

Policy Brief

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The National Infrastructure Assessment – A Transformative Opportunity For UK Infrastructure



Key Findings

To realise its transformative potential the National Infrastructure Assessment (NIA) needs to be based on a forward looking, innovative and systemic approach. This includes:

- Adopting an infrastructure system-level process, aligned to a system-level vision with the purpose of defining infrastructure need not on a sector by sector basis, but more broadly at the system-level.
- Producing a systemic **vision** for infrastructure
- Wherever possible, framing infrastructure vision and need should be carried out in 'option-neutral' terms in order to enable (i) the identification of common needs that span multiple sectors, and (ii) the opportunity for innovative solutions to be considered
- Developing an additional set of forward looking, innovative, flexible and outcome-oriented indicators.

Policy Implications

- Achieving a truly holistic systemic view of national infrastructure requires collaboration of multiple private groups and government departments, as well as new type of infrastructure (i.e. new roads, railway, electricity generation and digital infrastructures). Each of which would present new requirements upon one another.
- A systemic approach to the National Infrastructure Assessment (NIA) would require extending the remit of the National Infrastructure Commission (NIC) to include social infrastructure, and not only economic infrastructure.

Changing the NIA alone will not be enough. An accompanying transition to an outcome based regulatory approach (as seen in the water sector) and a more joined-up approach to infrastructure governance are also needed.

- Adopting a cross-sectoral systemic approach to governance and regulation of infrastructure is necessary for facilitating systemic innovation.
- Developing portfolios of closely connected complementary projects creates more opportunities for a systemic approach to investment, rather than a series of projects framed in isolation. The portfolios should cut across sectors and each of those should have a strategic programme of development, providing a direction and pipeline of future work, and enabling synergistic outcomes.

INTRODUCTION

This policy brief is based on insights gained from research carried out within the International Centre for Infrastructure Futures (ICIF) project between 2013 and 2016. The brief responds to the UK government and industry agenda on creating a more strategic vision for UK infrastructure and introducing more coordination between different infrastructure institutions, projects and objectives. The NIC was set up in January 2016 to analyse the UK's long-term economic infrastructure needs, outline a strategic vision over a 30-year time horizon and set out recommendations for how identified needs should begin to be met, through the publication of a National Infrastructure Assessment once a parliament. This policy brief summarises the key points from the ICIF Response to the NIA: Consultation submitted on 5th August 2016.

The UK infrastructure is a complex interdependent system of systems, vulnerable to the emergence of System problems (e.g. challenges in resilience, carbon mitigation, flood management, climate change preparedness, sustainability, inclusivity). These problems emerge as a consequence of interdependent interaction between system components (including the political, social and economic context in which they are embedded), and are best managed collaboratively.

The objectives Government has set for the NIC will require the criteria against which infrastructure decisions are evaluated to be broadened. This will involve shifting from solely driving economic growth to include a focus on understanding and enabling desired outcomes, managing infrastructure as an interdependent system, and planning strategically infrastructure in the UK to:

- **foster long-term and sustainable economic growth across all regions of the UK**
- **improve the UK's international competitiveness**
- **improve the quality of life for those living in the UK**

This policy brief attempts to outline key steps in developing **an inclusive strategic vision for infrastructure** for the UK through the NIA. The NIA is a transformative opportunity:

- to guide strategic coordination of infrastructure interdependencies for economic and social gains, rather solely improving cross sector efficiencies
- to go beyond shorter-term pilot projects, ad-hoc experiments and lowest-hanging-fruit approaches to cross-sector interactions towards integrated infrastructure planning and policy (for services such as intelligent mobility and intelligent infrastructure)
- to tackle the existing limitations of governing infrastructure interdependencies, which do not fall within the remit of any one institution (such as a specific economic regulator) and whose impact will be limited by being placed within the domain of one economic regulator
- to strategically address system problems by identifying the

root causes and targeting action at the point in the system where it is most needed rather than addressing symptoms at the point they are observed.

A SYSTEMIC APPROACH BUILDING ON INTERDEPENDENCE

The NIA has the potential to deliver the greatest level of new insight operating strategically, developing a systemic vision for infrastructure, adopting system-level processes, and aiming to define infrastructure need not on a sector by sector basis but more broadly at the system-level. We propose placing the management of system level properties at the heart of the NIA methodology.

Infrastructure interdependence is a substantially broader concept than mere dependence on the immediate inputs that infrastructure requires to function. Infrastructure is also interdependent with the dynamic context (social, political, economic, financial, legal, environmental, regulatory, local, global, spatial and temporal) in which it is operates. Therefore, interdependence is: an opportunity to improve system performance. An intentional change to any of the above contextual factors can be used as a strategy to improve system performance (i.e. address a performance gap).

Conversely, interdependence is a risk to system performance because a change to any of the above contextual factors could have unintended consequences for other elements of performance elsewhere in the system. Furthermore, system properties such as cascade failure risk, resilience and flood risk (which are most effectively managed at the system level) emerge - often unforeseen - as a consequence of interdependence. Governing interdependent systems requires a systemic approach, and not just an integrative method or model.

Historically, the focus of infrastructure interdependency has been on resilience and the risk of cascade failures. This has led to a narrow conceptualisation of infrastructure interdependency in terms of spatial proximity and/or functional reliance. The benefit of a forward looking mechanism such as the NIA considering infrastructure interdependencies is that it can go beyond looking for opportunities for synchronising economic, policy and regulation activities across individual sectors, and create an understanding of how integration between sectors can take place in a way that can help meet policy objectives.

Framing need against traditional and static sectors can impede the ability to assess the full impacts of future challenges. How expectations and infrastructure purpose are framed will directly shape the actual outcomes delivered. Furthermore, vital interdependencies that cut across sectors

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might be inadvertently hidden by assuming they are not significant to the analysis. Developing a holistic systemic view of national infrastructure is particularly important when assessing fundamental societal needs as it is arguably not possible to do this adequately from a segmented model. Total societal need is not an aggregate of the needs of each sector. There is a difference between saying (i) the motorway is reaching capacity we need extra lanes, and (ii) a 21st Century economy needs to enable peripatetic workers. The first is framed in such a way as to bound the solution, it places the focus and control of resolution into one traditional sector. The second, while arguably more vague, addresses a fundamental need. It suggests a desired outcome that supports a higher-level objective.

Developing a systemic view of national infrastructure will help focus on delivering outcomes valued by society. Understanding future infrastructure needs must go beyond a simple extrapolation of current demands. Evaluating the drivers of infrastructure need should therefore also reflect on desired outcomes and how they may change in the future.

The constraints of path dependency, resource allocation and problem-solving can create difficulties in trying to approach decisions in complex infrastructure systems from traditional sector-based approaches. This is further compounded by the artificial separation between social, economic and environmental infrastructure in the NIA and NIC's remit.

A SYSTEMIC NIA METHODOLOGY

We proposed developing a systemic toolkit comprising a set of transparent, structured, interconnected and flexible methodologies for (i) Systemic Infrastructure Visioning, (ii) Performance and Needs Analysis, (iii) Option Identification, and (iv) Option Selection.”

1. Systemic Infrastructure Visioning

State the outcomes that society expects infrastructure to contribute toward achieving. Frame outcomes at the system-level in neutral terms independent of specific solutions, sectors or technologies

2. Analysis system performance to identify infrastructure

Evaluate strategic system performance with reference to the outcomes the infrastructure is expected to enable. Identify 'performance gaps', where actual falls below expected, define infrastructure need using these gaps. NB Frame need at the system-level in neutral terms independent of specific solutions, sectors or technologies

3. Option identification

Develop a process to identify options (possible solutions). Open this process to other sectors and non-traditional providers by publishing a 10-30 year pipeline of neutral infrastructure needs (independent of specific solutions,

sectors or technologies) to signal the infrastructure problems that need innovative solutions.

Significantly, options identified through this process do not have to be infrastructure, they can be an intentional change to any element of the interdependent context in which infrastructure exists.

4. Option selection

Define the selection criteria that will be used to evaluate the relative merits of different options. Two types of selection criteria should be defined:

- 'outcome-linked' criteria - directly derived from the desired outcomes and defined on a need-by-need basis
- 'systemic criteria' linked to fundamental systemic properties that must be collectively managed to minimise risk of emergent system problems

Develop a clearly defined and transparent process to apply selection criteria.

Examples of possible criteria for evaluation include expected impact on overall system resilience, carbon footprint, lifecycle cost (TOTEX), is it fit for purpose given the specific local context, does the solution address the root cause of the need or merely a symptom

5. Review findings from steps 1 -4 at every NIA

NIA PERFORMANCE INDICATORS SHOULD

Take account of the dynamics and interactive complexity of systems, accounting for the whole infrastructure system, lifecycle and the wider context.

- Be outcome oriented, i.e, aligned with a shared vision for national infrastructure by government, industry and society
- Be transparent and forward looking to enable innovation
- Reveal the performance gaps (where actual performance is below expected performance defined by outcomes)
- Be easy to interpret and flexible (i.e. not overly constrained in practice by regulatory time horizons)
- Be connected to adaptation and complement existing industry indicators
- Be presented in a way which prevents biases on how the data is collected, treated, aggregated and normalised, from preventing the creation of perverse incentives
- Be innovative and related to public expectations and needs
- Allow for intelligent design, identify opportunities, account for different audiences and communicate uncertainty

THE NIA AND NIC SPECIFIC STUDIES SHOULD BE

Systemic in scope - examine the system as a whole and be mindful of the need to address system problems

Purposeful - aligned to a coherent strategic vision of the services and outcomes infrastructure can be expected to provide and facilitate

Evidence based and traceable - the rationale, assumptions decision-making process should be recorded for future reference.

Collaborative - if input is sought through consultations, the methodological compatibility of the consultation must be explicit.

Reflexive and flexible - the process itself should not be so fixed or rigid to prevent improvement or adaptation to meet changing needs even over short time-horizons. The principle of regular review is essential to the validity of the NIA. Every NIA should begin by reviewing the previous NIA, and assessing whether previous NIA recommendations remain 'fit for purpose' in the new context.

Option-Neutral - The terms of reference for the NIA, and need assessment findings should be framed independent of specific options that might be used to fulfil need.

Outward Looking - The NIA should actively seek to learn from related disciplines and international best practice. Lessons learnt by the Committee on Climate Change on risk assessment and the Adaptation Sub-Committee, for example are applicable to the design of NIA methodology.

FURTHER INFORMATION

ICIF

The International Centre for Infrastructure Futures (ICIF) is an interdisciplinary, practice-orientated research centre conducting fundamental research on infrastructure interdependency, policy, innovation, regulation, management and financing. ICIF was created to identify what combinations of actors, regulations and technologies can provide for the effective planning, design, investment, construction, delivery and use of infrastructure services that underpin economic activity and improve citizens' quality of life within modern societies. ICIF brings together leading academics from six UK universities: University College London, Cranfield University and the universities of Bristol, Brighton, Sussex and Southampton. It is funded by the Engineering and Physical Sciences Research Council and the Economic and Social Research Council (Grant reference: EP/K012347/1)

SPRU

With 50 years of experience, SPRU is internationally recognised as a leading centre of interdisciplinary research on science, technology and innovation policy. Our research addresses pressing global policy agendas, and we are driven by a desire to tackle real-world questions, whilst also contributing to a deeper theoretical understanding of how innovation is shaping today's world. Our group of academic researchers working on infrastructure issues use SPRU's expertise in innovation and policy to understand the governance and development of critical infrastructure sectors and services, internationally and in the UK.

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