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Editorial
Tully

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Editorial

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Welcome to this issue of *Infrastructure Asset Management* and welcome to our new Editor in Chief Arun Kumar, Emeritus Professor, RMIT University, Melbourne, Australia.

I am sure that Arun will join the Editorial Panel in thanking Krisen Moodley, former Editor in Chief, for all his hard work and encouragement over the last three years to make the journal the success it is today.

This Editorial reviews three papers

- Quality data for strategic infrastructure decisions in Ireland (Moloney *et al.*, 2017)
- Building resilience in virtual and physical networked operations (Phillips and Hay, 2017)
- What does NDE need to achieve for cast iron pipe networks? (Rainer *et al*., 2017).

Reading through these papers, I was struck by the almost inescapable role of data in infrastructure asset management approaches today. This holds true in the management of physical infrastructure assets and the analysis of resilience in physical and virtual networks.

A digital framework is at the heart of realising the benefits of infrastructure investment decisions, system of system effects, manageable whole-life costs that meet the expectations of society and network resilience in times of crisis. Data management must follow established building information modelling processes or other recognised standards to allow a common system understanding between the various communities that access the data, and they must be applied consistently across the public and private sectors.

While an organisation may have the capability and willingness to incorporate these methodologies for infrastructure and asset management decisions, their fullest benefits can only be achieved if they are applied system-wide and not in isolation. This is probably the greatest challenge.

Major infrastructure projects such as Crossrail or Tideway are fortunate in being able to create bespoke asset management systems in light of the most up-do-date thinking and practices, but there is a potential point of weakness if the features and limitations of other systems relevant to the project are not fully taken into account. What is really needed is a 'system of systems approach' to asset management and resilience.

Our first paper (Moloney *et al*., 2017) identifies a lack of consistent national and regional policy in investment decision-making in Ireland, which has led to investment decisions being made in isolation without assessing the impact on other systems. During the decade 2000–2010, Ireland went through dramatic economic change, culminating in the economic bailout of 2010. The paper describes the creation of some 2800 ghost estates as a result of the economic downturn, while large urban areas are now experiencing a housing shortage.

Although there were increased levels of infrastructure investment in the period compared to previous periods, opinion is varied as to whether the right investment decisions were made at the time. The Organisation for Economic Co-Operation and Development positions Ireland in the lowest third in terms of the quality of its infrastructure. The challenge ahead, it would seem, is to develop the political will and change in mind-set to set up the equivalent of the UK's Infrastructure Commission for infrastructure decision-making, to enable a system of systems approach.

The first step, as the authors point out, is to recognise that the immediate challenge in achieving this outcome is gathering the asset data to build the databases and constituent system models that will eventually inform these infrastructure decisions.

The second paper (Phillips and Hay, 2017) is a fascinating read exploring the world of building resilience in virtual and physical networked operations and follows on from a previous paper published by Hay (2016). The focus of this paper is on operational resilience theory and the complexity of risk and resilience dependency with networked operations. The resilience framework is based on the ISO 31000 standard risk management process (ISO, 2009). The paper states that 'Infrastructure can be robust but not resilient as it cannot self-recover. It is made resilient by strengthening the systems that it enables and that can allow it to recover.' In this paper, infrastructure is described as consisting of the built and natural environment as well as the virtual one, such as mobile communication systems. By applying the framework steps ((1) mission and operation definition; (2) operational system analysis; (3) risk and option analysis; (4) define, refine and project the tableau) to the operation of an emergency fire service, the dependency and complexity of physical and virtual networks are examined.

The case for a system of systems approach is made to enable effective response and recovery. While we may be more familiar with the frequently used definition for resilience – the ability to sustain impact and bounce back – the authors define the capability for network resilience in eight characteristics from the macro to the micro level: unified, coordinated, connected, engaged, reliable, resourceful, agile and autonomous. Seen in this context, resilience

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is the product of good physical design and well-constructed support systems. If the attributes of a successful response by the community to a serious flooding event, as described in the paper, were to be listed I am sure they would include some if not all of these characteristics.

The final paper by Rainer *et al*. (2017) looks at the thorny issue of appraising and replacing old and ageing cast iron water pipe networks built to standards 100–180 years ago but still expected to meet the needs of 21st century communities.

Technical solutions have been developed over time to detect defects and network operators are in a position to proactively manage their network. Indeed structural health monitoring using sensors that are able to relay data in real time are being installed on today's megastructures (Livina and Perry, 2017) but the vast majority of infrastructure assets will continue to rely on a system-wide strategy that recognises points of vulnerability and ways of detecting them.

The paper reminds us of the need to have a strategy for asset deterioration and degradation. The mechanisms for deterioration will vary from asset type to asset type, but degradation or loss of function has consequences and can materialise suddenly without warning.

To conclude, the 'systems of systems' approach for infrastructure asset management has a place in national strategic asset management and operational resilience theory. The occasional burst water main built over 100 years ago ably demonstrates the multiple impacts flooding has on other systems, tests our responses and recovery times and reminds us of the need to limit system-on-system impact through targeted asset deterioration and degradation strategies.

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