Structural Health Monitoring - A Sustainable Way Forward

ANSHM Workshop, Sydney 25 November 2022

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Structural Health Monitoring – WHY?

	Conventional Inspections	SHM	Advantages of SHM
Road / Rail / Pedestrian Traffic	To be closed for every periodic inspection	Remain operational	• No Train replacement Bus • No traffic diversion / lane closure
EWP / Hi Rail / UBIU	Required at all times	Requirement is minimized	• Reduced emissions • Safe
Frequency of Inspection	Only during rail possession / permission to close lane	24/7/365	• Inspect as required
Safety (personnel)	All site related works pose safety risks	Site access not required every time	• Assess from desk
Assessment	Assumed behaviour	More accurate assessment	• Presents the current state / behaviour of the structure
Data Integrity	Subject to human interpretation	Consistent data	• Minimizes human error

Reasons for SHM deployment

1. Assess behaviour of structure in its current state

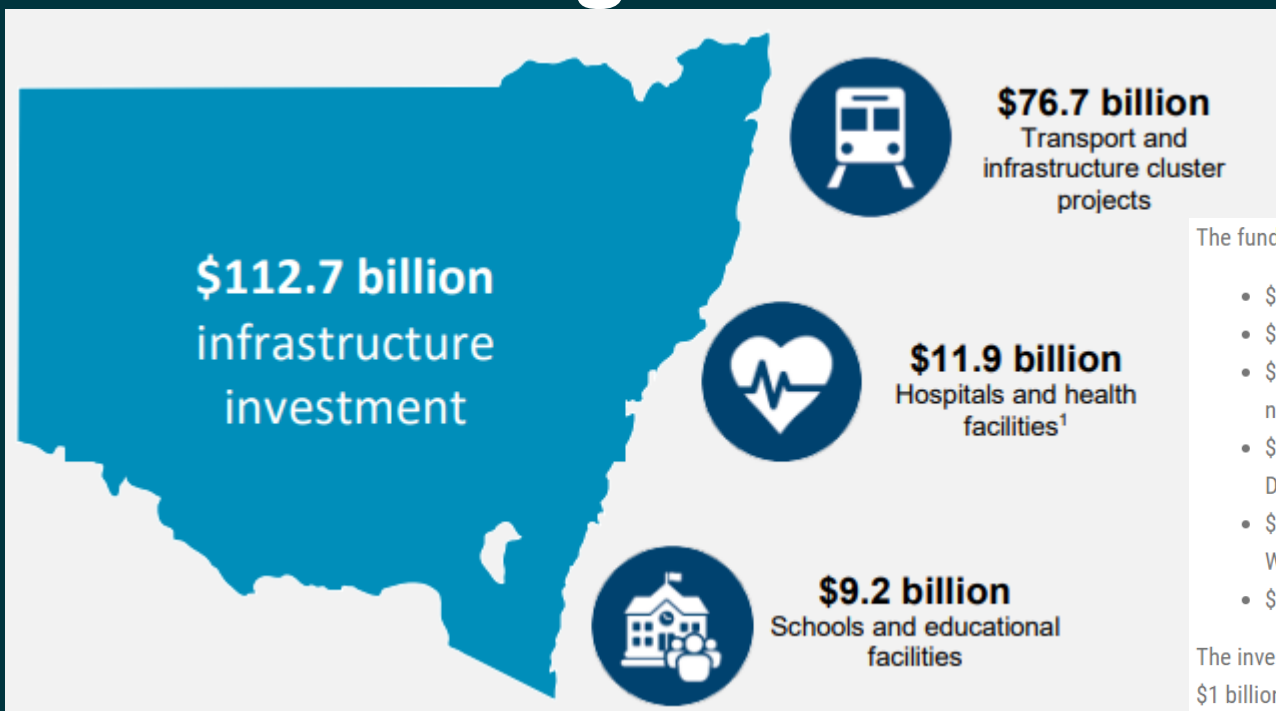2. Early asset intervention and remediation

3. Validate design

Aim

1. Plan optimum interventions

2. Make best use of resources

3. Extend the service life of the asset

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SHM – Methodology

- Desktop study of drawings
- Preliminary visual inspection
- Model and analyze bridge as per original design drawings
- Identify critical members based on analysis and initial visual inspection
- Design sensor layout for monitoring
- Install Sensors
- Establish connectivity for remote monitoring
- Collect data over a period
- Analyze data using AI techniques
- Calibrate bridge model to represent current state / behavior of the bridge
- Design targeted repair solutions
- Monitor the bridge post repairs (sensors installed remain all through the life of the structure)
- Nominate triggers for early warnings

2022-23 Budget

$112.7 billion infrastructure investment

$76.7 billion
Transport and infrastructure cluster projects

$11.9 billion
Hospitals and health facilities[1]

$9.2 billion
Schools and educational facilities

The funding commitments in the upcoming Budget include:

- $300 million for Western Sydney Roads Package and $500 million for the High Speed Rail Authority
- $2.2 billion for the Suburban Rail Link in Victoria
- $586.4 million of additional funding for a major upgrade of the Bruce Highway to widen a 13km stretch through Brisbane's outer northern suburbs
- $1.5 billion for upgrading important freight highways, sealing the Tanami, and upgrading Central Arnhem Road, as well as the Dukes, Stuart and Augusta highways in South Australia
- $540 million to upgrade Tasmania's important road corridors, including the Bass Highway, the Tasman Highway and the East and West Tamar Highways
- $125 million funding to help build an electric bus network for Perth

The investment allocates $2.75 billion for Victorian projects; $2.5 billion for those in the Northern Territory; $1.47 billion for Queensland, $1 billion for New South Wales, $685 million for Tasmania; $670 million for Western Australia; and $660 million for South Australia.

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NSW Smart Infrastructure Policy

1.4 Smart infrastructure defined

For the purpose of this Policy:

- infrastructure means a system of physical and digital assets that enable the delivery of the services that are the foundation for a successful economy and society'[2] (e.g. transport modes, street furniture, bridges, hospitals, schools, parks, waterways, green spaces, prisons etc).

- smart infrastructure is infrastructure that uses technology and data to optimise performance, increase capacity and achieve a greater return on investment. It uses smart technology (e.g. sensors, computing algorithms) to generate meaningful insights for service and infrastructure providers (including Government, businesses, partners and consumers) who can make better informed decisions about service outcomes for their customers, places (or communities) and the asset(s).

- Smart technology is comprised of devices that can be connected or interconnected. It is comprised of hardware and other physical assets that are embedded with processors, sensors, data storage, software and connectivity that allow data to be

1.5 Benefits of smart infrastructure

Smart infrastructure will help the NSW Government to realise benefits including:

- Improved customer outcomes – agencies will be able to use data insights derived from smart infrastructure to improve customer engagement, personalise services to individual needs, and better understand how customers interact with infrastructure and the built environment.

- Productivity improvements – data and technology facilitate transparency and accountability for asset performance and capacity. This information can optimise asset performance, whilst also enabling agencies to apply these learnings to other existing and future infrastructure.

- Information driven decision making – agencies can use the data generated from smart technology to optimise the use of current and future infrastructure and its surrounds (i.e. comparing performance to scale efficiency gains across similar infrastructure, demand driven service delivery, more efficient design and construction of new infrastructure).

- Whole-of-lifecycle asset management – agencies can use this data to deliver user-centric infrastructure and proactively identify and predict maintenance and operational needs based on real-time infrastructure conditions. This can facilitate planned and preventative approaches to asset management that will result in a range of benefits – for example, reduced costs and service disruptions as maintenance is delivered as needed (rather than periodically).

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SHM for Smart, Sustainable Infrastructure

- All new infrastructure should have SHM embedded

  - to provide early warning for interventions

  - to reduce risk of catastrophic failure (Florida Pedestrian Bridge – 5days life!)

  - to help in informed timely low-cost interventions instead of unplanned, delayed high-cost interventions

  - to minimize need for specialist inspection and maintenance

  - to ensure continued service performance

  - to extend the service life of the structure

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Structural Health Monitoring

✓ESG

✓Sustainability

✓Net Zero

✓Safe

Every New Asset with embedded SHM

- Is one asset less to be inspected conventionally

- Frees up resources for better allocation

- Provides more confidence in the serviceability of the new infrastructure

- Has less environmental impact

- Provides greater level of confidence to engineers to provide optimal design solutions

- Minimizes redundancies in designs and standards

- Provides an immediate quality check on the constructed asset

- A Smart & Sustainable asset is built

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Thank you.

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