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Prosperity in a Rocking Boat

Peter Dudley ISNGI 2017

Vickers' "Rocking Boat"

In 1970 Geoffrey Vickers was warning about the dangers inherent in the operation of what he called "Self-exciting Systems"

Self-exciting systems are those which, by simple virtue of their operation, encourage or intensify their own future operation.

One of these was progressive urbanization

By 2050 it is projected that 75% of the world's population – approximately 7.5bn people – will live in urban areas

And more that a third of these will live in "informal settlements – slums

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The Urban Rocking Boat

Planning to provide

... resilient infrastructure solutions to twice as many people with half as many resources

Might not be ambitious enough

And the costs of failure could be very high, e.g.,

Urban Collapse or Urban Conflict

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The Challenge

New thinking about how to design, manage, organize and deliver infrastructure projects is required to ... deliver more successful outcomes than are currently being achieved

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The Challenge

At the risk of controversy:

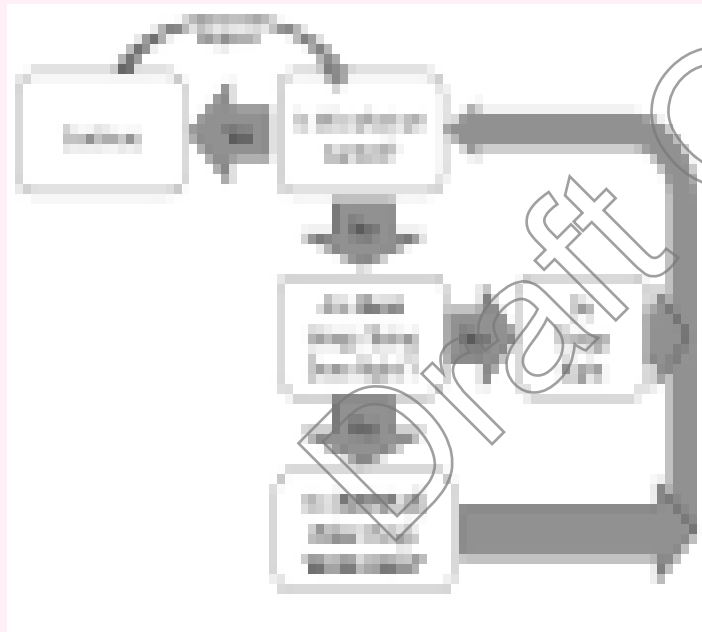
NGI will not be defined by technology

It will be defined by intelligence and autonomy in implementation across all levels from distribution and delivery to design and commissioning

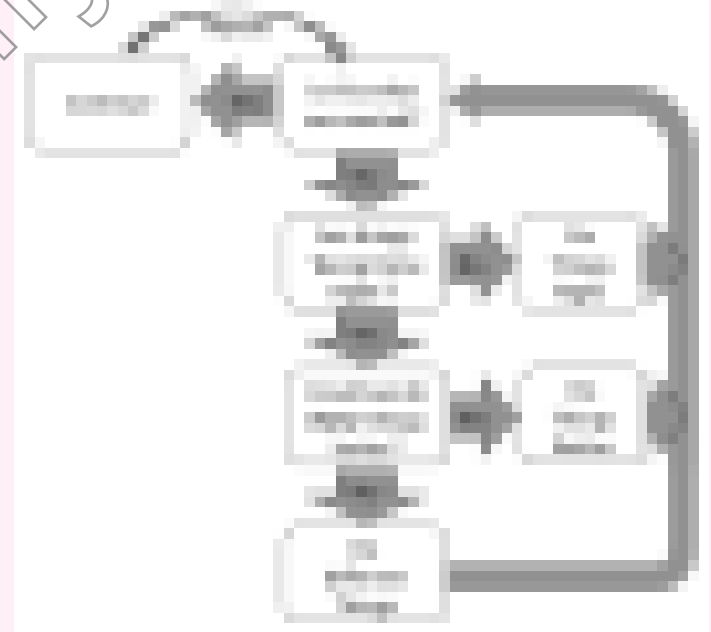
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The Challenge

That is, we need to move
from thinking like this ...



... to thinking like this



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The Challenge

As the networks infrastructure services are delivered across become more

Interconnected
Interactive
Interdependent

they will become so complex that, unless this is addressed, they become formally 'unknowable' – if they are not already

If we are to utilize this kind of network we will have to relinquish conventional notions of direct human control

The networks will have to become autonomous – self managing

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The Challenge

There will also be a need for the ability to provide adaptive capability at the level of the physical development of the delivery networks. This will be comprised of three communities:

Policy and Commissioning

Research and Development

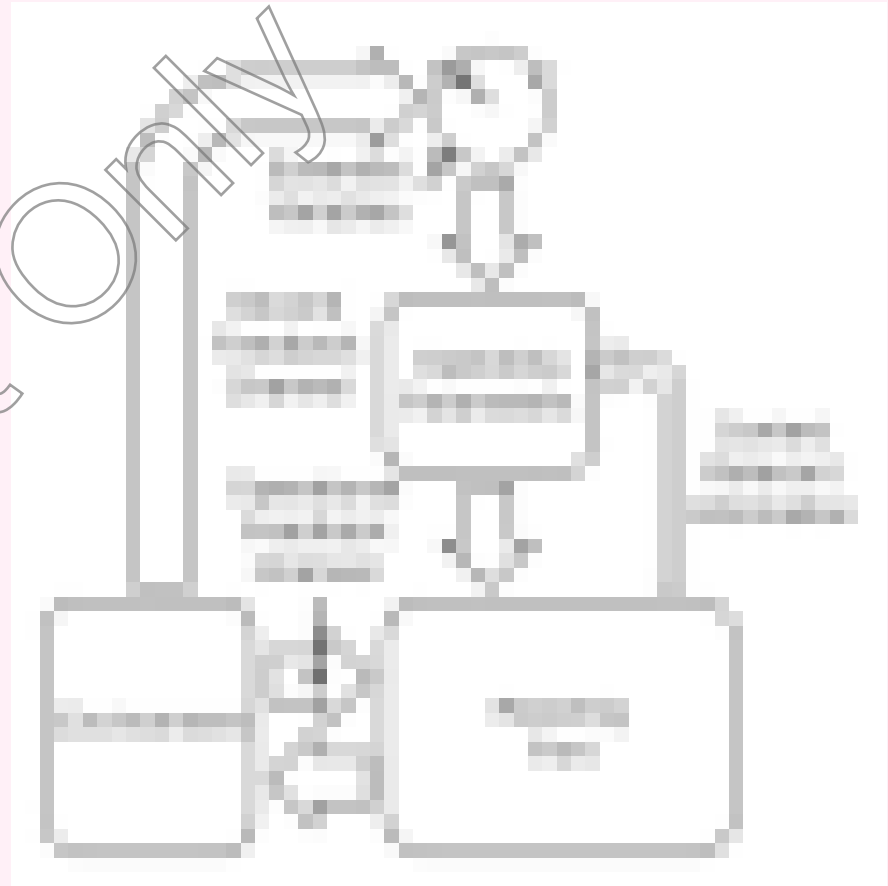
Provision and Delivery

Understanding and utilizing the way these communities interact will be a central element of the future provision of infrastructure services

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Learning Systems (1)

Ashby's "Ultrastable System" provides a standard rubric for the design of learning systems. It is capable of learning and 'learning to learn' against internally defined reward functions.



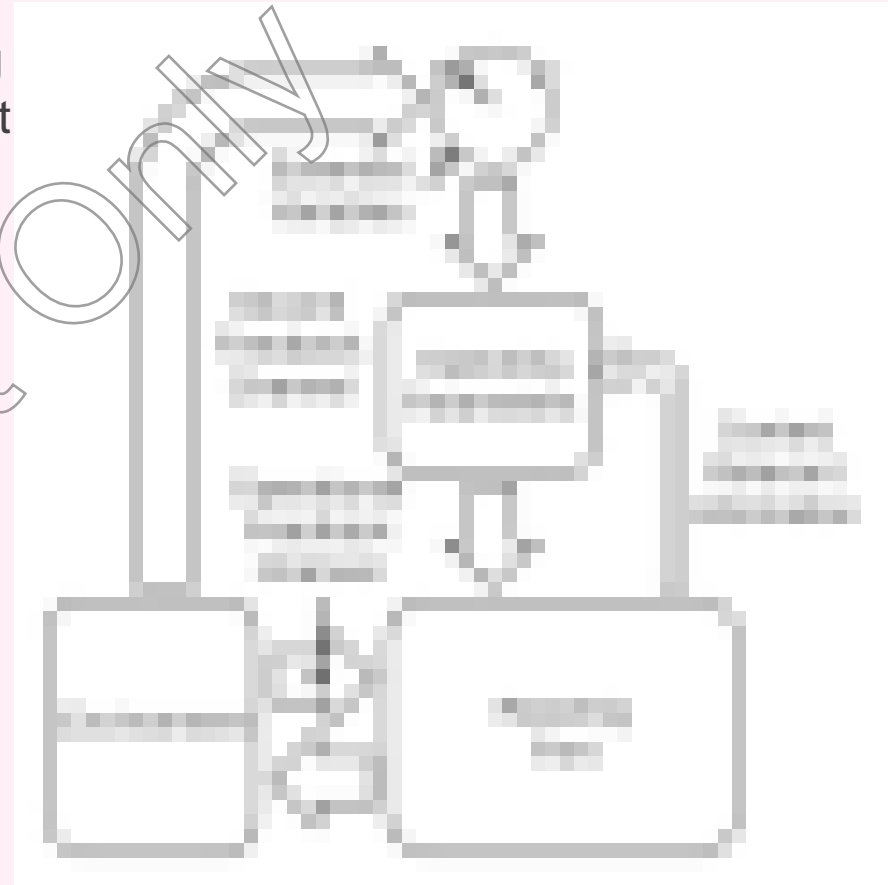
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Learning Systems (1)

And can, combined with appropriate machine learning capability, be use to construct intelligent networks, i.e.

In the firmware of the functional nodes; and,

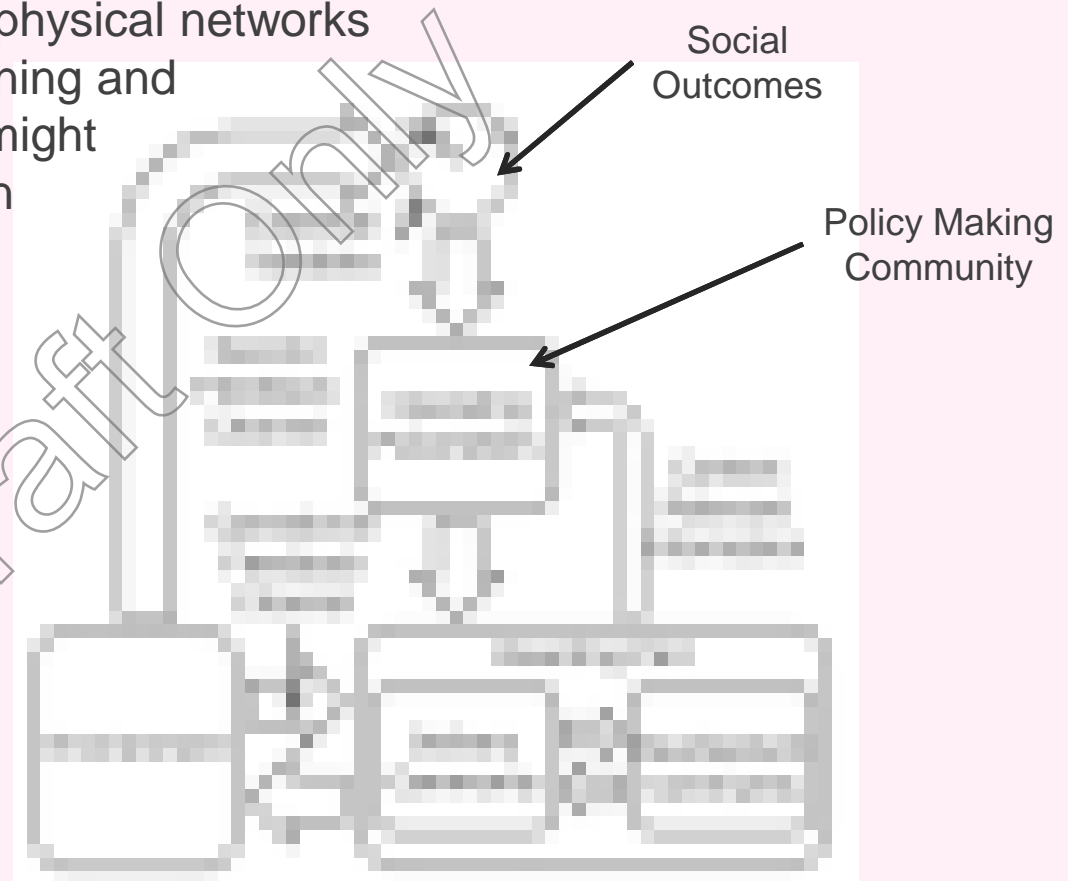
As software 'bots' to model and manage regions within and between networks.



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Learning Systems (2)

At the level above the physical networks the design, commissioning and delivery communities might be expected to function like this ...



With the autonomous networks embedded in 'Delivery'

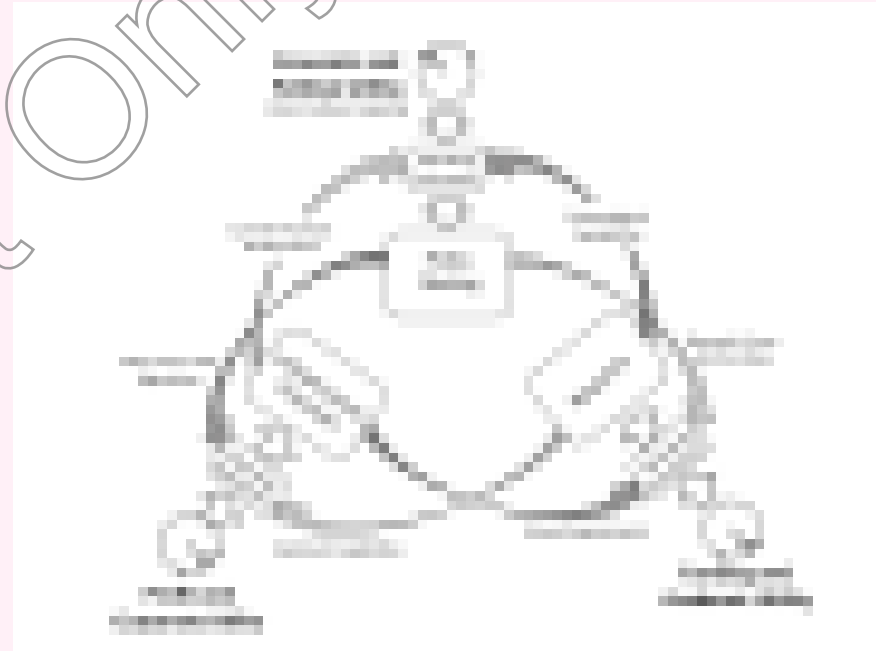
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Learning Systems (2)

But, in a mixed economy, establishing the operating parameters will probably work more like this ...

Policy Making Community



Delivery
Community

Development
Community

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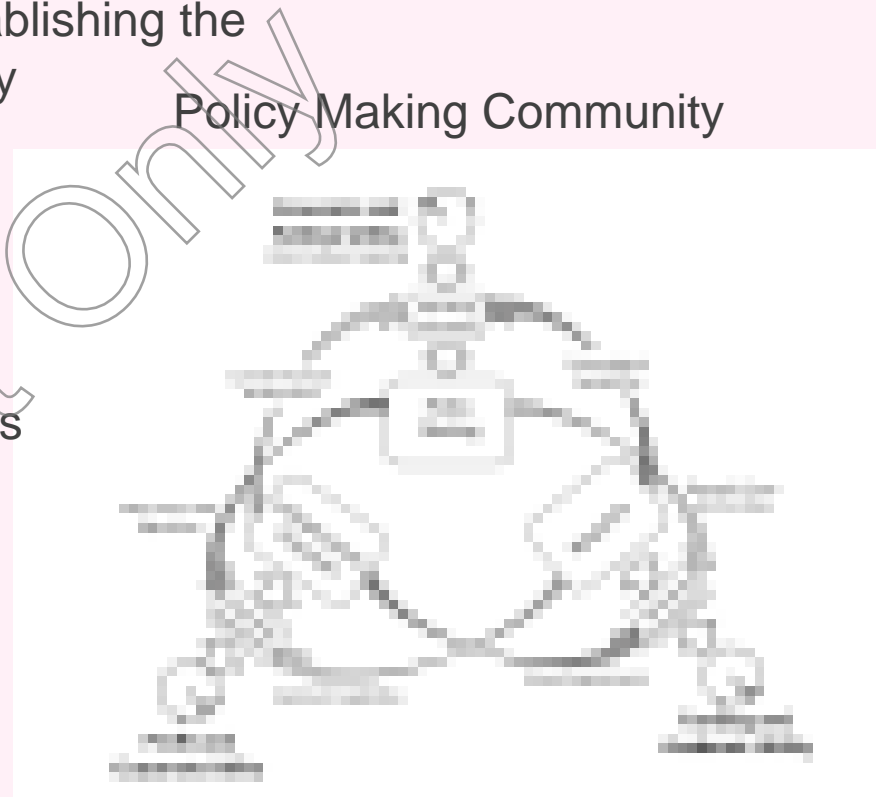
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Learning Systems (2)

But, in a mixed economy, establishing the operating parameters probably works more like this

With each of the three communities attempting to maximize their own interests in a common, co-created environment

Note: the outputs of each affect the operating parameters of the others, not their activity directly



Delivery
Community

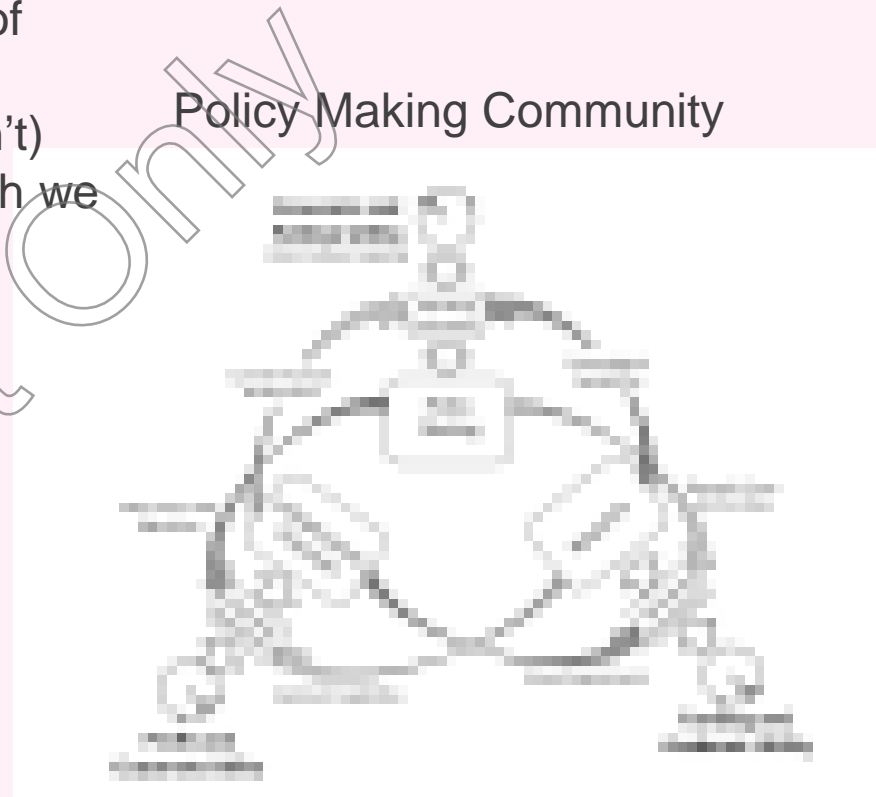
Development
Community

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Learning Systems (2)

Understanding the operation of this "co-regulator" in principle (which, it is suggested we don't) and utilizing it in context (which we therefore can't), is likely to be key to defining the future of infrastructure development



Delivery
Community

Development
Community

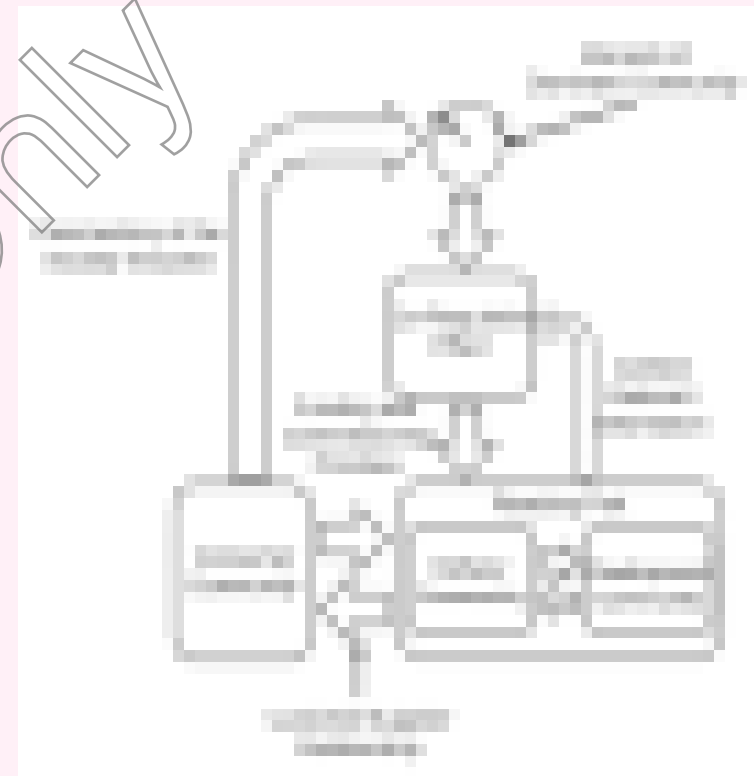
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Difficulties

Left to its own devices, the model will operate so as to skew any consensus reached in favour of the dominant participant

Leading to a result that will deliver minimal infrastructure needs to the 'socially enfranchised' within the tolerance of the dominant interest group



But still continue to exclude 25% of the world's population

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Pragmatics

Completing 'This Generation Infrastructure', e.g.,

Asset management systems are inaccurate, inconsistent or, wrong;

We need models of criticality, susceptibility and exposure relating to key functional nodes; and,

More use of sensor and telemetry capability – a significant proportion of current knowledge is modelled/estimated rather than reported

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Research

The understanding of structural learning systems that led to the proposal of the co-regulating system is not well developed – perhaps because it falls between (or across) disciplines.

However, it suggests “new thinking” and “integrated approaches” that hold the promise of intelligent, learning based infrastructure systems able to “deliver more successful outcomes than are currently being achieved”.

A first step forward would be the establishment and funding of the research needed to develop that understanding.

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