Call for proposals:
Defining the Research Agenda and Research Landscape for digital built Britain
Tender 8: Integration and optimisation of services embedded in the built environment

Closing date: 9th September 2018

1. Overview

The Centre for Digital Built Britain (CDBB) invites proposals to draft reports which describe the capabilities the UK will need to create, exploit and enjoy digital built Britain over the next several decades, the research agenda needed to deliver these capabilities and the landscape of research competence available today to act as a starting point.

Rather than try to cover the whole landscape in one tender, nine Tenders are being offered in parallel and bidders are invited to bid for any or all of the Tenders. Each Tender will be competed separately.

Key dates are given below.

CDBB will integrate the results from these Tenders and from the work of the current Research Network to create a single report during the first quarter of 2019. During that time, CDBB will invite comment and contribution as appropriate on emerging drafts either by email or by participation at workshops and seminars.

Key Dates

Call for proposals	30th July 2018
Closing date for expressions of intent to bid	20th August 2018
Closing date for receipt of proposals	23:59 9th Sept 2018
Target date to inform successful bidders	24th September 2018
Interim report (focusing on landscape with initial proposals for agenda)	12th November 2018
Final Report	20th December 2018
Workshops to discuss final outcomes	1st Quarter 2019

2. Background

The Centre for Digital Built Britain is a partnership between the Department of Business, Energy & Industrial Strategy and the University of Cambridge. It seeks to understand how the construction and infrastructure sectors can use digital technologies and innovations to better design, build, operate, integrate the built environment. The Centre was established by HM Government in the 2017 Autumn Budget as the custodian of the UK BIM and Digital Built Britain Programmes.

A digital built Britain harnesses the wealth of data being created by digital construction, high performing assets, smart cities, the digital economy and connected citizens to deliver a Britain that is fit for the future.

A digital built Britain will:

- understand what information is needed to enable better through life economic, social and environmental value from our built environment
- exploit new and emerging digital construction and manufacturing skills and technology to reduce costs and increase productivity
- champion human-centric design of infrastructure and the services they deliver
- grow new career, business and export opportunities.

It will be achieved through changing the way we design, build, operate and integrate our physical, social and economic infrastructure and the services they deliver.

The CDBB Research Programme has been set up to map out and to support the creation and adoption of the necessary capabilities, from identification, through early stage research, to formalisation and codification to a point where the capabilities can be adopted by stakeholders. The CDBB Research Programme aims to build effective relationships with the research community to identify and signpost expertise and insight, enabling results of innovative academic research to inform the development of a digital built Britain and to become part of professional practice. It actively feeds in to the wider development of digital built Britain and gathers research requirements. Furthermore, it brings together academic researchers, industry, and stakeholder organisations to drive the creation of a digitally-enabled landscape.

The Research Programme co-ordinates and guides the support of research and other mechanisms to create, demonstrate and make available the capabilities needed.

CDBB and others will, in future, commission research which will provide “the **insights** and **capabilities** needed, at the right time, in order to deliver and manage Digital Built Britain for prosperity, the good of citizens, and the environment **through asset, infrastructure and service lifecycles** in the face of **changing contexts** . There are, of course, many centres of competence which are able to deliver such research and which have done so in the past. Such centres also contain skilled and experienced people able to contribute immediately to the pursuit of opportunities and the solution of problems. These can easily become use-cases and demonstrators which support the

dissemination and adoption of new insights, skills and capabilities. **CDBB seeks to map out the landscape of current competence and the research agenda for the future**.

This work seeks answers to three key questions, for each the various topic areas that comprise the digitalised service and built infrastructure landscape of the future:

1. What new capabilities the UK will need (and when)
2. What research, development and demonstrations are necessary to build, deploy and disseminate such capabilities
3. Where there is, today, the basis for such development and demonstration

The answers to questions 1 and 2 will cover the research agenda and the answer to question 3 covers the research landscape.

There is, of course, a very wide range of research which has been and could be relevant. To focus on the remit of CDBB, we seek a tighter focus which concentrates on the intersection of digitalisation, of the built environment and then only on the other aspects that overlap these two.

There may be research insights, competence and capabilities which are not currently applied to digital built Britain but which could be easily transferred and which would provide immediate value to stakeholders. If immediately relevant and clearly applicable, this research is also of interest.

To further clarify the task of identifying useful capabilities and future needs we suggest bidders focus on the effects of digitalisation on the built environment and its stakeholders and on four elements

- What will be enabled? (opportunity)
- What can be exploited? (opportunity)
- What needs to be avoided? (threat)
- What will need to be done / solved? (capability)

In this context, capabilities will need knowledge and capacity. It is often useful to characterise capabilities with the phrase “we know how to XXXX”. This highlights knowledge which can be used for a specific purpose. Furthermore, it becomes possible to subdivide such know-how by exploring the subsidiary “we know how to” elements required to achieve a higher level “we know how to”.

Where capacity needs tools and resources then these too need to be identified alongside the know-how to deliver the capability. The role of research is primarily to deliver the know-how and hence a logical link can be drawn from capability needs to a research agenda.

3. Deliverables

Bidders are asked to provide Word document reports which define

1. What new capabilities the UK will need (and when)
2. The research, development and demonstration necessary to build, deploy and disseminate such capabilities
3. Where there is, today, the basis for such development and demonstration

The answers to questions 1 and 2 will cover the research agenda and the answer to question 3 covers the research landscape.

Part 1 will identify, within the specific domain, what will be the capabilities that the UK will need to specify, deliver, manage and gain benefits from the envisaged new digital built Britain. This will be a world created by application of digital-based technologies, tools and philosophies to the built environment and to infrastructure (both economic and social) , a world characterised by integrated services embedded in and based upon built assets and infrastructure, and a world in which stakeholders are enabled to participate at all stages though new tools and new modalities.

The description of capabilities must be structured in a manner to clearly identify the benefits and outcomes enabled by such capabilities and the supporting contributing capabilities necessary. A hierarchical structure may prove appropriate.

Part 2 will define the research, development and demonstration necessary to build, deploy and disseminate such capabilities. This definition should be hierarchical, in the sense of identifying overarching research themes, beneath which candidate programmes and projects are identified. Bidders should consider the potential timeliness and scope of demonstrators and case studies to disseminate the proposed research and encourage its adoption.

CDBB seeks explicit definition of the urgency and importance of the themes developed in both parts 1 and 2. This prioritisation need be done only at thematic or programme level because CDBB will need still to combine the component suggestions and priorities into a complete picture.

Part 3 will describe the primary centres of competence in the UK and significant international centres in appropriate domain, with links to the websites of the main protagonists. These centres of competence will reflect leading areas of research and institutions where there is a depth of capability to conduct fundamental and applied research and also to work with industry to embed the results of research into pragmatic capabilities. The descriptions will include a brief summary of the particular areas of focus. Part 3 will also identify key thought leaders and opinion formers.

It is intended that the reader of the 'research landscape' document will be able to quickly find the one or more centres where they can find a pool of competent researchers able to advise on problems in the domain and or able to undertake research to create new insights or to solve problems in the domain.

Deadline	Deliverables
12th November	An interim report providing the majority of the description of the Research Landscape plus the highlight and primary themes of the Capability needs and the Research Agenda
20th December	A final report detailing the Capabilities needed within the topic area, the prioritised Research themes and subthemes required to deliver the capabilities and the description of the Research Landscape in the topic area.

4. Scope of coverage

Because of the massive potential scope of this work we do not expect bidders to cover the whole scope; instead bidders are invited to address one or more of the topic areas listed below and detailed in Annex One.

This Tender is to cover the following topics; Tender 8: Integration and optimisation of services embedded in the built environment.

The following adjacent Tenders are also being tendered

- Tender 1: Stakeholders, Purpose-setting and decision-making
- Tender 2: Governance, social constructs and frameworks
- Tender 3: Context, external influences, drivers and disruptors
- Tender 4: Complex integrated systems
- Tender 5: Making the digitally enabled services and supply chain work
- Tender 6: Data and information
- Tender 7: The creation and through-life management of built assets and infrastructure
- Tender 9: Learning, adaptation and change

In addition to detailing the adjacent topic areas, Annex One also describes the generic topics to be covered in this Tender.

Bidders are asked to describe their proposed structure for deliverables. See Annex One for further detail.

Bidders may also wish to provide illustrative examples within their final reports of how the capabilities and research will affect different aspects of digital built Britain. Such illustrations may highlight unique aspects of some sectors, some parts of society or some issues that particular groups of people may face. Furthermore, such illustrations from one aspect may raise valuable questions or insights for another. Annex Two identifies example candidate 'perspectives' that bidders may choose to use.

5. Resources

Bidders will find potentially useful resources on the CDBB website including a description of the overall Research Landscape Framework and the outcomes from the April workshops which first explored these topics.

6. Intellectual Property

Intellectual property in the delivered reports will remain with CDBB and CDBB grants the originator a free non-exclusive license to the materials. CDBB reserves the right to publish all or part of the delivered reports and to edit materials as part of CDBB outputs.

7. Budgeting, assessment of bids and contracting

It is envisaged that each Tender will require a budget of about £50,000. Bids are to be fixed price and inclusive of VAT where applicable.

CDBB will not be providing further funding for attendance at workshops and seminars to discuss drafting of the integrated work.

Bids are invited from academic and commercial organisations. Collaborative team bids are welcome, especially if such teams can demonstrate a greater capacity to provide insights and to cover the scope required.

Each Tender will be assessed individually. Bidders should regard each Tender as a separate package.

CDBB reserves the right to select none, one or more bids within a topic area.

CDBB will assess the proposals, guided by opinion from internal and independent reviewers. We aim to inform successful bidders by 24th September 2018.

The criteria for assessing the proposals will include:

- Breadth and depth of coverage proposed: CDBB recognises that each Tender calls for considerable scope of coverage. Bidders are encouraged to describe how they will provide this coverage and the depth that they believe they can offer.

- Quality of insight: Forecasting capabilities needed and the requisite research programmes calls for insight, experience and exposure to the likely future issues. Bidders are asked to identify how they will deliver robust proposals of future capability and requisite research and how they will cover the research landscape.

- Team proposed: With short timescales and the requested scope, a skilled and experienced team will be essential.

- Likelihood of success: Bidders must propose a workplan which lays out activities and outcomes, identifies risks and plans for their management. The cogency and structure of the bid will be regarded as a possible indicator of the quality of the final deliverables.

- Value for money: Budgets will be viewed in light of the workplan and the proposed depth / scope of coverage. Bidders are invited to clarify as far as possible how the budget will be used and the effort to be deployed.

The Chancellor, Masters, and Scholars of the University of Cambridge will be the contracting authority and will contract with a single lead organisation for each successful bid. All the awarded projects will be contracted under a pro forma contract, without amendment (unless requested at proposal stage). The contract pro forma is available upon request from research@cdbb.cam.ac.uk.

8. Bid format

Bidders are asked, please, to submit a non-binding expression of intention to bid by 20th August 2018.

We envisage a covering section of about two pages to introduce the bid team and a technical section of no more than eight pages. Annexes are acceptable to cover descriptions of the experience of the team. See Annex Three for the mandatory cover sheet for bids.

The technical content of the bids should

- Demonstrate an understanding of the issues within the topics of the Tender, addressing both scope and depth
- Discuss how the bidder will identify and select relevant capabilities and research, alert to the risks of scope creep
- Describe the proposed approach, workplan, timescales and envisaged effort for constituent tasks
- Describe the structure that will be adopted for the reports
- Discuss project uncertainties and risks and their mitigation
- Justify the budget proposed

9. Further information and contacts

Please submit proposals and direct any questions in an email to research@cdbb.cam.ac.uk.

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Annex One: Detailed description of Tender
Tender 8: Integration and optimisation of services embedded in the built environment

1.1 INTRODUCTION

This annex describes the Tender for which bids are sought. It begins with a general introduction to the topic areas followed by more detailed descriptions of the scope of coverage of this particular Tender.

Bidders are asked to cover the whole topic within the Tender.

Bidders must consider, for the topic area within this Tender, three other aspects:

- The though-life implications and aspects – see the figure below

- The implications of different spatial scales, from within a building to country-wide
- The implications of assets with lives which could (and do) exceed a century

1.2 BRIEF DESCRIPTION OF TENDERS AND TOPICS

The Tenders and topics relate to the framework which CDBB is currently using to structure calls for research and will probably use to structure the final research agenda and capability landscape document. This framework may evolve during the course of the work, but the definition within this Annex forms the basis for the tender.

An introduction to the framework itself can be found on the CDBB website.

1.2.1 STAKEHOLDERS, PURPOSE-SETTING AND DECISION-MAKING

This topic covers the capabilities needed, in an increasingly digital world as services and built assets are increasingly integrated, for the people and stakeholders of the UK to competently decide what they would like to do with their built environment and the services based in the built environment, and how they wish to prioritise, make trade-offs and decide about the purpose, direction, priorities and target outcomes, through-life and over the life of the assets and services.

It must cover the processes and tools by which the full set of stakeholders are identified, (those excluded /disadvantaged as well as those who benefit), and how they discern, negotiate, specify, extract and monitor value from services and the underlying assets, through-life.

The emphasis must always be on the ways that digitalisation and integration will affect this area and how new technologies will interact with stakeholders, their behaviours, processes and tools in this complex socio-technical world. GovTech as a general domain is in scope to the extent that is does or will affect digital built Britain.

1.2.2 GOVERNANCE, SOCIAL CONSTRUCTS AND FRAMEWORKS

This topic covers the capabilities needed to provide and evolve general constructs and frameworks within which digital built Britain can be governed and managed. Its scope is the full range of sectors involved in creation and delivery of built assets, infrastructure and services, plus the consequential impact on the natural environment and the social fabric of Britain, through-life and throughout the creation of the built environment and the provision of services and benefits to stakeholders.

This will cover topics such as “the rules of the wider social and economic processes” within the political economy which give rise to policy, law, regulation, standards, business models, and contractual structures which condition the way digital built Britain will unfold.

GovTech as a general domain is in scope to the extent that is does or will affect digital built Britain.

This topic interfaces with “Stakeholders, Purpose-setting and Decision Making” and with “Making the digitalised service and supply chain work”. “Stakeholders, Purpose-setting and Decision Making” and “Making the digitalised service and supply chain work” address the matters of specific people and organisations working in particular circumstances, whereas this topic addresses the general contexts that apply to all working within digital built Britain.

1.2.3 CONTEXT, EXTERNAL INFLUENCES, DRIVERS AND DISRUPTORS

This topic addresses the capabilities needed to understand and predict contextual trends, drivers and disruptors and their interplay with digital built Britain, especially as digitalisation and integration increases. Generic studies of trends and drivers are out of scope; of interest here is the matter of specifically how their interaction is to be predicted and managed in the built environment and the embedded services and how digitalisation will impacts such prediction and management.

1.2.4 COMPLEX INTEGRATED SYSTEMS

This topic will explore the capabilities needed by the UK to understand the behaviour of Complex Integrated Systems (such as transport, power, communications, water supply etc.) to predict and manage their behaviour, especially as the complexity and integration of digital built Britain increases.

Topics will include the emergent and predicted or designed behaviours and their causes within complex systems of integrated built assets, infrastructure and services, encompassing the assets and systems, the data and information and the organisations themselves.

Attention should be focused on the specifics of digital built Britain, on integration between built assets and between services and assets, including system and organisation interactions associated with the built environment and economic and social infrastructure, encompassing the assets and systems, the data and information and the organisations themselves.

1.2.5 MAKING THE DIGITALLY ENABLED SERVICE AND SUPPLY CHAIN WORK

This topic explores the capabilities needed by government, by those involved in the specification, design and delivery of built assets and across a portfolio of services, through-life, for businesses and citizens, and the capabilities needed by government, business and citizens to best derive value.

The operation of digital built Britain will take place within the social construct and in pursuit of agreed purposes. This area considers how such operations will be managed and enabled within specific supply chains, how organisations will work together, how services will interact with the built environment and how users will make best use of the value offered. The domain must be considered through-life across the life spans of long-lived assets and services.

It will consider the capabilities needed to use operational rules (explicit and tacit), processes, tools and interactions to deliver and manage built assets which in turn support the delivery and management of services which add value, used and enjoyed by government, industry, society and people, especially as the focus shifts from 'design and build' to 'operate' and to 'integrate'.

1.2.6 DATA AND INFORMATION

This topic will explore the capabilities enabled by new technologies, tools and approaches emerging from data and information management, to acquire, create and manage the data in forms that allow secure interoperability and integration, then allow analysis and interpretation to create insights and support design of assets and services to derive value across organisations and through life.

Social aspects of data should also be considered including, for example embedded bias, the acceptability of data collection in different places, control, and accessibility / usability.

This topic needs also to consider the infrastructure to support the management of data and information through the lifecycle of services and assets, especially as integration between systems and organisations and between services and users increases.

Looking through-life the topic must address how data and information characteristics and the behaviours triggered and enabled will change as digital built Britain moves from 'deliver' to 'operate' and so to 'integrate', across stakeholders and over long timescales.

1.2.7 THE CREATION AND THROUGH-LIFE MANAGEMENT OF BUILT ASSETS AND INFRASTRUCTURE

This topic will explore the capabilities needed by the UK to best design, build, manage and maintain the core built assets through-life, especially as philosophies from product-oriented and manufacturing industries are brought to bear in an increasingly digitalised and integrated digital built Britain. It will also consider the issues associated with legacy assets and their management.

In all cases the focus will be on the data-rich aspects and the contribution of digitalisation and new enabled capabilities and technologies[1], considered across different spatial and temporal scales.

1.2.8 INTEGRATION AND OPTIMISATION OF SERVICES EMBEDDED IN THE BUILT ENVIRONMENT

This topic will explore the capabilities to specify, procure, design, deliver and manage services based on and embedded in the built environment to optimise effectiveness, efficiency and productivity for their stakeholders making best use of data and information through-life and across assets and infrastructure. The implications of continuing integration should be explored.

1.2.9 LEARNING, ADAPTATION AND CHANGE

This topic addresses the capabilities needed to implement the changes necessary to deliver and benefit from digital built Britain effectively, recognising the increasing digitisation and increasing integration of services and assets/infrastructure. This will involve an ever-wider range of stakeholders across and along extended value networks and ecosystems, entailing consideration of ever-wider ranges of competence and attitudes. The work in this topic must be focused on the digital agenda and by the implications of flows of information forwards and backwards through the envisaged digital built Britain as the philosophy migrates from today towards integration and long-term stakeholder outcomes.

General change management topics are out of scope; attention should be focused specifically on the capabilities and research relevant to digitalisation and integration around built assets and the services they support for the benefit of the UK.

1.3 DETAILS OF THE CONTENT OF THIS TENDER AND ITS COMPONENT TOPICS

INTEGRATION AND OPTIMISATION OF SERVICES EMBEDDED IN THE BUILT ENVIRONMENT

This topic will explore the capabilities to specify, procure, design, deliver and manage services based on and embedded in the built environment to optimise effectiveness, efficiency and productivity for their stakeholders making best use of data and information through-life and across assets and infrastructure. The implications of continuing integration should be explored.

It may prove helpful to draw the distinction between services enshrined in an asset (e.g. “transport” from a road) and services operating within the context of an asset (e.g. health services within a hospital). Distinguish also between services derived from economic infrastructure and social infrastructure.

Note the adjacency of subject matter in the other topics, especially “Making the digitally enabled services and supply chain work”.

[1] Social aspects will be covered in the topic areas “Making the digitally enables service and supply chain work” and “Learning adaptation and change”

Candidate topics and elements should include, inter alia

- Understanding and managing service ecosystems in the context of built assets and infrastructure
    - Data-rich services in the context of the built environment;
    - Service ecosystems
    - User interfaces / touch points
    - User understanding of service provision, interaction and participation in the service process in a digital and integrated built Britain
    - Managing interfaces with cyber-systems (short lifecycles) and built assets (long lifecycles)
    - Managing security across and between systems, organisations and people
    - Service specification, process design, delivery and management in digital built Britain

- Frameworks for enhanced service architectures and service design integration
    - Key requirements for standardisation - especially between services and at the interfaces to built assets and their design, build and maintenance
    - Potential and opportunity for a services architecture to enable consistent mapping of activities, standards and data between service providers, specifiers and owners/operators of built assets
    - Development of a service lifecycle and value chain architectural framework with a focus on public services, from which the standards appropriate for that service can be associated or developed.
    - Information and tools needs to manage and exploit services in a data-rich built environment

- Value creation, delivery and extraction
    - Service integration for optimised performance;
    - Measuring performance and setting KPIs
        - Real time and closed loop service measurement
    - Service performance management with real-time data from users and built assets
    - Business models as the processes of 'operate' and 'integrate' become more important

- Integration and interfaces
    - Integration of service-service, service-asset, and asset-asset via processes, systems and organisation interfaces
    - Interplay and interface management between services and assets / infrastructure at different levels of integration
    - Socio-technical perspectives on the service / built asset / user interactions

- Responsibility and liability
    - Regulation in services based on infrastructure assets
    - The social acceptability / ethics / regulation of tracking users to optimise services;
    - Service resilience under data/information failure and degradation

- Service resilience and operation under failure modes (especially when injected by aspects of the built environment)
- Security of people, assets and data

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Annex Two: Description of Perspectives

Bidders may choose to illustrate their exploration of Capabilities and requisite Research for digital built Britain by highlighting particular perspectives and the use cases that arise. Specific research competence areas where perspectives are applied to digital built Britain will also be a useful part of the Landscape. Below are example perspectives that might elicit particular insights about future capability and research needs.

Perspectives:

- The aspects of social diversity (race, ethnicity, religious beliefs, socioeconomic status, language, geographical origin, gender and/or sexual orientation) and so to explore the insights and capabilities that will facilitate equality and equity in digital built Britain.

- Community and social cohesion, and the interactions with increasingly digitalised and integrated services and built assets and infrastructure (both economic and social infrastructure).

- Aspects such as i) Health and Well-being, ii) Education, iii) Work and Employment, iv) Mobility, v) Crime and terrorism and vi) legal and judicial aspects of society's and people's interactions with the services and assets of digital built Britain.

- Economic infrastructure perspectives such as i) Water and sanitation, ii) Energy and Power, iii) Communications, iv) Mobility and transport (of people and goods).

- Social infrastructure perspectives such as i) Hospitals, ii) Schools, iii) Places of worship, iv) Arts and culture, v) Sports, and others.

- Commerce, manufacturing, industry, markets and trade and the ways in which the digitalisation and integration of services and assets envisaged within digital built Britain might affect and improve performance.

- Aspects of "Place" (urban, rural, coastal, inland), and the role of digital and enhanced geo-spatial location, and way-finding technologies and their adoption by different stakeholders and users.

- Aspects of sustainability and environmental impact improvement and the insights and capabilities to address these in digital built Britain.

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Annex Three: Mandatory Cover Sheet for Bids

Response to call for proposals: Defining the Research Agenda and Research Landscape for digital built Britain		
Lead organisation name		
Lead technical contact's name		
Lead technical contact	**Email:**	**Telephone:**
Lead technical contact address		
Lead commercial contact name and contact details		

Please complete the following table. Bidders must explicitly identify the Tenders for which bids are offered and the Tenders for which no bid is offered.

Tender description	Bid (Yes/No)	Fixed price of Tender (including VAT)
Tender 1: Stakeholders, Purpose-setting and decision-making		
Tender 2: Governance, social constructs and frameworks		
Tender 3: Context, external influences, drivers and disruptors		
Tender 4: Complex integrated systems		
Tender 5: Making the digitally enabled services and supply chain work		
Tender 6: Data and information		
Tender 7: The creation and through-life management of built assets and infrastructure		
Tender 8: Integration and optimisation of services embedded in the built environment		
Tender 9: Learning, adaptation and change		