneficial. CCAV provides some support to knowledge share between projects, but the Smart Cambridge team have also visited the projects in Scotland and engaged with others. Moreover, Stagecoach is involved with three of the CCAV projects which furthers knowledge sharing, ensuring AV development with government funding is not happening in silo.

One partner felt that communications had gone quiet during the bid stage, however this has now been resolved. Partners were pleased with the communications from GCP, particular during the challenges with the lead partner.

Stakeholders were clear that the trials into AV would not have been possible without GCP and the significant funding from CCAV. Their own organisations would not have supported a business case for trials of this scope and scale.




*Source: Connecting Cambridgeshire webpage*

## Smart Panels Case Study

Smart Panels are screens which display accurate and real-time travel and weather information to commuters in businesses and public spaces across Cambridge. The project was funded by the Greater Cambridge Partnership (GCP) with in-kind support from the University of Cambridge Computer Laboratory. The university built the transport data platform, known as the Intelligence City Platform, and were responsible for aggregating and analysing the data displayed on the screens.

The first Smart Panel was installed in Shire Hall reception, the then Cambridge County Council headquarters, in July 2018. There are now 43 active Smart Panels. A mobile version of the Smart Panels was also developed, called Pocket Smart Panel, which can be bookmarked to enable users to customise travel information according to their location. The mobile-friendly webpage was prototyped in June 2019. It now has c.200 active users each day.

The aim of the Smart Panels project was to encourage commuters to use more sustainable forms of transport, such as buses and trains, rather than relying on cars. The Smart Panels project was intended to generate the following outcomes:

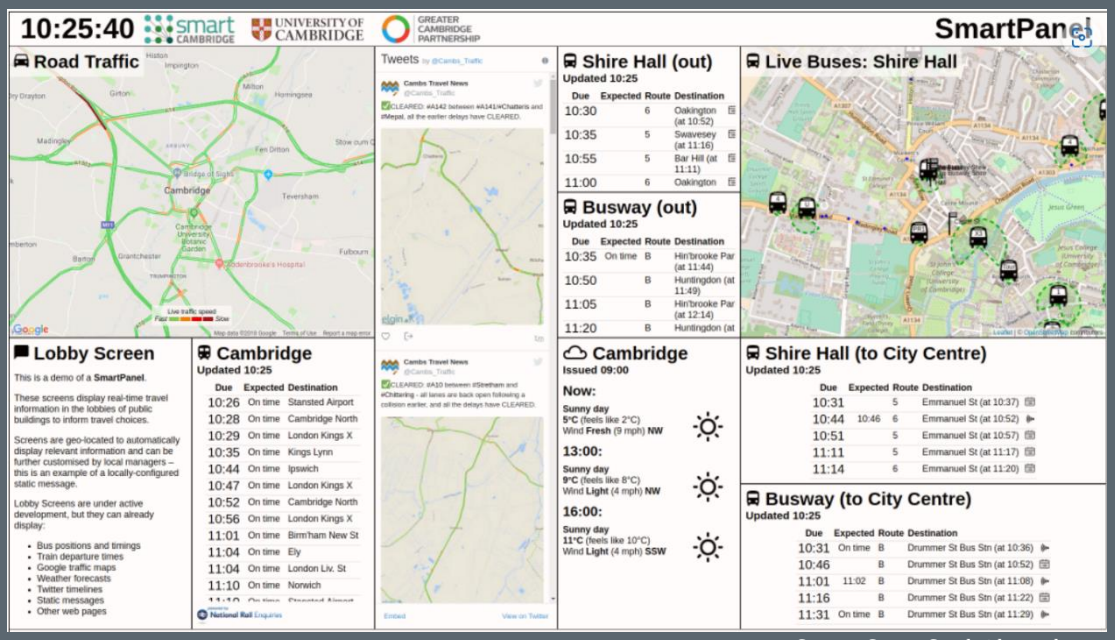
- Improved integration of the transport system. Smart Panels make accurate travel information more accessible to commuters, which supports multi-modal commuting: as one consultee commented so *"you can understand if the bus is on time or if there are any delays on the train. That then allows you to make other transport decisions".*
- Greater access to real-time travel information encourages commuters to make more sustainable transport decisions, particularly because the screens display road network, highlighting road congestion and dissuading people from using their car.
- Raised awareness of the wider Smart Cambridge programme, including the aim to shift transport behaviour in the city towards more sustainable forms of transport. The screens are branded with logos for Smart Cambridge, GCP and the University of Cambridge, meaning that they act as a *"visible symbol"* of the programme's overarching ambitions.

To date, there has been no formal evaluation of the effect of the Smart Panels on travel behaviours. As such, the outcomes listed above should be treated as anticipated. In developing the projects monitoring and evaluation plan, advice was sought from the What Works Centre for Local Economic Growth. This project was determined that an impact evaluation using a counterfactual was not possible. This is primarily due to three factors: i) selection into treatment (screens were not allocated randomly but located in reception areas of volunteer organisations), (ii) the small number of screens (c.20), and

a lack of robust data (no baseline data and no clear and affordable mechanism to collect data for treatment or any potential control groups).

Key learnings/reflections that have emerged from the Smart Panels project:

- Given the wider programme of transport improvements across Cambridge, undertaking a robust evaluation of the outcomes and impacts of the Smart Panels project is challenging due to difficulties attributing any changes to the project.
- The collaboration between the University of Cambridge and GCP has been a key enabler of the project. The level of partnership working and engagement was regarded as notable and an example of good practice.
- The current delivery model, where the onus is on the University of Cambridge to manage the screens, is not considered sustainable. Therefore, the next step for the Smart Panels project is to develop a commercial model where the screens are rolled out through a market provider.




*Source: Smart Cambridge webpage*

## Network Management Interventions: Starling Intelligent Crossings Pilot and Vivacity Smart Signals Pilot

The Smart Cambridge programme is delivering two Network Management Interventions pilot schemes in partnership with the broader Connecting Cambridgeshire programme (hosted by Cambridgeshire County Council and led by Cambridgeshire & Peterborough Combined Authority). These pilot schemes are trialling 'intelligent' traffic sensors and signals to test whether they can improve management of the road network through prioritising certain road users and optimising traffic delays. The pilots' aims, in line with GCP objectives, are to ease congestion and prioritise greener and active travel.

The **Starling Intelligent Crossings** pilot ran from June to June 2022-2023 and trialled intelligent sensors on pedestrian crossing signals on East Road, outside of Anglia Ruskin University. Starling sensors are designed to detect different road and pedestrian user types in order optimise pedestrian crossing signals. The trial tested Starling's signal operations against traditional crossing sensors, as well as capturing data on pedestrian types, pedestrian behaviours and wait times. The pilot scheme's direct costs (£50k) were covered by Starling, with some support from the GCP (for example, staff time and sensor deployment). An application has been made to the Department for Transport's Green Light Fund for a second phase of the trial.

The pilot achieved the following outcomes:

- Enhanced understanding of transport planning conditions, challenges, and opportunities through the capture of pedestrian data that had not been captured at the site before.
- Improvements to the pedestrian experience on East Road, with a reduction in crossing waiting times of 38% and a reduction in near-misses between vehicles and pedestrians.
- Initial findings from the trial were reported at a national conference for signal engineers and the technology was seen by consultees as having national significance for the signals industry.

Roll-out of the Starling sensors at more junctions is expected in the 2024/25 financial year, with some funding from GCP and a possible larger rollout from DfT funding (both dependent on funding confirmation). Sensors are expected to improve pedestrian experience and capture data from roll-out, and to improve following a learning period for the AI software. Roll-out of multiple sensors is expected to achieve greater understanding of pedestrian and cyclist behaviours (including other users such as

wheelchair users and pushchairs) in Cambridge, as well as test the effectiveness of 'walking corridors' that prioritise pedestrian movements through the city.

The **Vivacity Smart Signals Pilot** has involved two phases. The first phase involved a trial that ran from March 2022-23 which installed Vivacity sensors at the 'Robin Hood junction' in south Cambridge. Data from the sensors was used to train an AI algorithm which then controlled local traffic signals. It was intended to test Vivacity 'intelligent' signals control against conventional signalling technology. A second phase of the trial started in Sept 2023 on a network of signals on Hills Road (near to Hills Road Sixth Form College), with the aim of assessing the capability of Vivacity control methods to prioritise pedestrians and more sustainable methods of transport. The trial was funded by Vivacity, with GCP covering the costs to procure the sensors and a management fee to Connecting Cambridgeshire for staff time. It should be noted that the project extended significantly beyond its planned timing due to the need to adjust and test the technology in the real-world.

The trials have led to the following outcomes:

- Increased understanding of the impact of intelligent traffic signal controls on congestion. Trials found that Vivacity Smart Signals could match the current system, but not significantly reduce congestion (matching peak hour operations, and marginally improving off-peak) – partly due to safety constraints required for real-world traffic signal operations.
- Improved data collection on transport conditions and usage through deployment of Vivacity sensors.
- Potential for improved prioritisation of buses, cyclists and pedestrians at the Hills Road trial site.

*Key messages/reflections*

- The County Council's Road Traffic Signals Team have been crucial in assisting with these trials. However, they are a small team with limited capacity and facilitating the testing and running of some of these trials has been a challenge.
- Cambridge's reputation as a city that is open to innovation has been an important factor in companies using Cambridge as a trial site for new technologies.
- The nature of these pilots as 'innovation trials' has meant that timelines may progress differently than planned, when technology works differently than expected. This has not created extra cost to GCP and is considered normal for these kinds of trials. Similarly, there was acknowledgement that the outcome of these types of trials

may be 'negative' in that the technology does not work or deliver the desired solution, but that this is still a valuable outcome, with intelligence and learning generated to inform future investments and interventions.

- Both pilots were affected by vandalism of sensors.
- Both schemes are expected to deliver policy outcomes over the next few years, as trials in Cambridge provide evidence that will drive future policy and safety standards.

# Annex B: Overview of programme activities

**B.1** The table below provides a high-level overview of the ongoing and complete activities delivered by Smart Cambridge.

**Table B-1: Overview of programme activities**

| Project | Summary | Status |
|---|---|---|
| AppyWay: Digisting Traffic Road Orders | Worked with AppyWay to digitise Cambridge's Traffic Regulation Orders and build a management tool for creating or changing orders. | Complete |
| Bus Pinch Point study | The study ranked junctions in Greater Cambridge by the amount of time bus services are held up, considering nearby stops and other junctions. A further piece of work analysed capacity of buses through junctions and the potential impact of delays on CO2 levels. | Complete |
| City Access programme workstreams | Supporting GCP's City Access team in technical and behaviour change aspects as well as the development of the freight strategy and action plan of the work. | Ongoing |
| Covid-19 Data Dashboard | During the Covid-19 pandemic, sensors deployed as part of Smart trials provided a significant proportion of the data collected to analyse changes to travel patterns as a result of Covid-19 restrictions. This fed into a dashboard report. | Complete |
| Data Visualisation work packages | Work package focused on data visualisation for example, ingesting data from the Vivacity sensors and other key data streams have into the latest version of the Geospock platform and producing dashboards in PowerBI. | Complete |
| Development of Intelligent City Platform (iCP) | Overall aim to collect, process and make available data to help improve transport and reduce congestion in Greater Cambridge. Involved establishing three main components: a data network, a data hub and a city-wide sensor network. | Complete |
| Digital Twins | Work with the Centre for Smart Infrastructure and Construction (CSIC) to develop a 'digital twin' for the Cambridge Biomedical Campus, which will support modelling and policy development by bringing transport, air quality modelling and other infrastructure into one model. | Complete |
| Digital Wayfinding | The provision of digital travel information screens and integration of appropriate travel data sets to provide better information to travellers about their journeys. | Complete |
| Eastern Access Study (CCAV | Feasibility study exploring how Connected and Automated Mass Transit could be implemented in Cambridge to help to solve its complex transport problems. | Complete |

| Project | Summary | Status |
|---|---|---|
| autonomous vehicles project) | | |
| Fendon Road: ANPR and traffic count sensors | Seven ANPR and traffic count sensors were deployed in late 2019 and remained in place for a year, covering the period both during and after the works on Fendon Road. | Complete |
| First Steps to Intelligent Mobility | Early work focused on:<br>Research and data gathering about why people make specific transport choices in the Greater Cambridge area.<br>Investigating the current legislative, commercial and other barriers and opportunities with regards to integrated ticketing and on-line ticket purchase in Greater Cambridge.<br>An initial feasibility study to explore the potential for running autonomous vehicle trials, utilising the unique aspects of the guided busway. | Complete |
| Guidance System Review | The Smart Cambridge team continues to work in collaboration with the GCP Transport programme to coordinate investigations of guidance technologies and how they can safely and effectively support and enhance the schemes being proposed for Greater Cambridge. | Ongoing |
| Innovation Prospectus | Development of an Innovation Prospectus to support with actively engaging with the market. It sets out the challenges that the GCP is working to address and invites the market to trial new and innovative technologies. | Complete |
| Integrated Ticketing Report | Report on the opportunities/barriers/issues associated with integrated ticketing and online ticket purchase. This was initially completed in 2017 and subsequently reviewed in 2022. | Complete |
| MaaS options appraisal | Completion of scoping and an options appraisal for Mobility as a Service (MaaS). | Complete |
| Mill Road Bridge Closure 2019 sensor trial | Installation of traffic flow and air quality monitoring sensors on Mill Road. Data from sensor was collected and is available on the Cambridgeshire Insight website, and a final report was produced. | Complete |
| MotionMap | Development of an the MotionMap app to help people plan their journeys drawing on data collated through the iCP. | Complete |
| Network Management Interviews (Smart Signals) | Trials of intelligent sensors on pedestrian crossing signals and intelligent traffics signal controls. | Ongoing |

| Project | Summary | Status |
|---|---|---|
| New Communities | Activity focused on embedding 'smart' principles into place-making. This involved working with planners and developers to understand the opportunities for smart technologies to support the planning system and help develop better places. | Complete |
| Project Connector (CCAV5 autonomous vehicles project) | A trial of at-scale, on-demand self-driving vehicles on two sites in Cambridge, providing passenger services that will integrate with existing transport services. | Ongoing |
| Real Time Bus Data Audit | The Smart Cambridge team in collaboration with the CPCA have procured a consultancy to carry out an audit of the real-time data system to understand where issues may be impacting the quality of data. | Complete |
| Set up of interim data platform | To support officers in extracting intelligence and insight from data collected from the Strategic Sensor Network and other related data streams, a 'data platform' is needed. This is a central point for the automated uploading of data and to support different types of data analysis and visualisation required by GCP and its partners. Following engagement with the CPCA and CCC an interim solution has been procured and is in place which will support GCP data analysis over the next two years. | Ongoing |
| Smart Panels | Smart Panels are screens which display accurate and real-time travel and weather information to commuters in businesses and public spaces across Cambridge. | Complete |
| Strategic Sensor Network | Deployment of 96 sensors to monitor road usage across Greater Cambridge. The sensors provide ongoing counts of cars, pedestrians, bicycles and other vehicle types. | Complete |
| T-CABS (CCAV3 autonomous vehicles project) | T-CABS was an autonomous shuttle trial (involving three shuttles) that was delivered in 2021 in order to develop the technology and business model for an autonomous fare-paying public transport service. | Complete |

*Source: SQW review of GCP documentation. Note, status based on GCP Executive Board Papers 4th January 2024 (Progress reported up to 30th September 2023).*