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UK COLLABORATORIUM
FOR RESEARCH ON
INFRASTRUCTURE & CITIES
Inspired infrastructure
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Evidence Base and Portfolio of Tools and Techniques Underpinning UKCRIC's Research Capability in Cities

The investment case for UKCRIC's national facilities – the laboratories, urban observatories and modelling and simulation facilities – was created between 2013 and 2015, and was founded on an extensive portfolio of collaborative research combining many of those who would form the core UKCRIC membership. While £138m, a sum that is being matched by industry and the institutions hosting the facilities, was announced for the new UKCRIC facilities in 2015, many of the facilities are currently being constructed and the full capability will only be in place around the end of 2020.

Nevertheless, the foundations are strengthening via current grants and this has led to a capability and a capacity to support those working in infrastructure and urban systems. Importantly, the foundations cover a range of temporal scales from the immediate (e.g., current problem diagnosis, an understanding of current systems and performance) and the near future (solutions that would work today and into the future based on predictions and projections) to the far future (solutions that address both today's challenges and those revealed by far-future scenarios). Similarly, they cover tools and techniques that address generic issues, at a range of spatial scales from the global to the local, as well as specific contexts.

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Useful acronyms:

BER – Birmingham Eastside Research, esr.bham.ac.uk
DAFNI – Data and Analytics Facility for National Infrastructure, dafni.ac.uk
DRC – Designing Resilient Cities, Lombardi, *et al.* (2012), designingresilientcities.co.uk
FFoC – Foresight Future of Cities project, GoFS (2016a,b), gov.uk/government/collections/future-of-cities
iBUILD & ICIF – Infrastructure interdependencies & business models consortia, research.ncl.ac.uk/ibuild, ucl.ac.uk/steapp/research/projects/icif
ITRC – Infrastructure Transitions Research Consortium, itrc.org.uk

LC – Liveable Cities, liveablecities.org.uk linking to LC's tools, case studies and Little Books
MISTRAL – Multi-Scale Infrastructure Systems Analytics, itrc.org.uk
PCFUL – University of Birmingham Policy Commission on Future Urban Living, Rogers, *et al.* (2014), birmingham.ac.uk/research/impact/policy-commissions/future-urban-living
SUE – Sustainable Urban Environment programmes, epsrc.ukri.org/newsevents/pubs/suearcctreview
ULB – Urban Living Birmingham, tinyurl.com/UrbanLivingBirmingham
V2020 – VivaCity2020, Cooper, *et al.* (2009), vivacity2020.co.uk

To address a specific problem in a city, assemble an appropriately-broad, multi-disciplinary, multi-sectoral group of potentially interested parties who are able to represent the views of all stakeholders affected by the problem and its potential solutions, and provide each with the same opportunity to contribute. There are several approaches that are reported in the literature to support dialogue, build consensus, and so on.

[BER](#), [V2020](#), [DRC](#), [LC](#), [FULPC](#), [FFoC](#), many [SUE projects](#) and the sustainability literature.
[Rogers et al. \(2014\)](#)
[GoFS \(2016b\)](#)
[Wilson et al. \(2019\)](#)

Understand deeply the aspirations of the city and its citizens, noting that the city has several roles to play (e.g. governor, regulator, service provider), and the context in which the city exists (including both its history as well as its current context).

Aspirational Futures Tool.

[FFoC](#), [LC](#), [FULPC](#), and the sustainability literature.
[Hunt & Rogers \(2015\)](#)
[Rogers \(2018\)](#)
[Rogers & Hunt \(2019\)](#)

Diagnose fully the problems, noting the DRC experience that engineers focus upon solutions to problems while social scientists focus upon problem exploration, and other disciplines lie within this spectrum – a balance is required.

Urban Diagnostics Tool.

[ULB](#), [DRC](#), [LC](#), and the sustainability literature.
[Leach, et al. \(2019a\)](#)

Establish the baseline performance of the city in terms of its sustainability, resilience and liveability. It is helpful to make explicit the components of the city and infrastructure systems related to the problem and those that will be impacted by potential interventions by mapping them and establishing the dependencies and interdependencies between these systems.

Systems Mapping Techniques, CityLIFE Tool.

[DRC](#), [LC](#), [iBUILD](#), [ULB](#).
[Bouch & Rogers \(2017\)](#)
[Boyko, et al., \(2012\)](#)
[Rogers et al. \(2012a\)](#)
[Leach et al. \(2016, 2019b\)](#)
[Leach, et al., \(2017a, 2017b\)](#)
[Guerreiro et al. \(2018\)](#)
[Pregolato et al. \(2017\)](#)
[Heidrich et al. \(2013\)](#)

Apply ingenuity to create solutions to the problem, yielding a number of alternatives from which to choose the most appropriate. This is what engineers do, though necessarily in collaboration with problem owners and all other urban professionals. Provide intellectual leadership and global collaborations.

[Powell et al. \(2018\)](#)
[Caparros-Midwood et al. \(2017\)](#)
[Bai et al. \(2018\)](#)
[Rogers \(2018\)](#)

Assess the impact of the interventions on the city's urban and infrastructure systems using one of the many sustainability assessment frameworks, resilience frameworks and liveability frameworks. Iteration will be needed between the design of alternative solutions and impact assessment.

LC Liveability Framework (incorporating the City Assessment Methodology embodied in UKCityLIFE).

[BER](#), [V2020](#), [DRC](#), [SUE](#) and the literature. [LC tools, case studies and papers.](#)
[Leach, et al. \(2017a, 2017b\)](#)
[Leach et al. \(2019b\)](#)

Conduct a futures analysis to explore whether the interventions are vulnerable to future contextual change (resilient), i.e., they will continue to deliver their benefits and therefore the investment proves good into the long-term.

Designing Resilient Cities Tool.

[DRC](#), [LC](#).
[Lombardi, et al., \(2012\)](#)
[Rogers et al. \(2012b\)](#)

Simulate present and future need for infrastructure services and create infrastructure policies and plans to meet those needs. System-of-systems methodology that makes use of DAFNI's data, modelling, simulation and visualisation facilities.

ITRC and MISTRAL suite of NISMOD Tools. DAFNI.

[ITRC](#), [MISTRAL](#).
[Hall et al. \(2016, 2017\)](#)
[Ives et al. \(2018\)](#)
[Usher & Hall \(2017\)](#)

Make the case for change – establish a compelling 'business case' for the proposed intervention, based on the primary purpose and sustainability, resilience and liveability considerations.

LC Liveability Framework.

[BER](#), [V2020](#), [DRC](#), [LC](#), [SUE](#) literature.
[Leach, et al. \(2017a, 2017b\)](#)
[Leach et al. \(2019b\)](#)

Develop a suite of alternative 'business models' that capture the different forms of value that might be generated by the intervention, set against the investment required to implement it – identify all potential positive and negative consequences (e.g. cost) of the intervention. System maps show interdependencies between the amended system and other urban systems.

Systems Mapping Techniques, iBUILD Tools.

Much research on identification of economic, social and environmental value. [iBUILD](#), [ICIF](#).
[iBUILD \(2015, 2018\)](#)
[Bouch & Rogers \(2017\)](#)
[Bryson et al. \(2018\)](#)
[Rogers \(2018\)](#)
[Varghese et al. \(2018\)](#)

Understand all of the dimensions of governance (formal and informal) relevant to the intervention and the context in which it is to be implemented, and engineer changes to all of these systems in order that the intervention can be implemented without impediment and the business models operate successfully.

Little Book of Governance in the City.

[DRC](#), [LC](#). Covered explicitly in the [LCM](#).
[Honeybone, et al. \(2018\)](#)
[Rogers \(2018\)](#)
[Leach et al. \(2015, 2019b\)](#)

Trial infrastructure and urban systems interventions in UKCRIC's Laboratories – a complementary suite of 11 facilities covering surface and subsurface infrastructure systems, structures and foundations, sensors, materials, water and wastewater systems.

[UKCRIC-PLEXUS](#) is a pump-priming project that is paving the way for such collaborations.

Trial infrastructure and urban systems interventions in UKCRIC's Urban Observatories – a complementary suite of six observatories in Newcastle, Sheffield, Bristol, Birmingham, Manchester and Cranfield.

[UKCRIC-CORONA](#) is a pump-priming project that is paving the way for such collaborations.
[Ranjan et al. \(2017, 2018\)](#)
[Souza et al. \(2018\)](#)
[Creutzig et al. \(2019\)](#)

Trial infrastructure and urban systems interventions in UKCRIC's Modelling & Simulation Facilities – Data and Analytics Facility for National Infrastructure (DAFNI), hosted by the STFC, has world-leading capabilities for developing and running infrastructure and urban system models.

[DAFNI-N+](#) is a pump-priming project proposal that aims to pave the way for such collaborations.

Influence policy by drawing on research findings to help shape local and national government policy and make the case for the intervention to policy-makers.

Little Book of Governance in the City.

[FFoC](#), [FULPC](#), [LC](#).
[Honeybone, et al. \(2018\)](#)
[Rogers et al. \(2014\)](#)

Influence practice by supporting urban professionals to make more informed decisions – translating research findings to practice.

[V2020](#), [DRC](#), [LC tools and case studies.](#)
[Rogers \(2018\)](#)
[Leach et al. \(2019b\)](#)

The tools and case studies from Liveable Cities, available at [liveablecities.org.uk](#).

Inform and engage the public about the issues, and how they might be addressed.
The Liveable Cities Little Books, available at [liveablecities.org.uk](#).

Drawing on all above, particularly [LC](#), [ULB](#) and [Urban Observatories](#).

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