Purposeful and Systemic Infrastructure Governance – a pre-requisite for the creation of sustainable and inclusive cities (socieites)?

Short Abstract

Written in response to the question '*What governance innovations are needed to enable infrastructure development to contribute to the creation of sustainable and inclusive cities?'* This paper outlines important characteristics of infrastructure, briefly explores what is meant by the terms 'sustainable infrastructure' and 'inclusive infrastructure' and in this context proposes the development of Purposeful and Systemic Infrastructure Governance to support delivery of the above objective. Explanation is given of why these approaches to infrastructure governance are needed. More broadly the need for, and potential value of Purposeful Infrastructure Governance and Systemic Infrastructure Governance as an approach to infrastructure decision making focused on framing infrastructure decisions at the systems level, and involving citizens and infrastructure practitioners in development of a shared, structured and systemic vision of the outcomes society expects infrastructure to enable.

Introduction

During previous research[1][2], I experienced firsthand the difficulty of reaching consensus on questions of governance, infrastructure provision and environmental management, when those involved in the process do not have an opportunity to build self-awareness of the assumptions that inform their perspective and priorities, and take time to understand how and why these might differ from the equally legitimate perspectives of other stakeholders affected by the question. Therefore, before addressing the conference question '*What governance innovations are needed to enable infrastructure development that contributes to the creation of sustainable and inclusive cities?'* This paper explores in greater depth my personal understanding of the key words 'infrastructure', 'sustainable', 'inclusive' and 'cities'. Before aiming to define characteristics of both sustainable infrastructure and inclusive infrastructure, outlining the need for, and focus of, Purposeful and Systemic infrastructure governance.

Cities

I have chosen to frame the thinking in this paper in terms of societies rather than cities, because many infrastructure systems serve multiple urban areas, and many cities depend on fundamental inputs from outside the city boundary.

Infrastructure

It is difficult to reach consensus on a definition of infrastructure, and arguably unnecessary to do so. However, it is possible to state important characteristics that must be considered when making any decision regarding infrastructure. These are:

[1] Dolan, T., Parsons, D. J., Howsam, P., Whelan, M. J., & Varga, L. (2014). Identifying Adaptation Options and Constraints: The Role of Agronomist Knowledge in Catchment Management Strategy. Water Resources Management, 28 (2), 511-526. doi:10.1007/s11269-013-0498-6

[2] Dolan, T., Howsam, P., Parsons, D. J., & Whelan, M. J. (2014). Impact of European Water Framework Directive Article 7 on Drinking Water Directive compliance for pesticides: challenges of a prevention-led approach. Water Policy, 16 (2), 280. doi:10.2166/wp.2013.166

(i) *The purpose of infrastructure is to enable desired outcomes (including economic growth)*

(ii) *Infrastructure is a complex interdependent system of systems*

(iii) *The context (social, political, economic, financial, legal, environmental, regulatory, local, global, spatial and temporal) in which any infrastructure is embedded is of profound importance.* Source[3]

As a consequence of characteristic (i), infrastructure governance must be 'purposeful'. In recognition of characteristics (ii) and (iii), infrastructure governance must be 'systemic'.

Sustainable

The Bruntland Commission[4] defined sustainable development as *'development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'*

When applying this to infrastructure, I interpret sustainable as *'a requirement for the 'preservation of a flow of desired outcomes through time'.* Using this interpretation of sustainability, the specific infrastructure that delivers the desired outcome[5] is immaterial; the emphasis of sustainable is to preserve the ability to deliver expected benefits, rather than any specific mode of delivery of those benefits. This is consistent with literature on both ecological and strategic resilience and strategic resilience[6][7][8]

Therefore, a sustainable infrastructure is one that delivers the desired outcomes we want today, without impeding the ability to deliver the desired outcomes we require in the future. System properties (e.g system resilience and cascade failure risk, climate change adaptation and mitigation), which can only be managed systemically, have the potential to impede this ability. Therefore, sustainable infrastructure can only be achieved by taking a systemic approach to the management of system-level challenges. It follows sustainable infrastructure requires purposeful and systemic governance.

Inclusive

The Oxford[9] and Cambridge[10]' English Dictionaries, provide a number of definitions for inclusive. The two definitions most relevant in this context are

> **'***An inclusive group or organization tries to include many different types of people and treat them all fairly and equally'*
>
> *'Not excluding any section of society or any party involved in something'*

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[3] Dolan, T., Walsh, C. L., Bouch, C. and Carhart, N. (In press 2016) Infrastructure Strategic Performance Indicators – A New Approach?

[4] Our Common Future (1987 Brundtland Report) http://www.cfr.org/economic-development/report-world-commission-environment-development-our-common-future-brundtland-report/p26349

[5] Desired outcome(s) is defined as *''forward-looking statement (or set of statements) of what it is that infrastructure is expected to enable''.* in ref 2

[6] Holling, C.S., 1973. Resilience and Stability of Ecological Systems. Annual Review of Ecology and Systematics 4, 1–23. doi:10.1146/annurev.es.04.110173.000245

[7] Hamel, G., Valikangas, L., 2003. The quest for resilience. Harv. Bus. Rev. 81, 52.

[8] ICIF White Paper - Infrastructure Resilience: a multi-disciplinary perspective www.icif.ac.uk

[9] http://www.oxforddictionaries.com

[10] http://dictionary.cambridge.org/

An inclusive approach to infrastructure provision is therefore, one that includes all sections of society in defining the desired outcomes we expect infrastructure provision to play a role in enabling and aspires to provide services and products fairly and equally to all citizens.[11] Ideally an inclusive approach also evaluates performance and infrastructure need relative to these outcomes[12], and involves all citizens in a transparent process to identify infrastructure options, and evaluate these against clearly defined criteria derived from desired outcomes, and other fundamental characteristics (e.g system resilience and cascade failure risk, climate change adaptation and mitigation) infrastructure must embody to be sustainable. It follows inclusive infrastructure requires purposeful and systemic governance.

Introducing Purposeful and Systemic Governance

Purposeful Infrastructure Governance

At the most fundamental level, the purpose of infrastructure is to enable the desired outcomes of valued by society[13]. Purposeful Infrastructure Governance is an approach in which all governance structures are clearly aligned with enabling a strategic vision. Particular focus is given to:

(i) identifying and structuring the desired outcomes that Government, Industry and Society expect infrastructure to play a role in enabling
(ii) Structuring and conceptual mapping these desired outcomes through cross-sectoral engagement,
(iii)establishing a shared strategic infrastructure vision, that comprises these desired outcomes
(iv) using the vision as a framework with which to align, and against which to justify all infrastructure decision making.

Systemic Infrastructure Governance

Infrastructure systems cannot be sustainable unless system properties (e.g system resilience and cascade failure risk, climate change adaptation and mitigation) are managed effectively. Therefore a systemic approach to infrastructure and engineering governance and all other elements of infrastructure decision-making is essential. Systemic Infrastructure Governance - is an approach that recognises because infrastructure is interdependent across sectors and with the context in which it is embedded, all governance structures must primarily be framed at, and wherever possible promote decision-making at the whole system level. Systemic Infrastructure Governance complements purposeful infrastructure governance by ensuring that :

(i) desired outcomes, and therefore the strategic vision, are framed at the system level and in 'option-neutral terms' independent of specific infrastructure sectors, solutions or technologies.
(ii) infrastructure need is assessed by evaluating the gap between expected system performance and actual system performance[14]
(iii) a clearly defined, transparent, collaborative, inclusive process to identify and evaluate possible options to address infrastructure need is established

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[11] ICIF NIA Consultation Response available at www.icif.ac.uk
[12] See ref 2
[13] See ref 2
[14] John Beckford Consulting Ltd, Infrastructure as a System of Systems
http://beckfordconsulting.com/publications/

(iv) all major infrastructure decisions are made with reference to the impact they will have on the performance and resilience of the system in which they are embedded
(v) the extent to which infrastructure performance is interdependent with regulatory frameworks, governance structures, legal frameworks, citizens expectations and behaviour, societal structures, financial markets, technological trends, business models, finance, all levels of upstream and downstream supply chain and natural processes is explicitly considered when both defining need and identifying possible options to address need.

Strengthening the Case for Purposeful and Systemic Governance

Infrastructure (enabled by the PESTLE context in which it is embedded) provides the foundations of our modern societies (Figure 1)[15]. However the relationship between infrastructure, and the type of society (facilities and services) it enables is two-way (Figure 2)[16] and includes society. From this perspective the purpose of infrastructure is to enable the desired outcomes society collectively expects (Figure 3). Logically, a clear and shared articulation of these desired outcomes is, therefore, a pre-requisite to purposeful infrastructure decision making of any kind (performance measurement, needs assessment, project selection). However, rarely if ever are citizens engaged in open and collaborative discourse to identify and structure their expectations (desired outcomes) (red arrow in Figure 3.) Purposeful and Systemic Infrastructure Governance (as introduced above) aims to address this.

Layers	Examples of functions
Community services	Education, healthcare, safety and security, tourism, etc.
Community facilities (Contribution)	Residences, commercial buildings, office buildings, factories, hospitals, schools, recreation facilities, etc.
Community infrastructures	Energy, water, transportation, waste, ICT, etc.
NOTE "Water" includes sewage and wastewater as well as drinking water.	

Figure 1. Infrastructure as an Enabler of Facilities and Services (source: ISO on Smart Community Infrastructure)

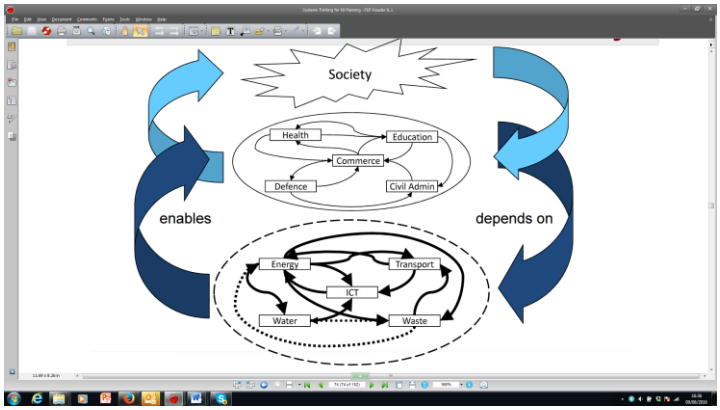

Figure 2. A Two Way Relationship Society as Emergent Property from Infrastructure Provision (Source: System Thinking for National Infrastructure Planning)

[15] PD ISO/TR 37150:2014 http://www.iso.org/iso/catalogue_detail?csnumber=62564
[16] John Beckford Consulting Ltd, System Thinking for National Infrastructure Planning http://beckfordconsulting.com/publications/

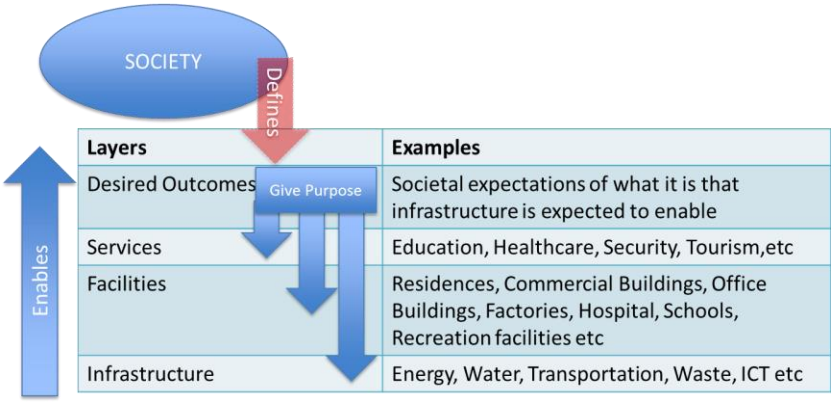

Figure 3. Society Dictates Expectation of Infrastructure (adapted from Fig 1 and 2)

At present no strategic (let alone systemic) vision for infrastructure exists in the UK[17], or in many other countries. The NIC[1819] model adopted in the UK, particular through the National Infrastructure Assessment (NIA) is a unique opportunity[20], and if successful the model will be adopted in many countries across the globe. At present the UK government have restricted the focus of the NIA solely to economic infrastructure (the bottom layer Figure 3). Consequently, the significance of social infrastructure (facilities and services Figure 3) will only be considered indirectly and infrastructure interdependence with external context and the need for shared systemic vision are at risk of being overlooked (red arrow Figure 3). On this basis, the case for Purposeful and Systemic Governance needs to be made, and methodologies to support it developed.

Similar thinking underpins the services led approach to infrastructure research[212223]. This approach allows both the purpose and the need for infrastructure to be defined in terms of the services expected, and interdependencies to be managed more effectively. The service-led approach has created opportunities for new infrastructure business models and value propositions, and in the context of smart infrastructure, the potential to integrate services across disciplines.

However, given that demand for these services and facilities is in turn shaped by the desired outcomes[24] that citizens expect infrastructure to enable, the purposeful and systemic governance approach outlined here proposes that a vision of desired outcomes is used to define infrastructure purpose. However, a systemic vision of desired services might serve equally well.

Conclusion

This Paper makes a case for Purposeful and Systemic Infrastructure Governance to support the objective of creating sustainable and inclusive cities (societies). The broad principles of purposeful

[17] National Infrastructure Assessment Consultation 2016 https://www.gov.uk/government/consultations/national-infrastructure-assessment-consultation
[18] The Armitt Review www.yourbritain.org.uk/uploads/editor/files/The_**Armitt**_**Review**_Final_Report.pdf
[19] https://www.gov.uk/government/organisations/national-infrastructure-commission
[20] Infrastructure Commission: what are the opportunities and how should it work? http://www.infrastructure-intelligence.com/article/oct-2015/infrastructure-commission-what-are-opportunities-and-how-should-it-work
[21] Land of the MUSCos: Multiple-Utility Service Companies http://sure-infrastructure.leeds.ac.uk/muscos/
[22] Transforming Utilities Conversion Points http://www.arcc-network.org.uk/project-summaries/tucp/#.V7XyNaLJ5nE
[23] http://www.arcc-network.org.uk/project-summaries/all-in-one/#.V7XyUaLJ5nE
[24] See ref 2

and systemic infrastructure governance outlined here are applicable more broadly to align infrastructure decision making with the desired outcomes society expects infrastructure to enable.

Further research is planned to develop a set of methodological approaches to apply the principles underpinning purposeful and systemic infrastructure governance. This work will draw on and adapt an approach to outcome orientated infrastructure performance indicators proposed following collaborative research between ICIF[25], IBuild[26] and Infrastructure UK[27], will build on elements of ICIF's response to the recent national infrastructure assessment consultation[28] and apply innovative approaches to engage citizens with identifying the outcomes they expect infrastructure at the identification of possible solutions to enable these.

Tom Dolan Short Bio

Dr Tom Dolan MSc, MBA is currently Research Associate and Centre Co-ordinator for the International Centre for Infrastructure Futures. Tom's current research interests include (i) how to align infrastructure performance indicators with those outcomes we expect infrastructure to enable, (ii) the role of personal perceptions, professional training, and other factors in problem framing and decision making, (iii) the development of robust methodologies for National Infrastructure Assessment, (iv) how system level properties of infrastructure systems can be more effectively communicated and managed.

[25] www.icif.ac.uk
[26] https://research.ncl.ac.uk/ibuild/
[27] See ref 2
[28] [28] ICIF NIA Consultation Response available at www.icif.ac.uk