

Emerging technologies and innovation in pavements – who will implement them?

Kym Neaylon, PhD, Executive Manager

Ray Farrelly, OAM, Chief Executive Officer

Centre for Pavement Engineering Education



What does the future hold for roads?

“My interest is in the future because I am going to spend the rest of my life there” - CF Kettering



Volvo Truck's all-electric driverless freight truck, dubbed "Vera".

Outline

Part 1. Emerging road issues

- Environmental changes
- Connected and Autonomous vehicles
- Marginal materials
- Alternative materials

Part 2. Skills

- Skills in the workforce
- Will robots take your job?
- Skills needed by a future pavement engineer
- Upskilling
- CPEEs approach
- Online learning

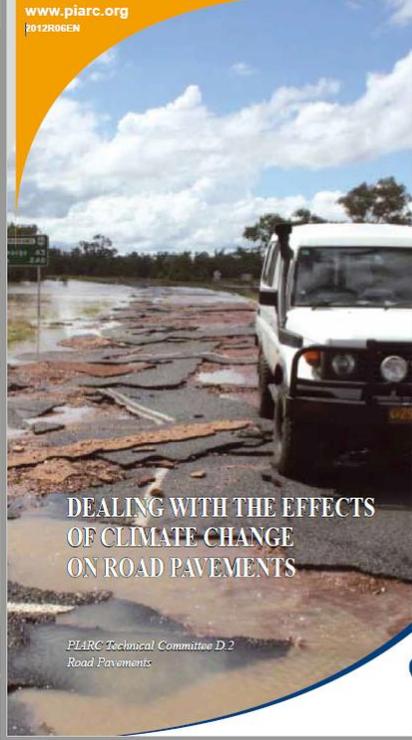


Part one:
Emerging pavement issues

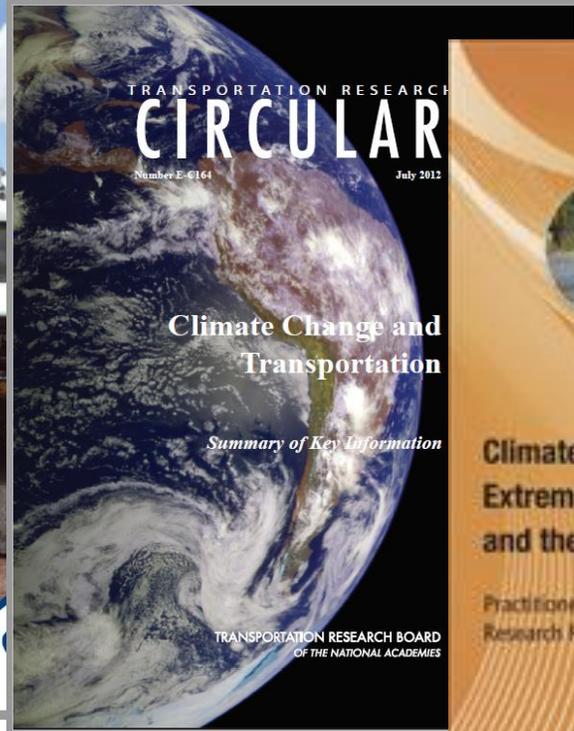
We will need to adjust pavements for climate change

AP-R243

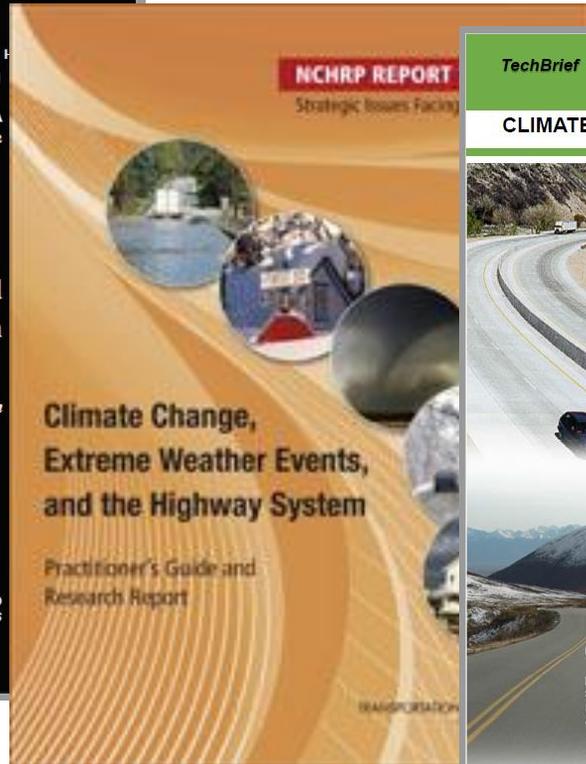
IMPACT OF CLIMATE CHANGE ON ROAD INFRASTRUCTURE



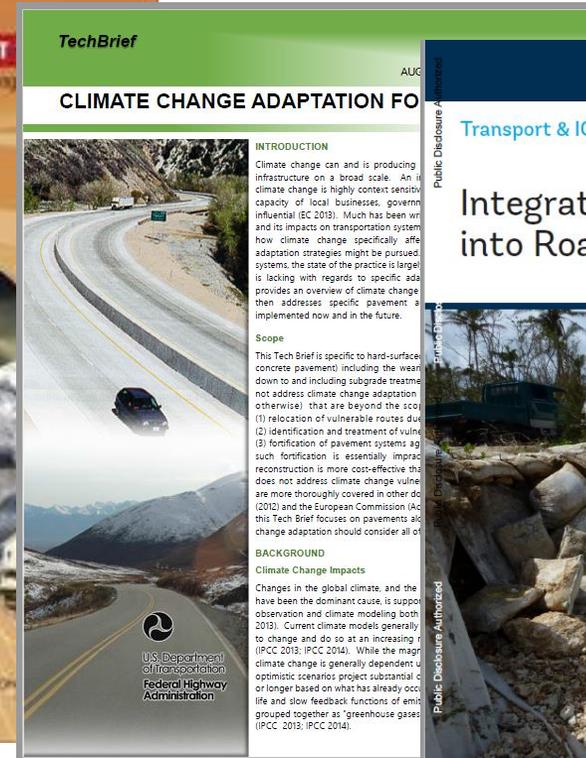
PIARC 2012



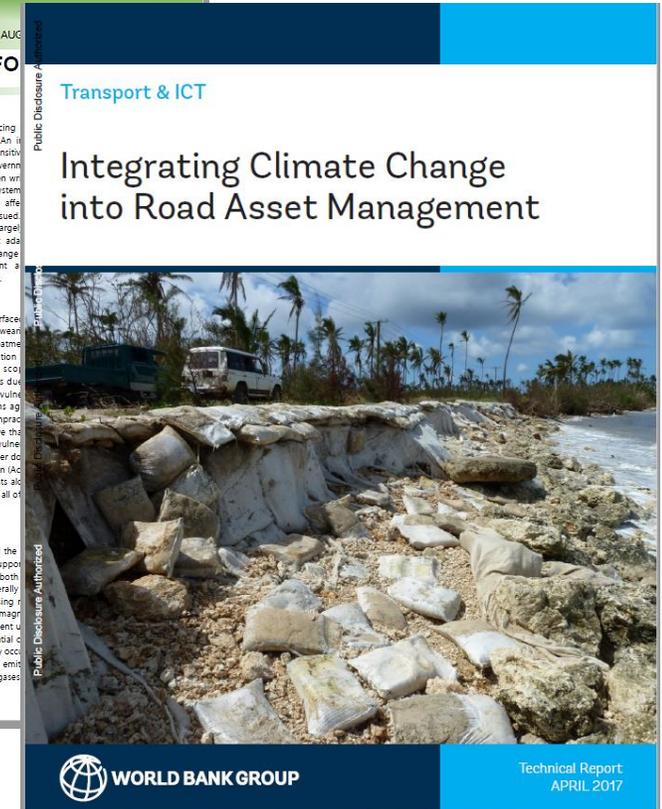
TRB 2012



NCHRP 2014

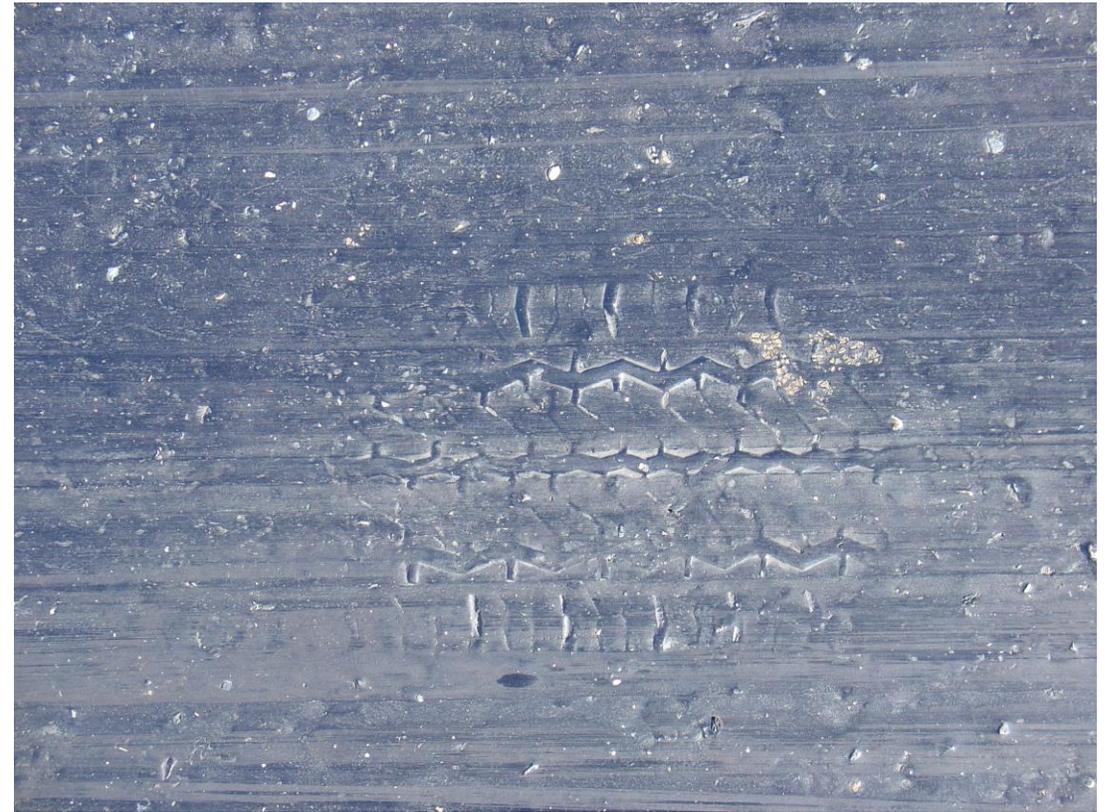


FHWA 2015



World Bank 2017

Higher number of consecutive hot days



Higher intensity rainfall events



Image: ABC News (2017) Springbrook Road after cyclone Debbie, Queensland.

Higher Average Temperatures

Impact on pavements

- Increased potential for rutting and shoving, requiring more rut resistant asphalt mixtures.
 - May require raising high-temperature asphalt binder grade and/or increasing the use of binder polymerization and/or improved aggregate structure in asphalt mixes
 - Increased use of rut resistant designs including thin, rut resistant surfaces
- Increased age hardening of asphalt binder
 - Use binders that age more slowly
 - Expanded use of asphalt pavement preservation techniques (e.g. rejuvenators) to address binder aging

Higher average annual precipitation

Impact on pavements

- Reduction in pavement structural capacity due to increased levels of saturation
 - Reduce moisture susceptibility of unbound base/subgrade materials through stabilization
 - Ensure resistance to moisture susceptibility of asphalt mixes
- Improved surface and subsurface pavement drainage
 - Use strategies mentioned previously
- Will likely negatively impact construction scheduling
 - Investigate construction processes that are less susceptible to weather-related delays

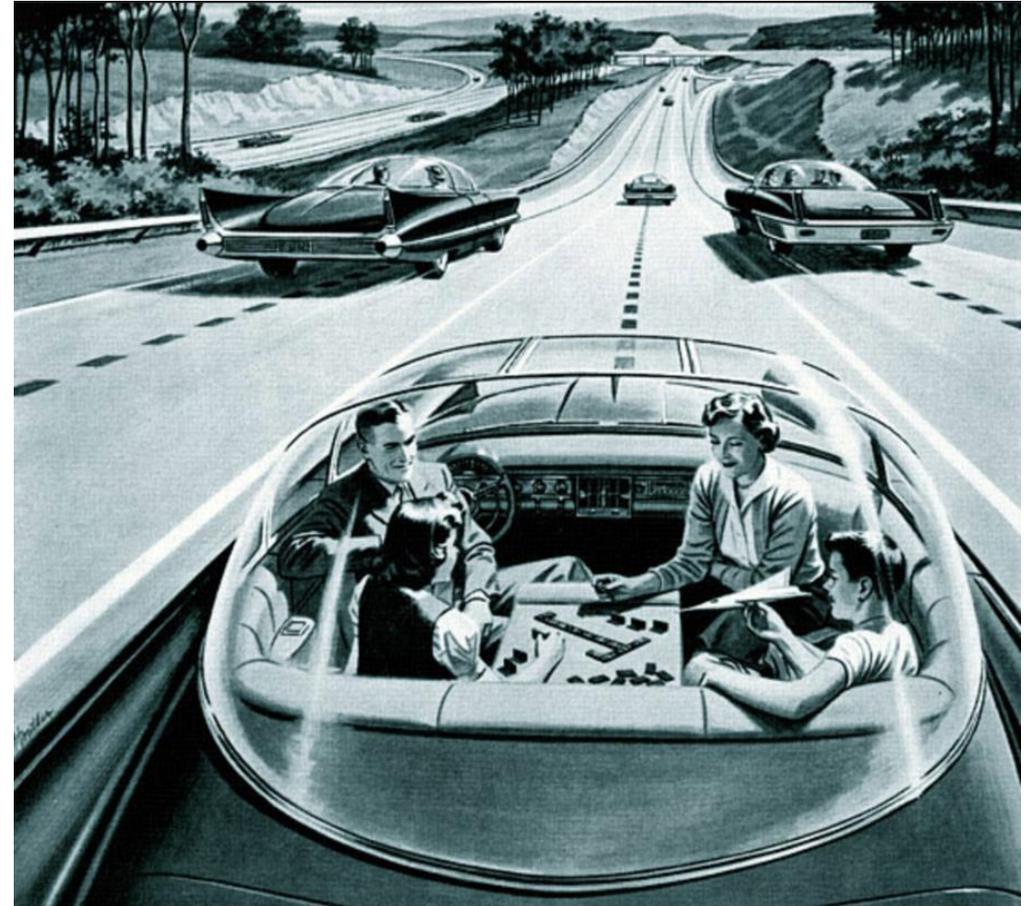
Wetter winters and drier summers

Impact on pavements

- Must address increased potential for soil shrinking and swelling due to moisture changes, particularly in times of drought
 - Incorporate soil modification/stabilization into design
- Use stiffer/improved pavement designs that are less susceptible to changes in subgrade properties incurred due to changes in moisture

Connected and Autonomous Vehicles (CAV)

- More cars on the road, or less cars?
 - Mobility service provider, or
 - Private ownership
 - Autonomous ride share an alternative to busses?
- Traffic wheelpath wander – yes or no?
- Dependant on good linemarking?



America's Power Companies' advertisement from 1956 depicting a future with autonomous cars.
Source: www.engineering.com

Bitumen alternatives

Tall oil pitch
Waste sawmill residue



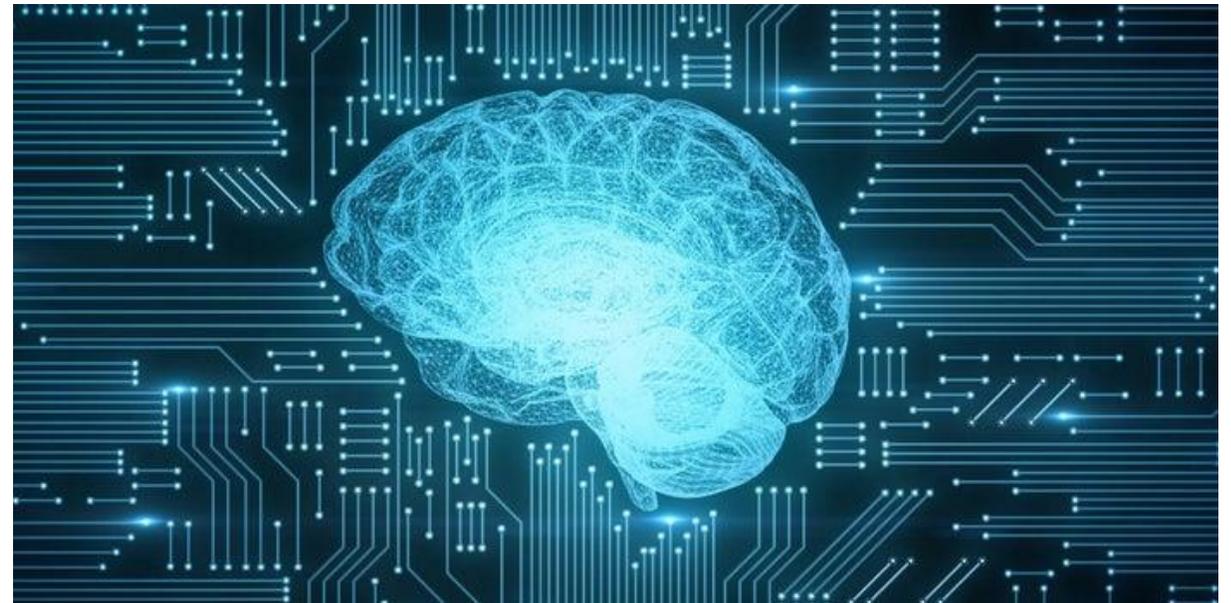
Alternative materials

- Waste plastic



- Soybean oil
- Glass
- Coffee grounds (?)
- Nanotechnology
 - Graphene nanoplatelet
 - Nano modified aluminium oxide
 - Nano silica
 - Nano-functionalised clay

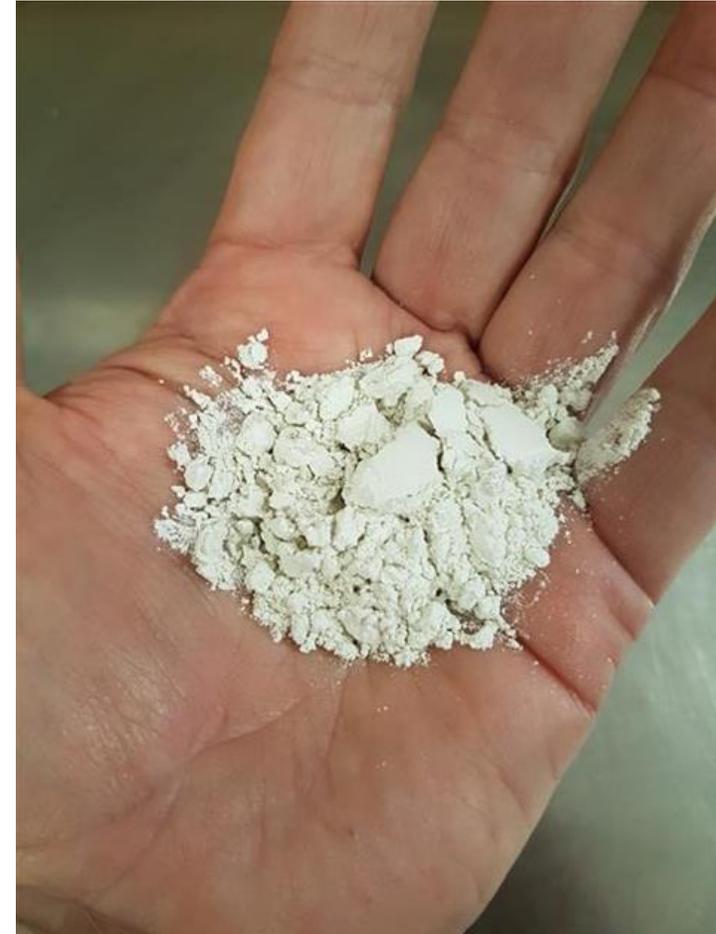
- Those materials yet to be developed by Artificial intelligence
- *AI could cut the development time of a new material from 10-20 years, to 1-2 years – Forbes (2018)*



Nano-functionalised clays

As a bitumen modifier:

- Mixing and compaction temperatures the same or higher than PMBs
- Better rut resistance than virgin binder
- Suitable for a higher level of DESAs
- Significant improvement in stiffness value at intermediate to high temperatures
- Better fatigue resistance than virgin binder





Part two:
Who will implement the changes?

Skills in the workforce

- Skills shortages remain a critical issue, with mid management professionals in engineering, technical and IT fields the most difficult to recruit – Hays Recruitment (2019)
- The key roads related occupations are already deemed to be in shortage at the national level – Austroads (2018)
- Australian Councils are struggling to fill engineering roles..... engineers represent the occupation with the greatest skill shortage – IPWEA (2019)

Hays plc, (2019), Salary Guide FY 2019/20, Report released on line circa 22 May 19.

Austroads (2018), Australia and New Zealand Roads Capability Analysis 2017-2027, Austroads Research Report, AP-R574-18, Hart, A and Logie, R, Sydney.

IPWEA (2019) Intouch, 20/03/19, viewed online

Melting bitumen leaves motorists 'sinking' into Queensland road, destroys tyres

By [Anna Hartley](#), [Sharnie Kim](#) and Adam Stephen

Updated 5 Jul 2018, 5:22pm



PHOTO: Drivers said they were "sinking" into the far north Queensland road. (Supplied: David Anthony, Tablelander)

Up to 50 people could be entitled to compensation after bitumen on a recently resurfaced road in far north Queensland melted around car tyres, causing traffic chaos and damage to vehicles.

RELATED STORY: [Explained: How heat affects roads, trains and planes](#)

RELATED STORY: [A freeway melted in Victoria — and it's only going to get hotter](#)

Maintenance of Existing Skills



“there are not enough local firms to get the job done”

AFR Friday 14 June 2019
www.afr.com | The Australian Financial Review

Infrastructure Summit 2019 News 7

Victoria stretched by Andrews' \$100b build

Construction capacity
Patrick Durkin and Mark Ludlow

Victorian Premier Daniel Andrews has conceded he cannot deliver a record \$100 billion infrastructure agenda without greater help from global construction firms.

The Premier introduced tough new state laws last year to require 90 per cent of "local content" on major projects but revealed on Thursday they would look to hybrid consortiums because there are not enough local firms "to get the job done".

Amid the biggest infrastructure boom in the country, Mr Andrews claimed Victoria didn't have the capacity to build the East-West link - to which the federal Coalition government has committed \$4 billion - because there were not enough raw materials such as gravel or concrete in the state.

"We are pretty well at full tilt with sand, gravel and concrete," Mr Andrews told The Australian Financial Review National Infrastructure Summit in Melbourne on Thursday.

"The notion we can just throw another major project into the middle of the biggest infrastructure agenda the nation's ever seen and not shelve or hold up the projects we're committed to, it doesn't make sense."

Opening up expressions of interest

Key points

- There are not enough local firms to meet the state's tough content rules.
- The Premier suggested contractors partnering with new international players.

that showed just three big building firms, Chinese-owned John Holland, Lendlease and Spanish-owned CIMIC subsidiary CPB Contractors, have earned \$10.5 billion between them since the Andrews government came to office.

"Just to be clear, we're not talking about big internationals coming in, taking over our major projects and sidelining local companies, I'm talking about our own tier-one contractors - potentially our tier-two contractors - partnering with new international players to manage this unprecedented workload," Mr Andrews said.

Local content rules are already causing headaches for the builders of the West Gate Tunnel, CPB and John Holland, who are facing fines over plans to import 33,000 tonnes of Chinese steel, despite a guarantee for 92 per cent local steel.

"Our local content requirements still remain in place... it's a little bit difficult

ways in which we can further fast-track our projects," Mr Andrews said. "And yes, he [Mr Tudge] is right to say some of the projects that we are building are years away because they are the biggest projects that have ever been built."

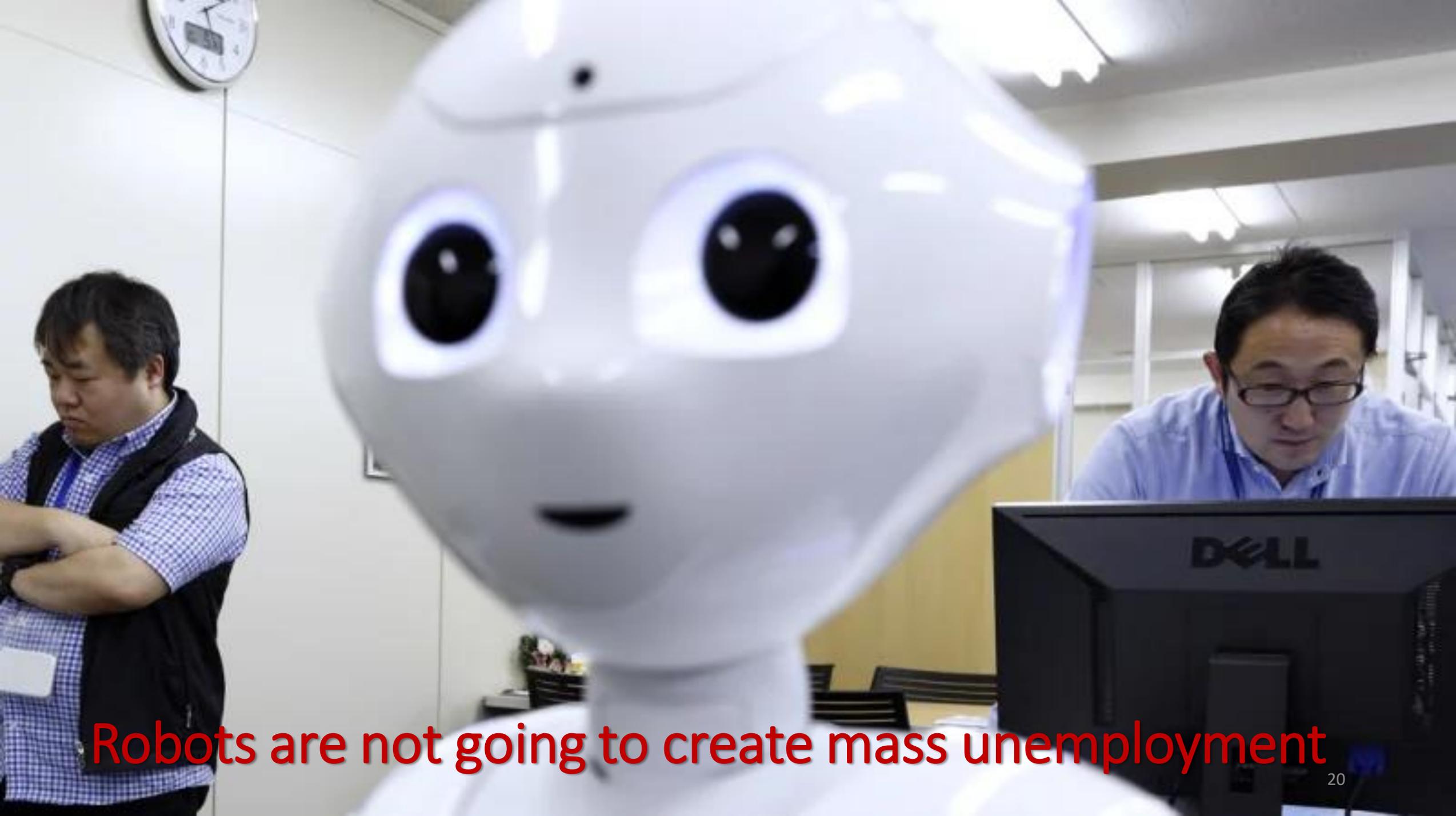
Mr Andrews backed moves by the Morrison government to fast-track to partner with the Commonwealth where they stack up." Mr Andrews once again fired back at the Morrison government over its \$4 billion election commitment to build the East-West Link, saying he still wasn't interested because it would not be enough.



Daniel Andrews yesterday: "We are pretty well at full tilt with sand, gravel and concrete." PHOTO: EAMON GALLAGHER

Robots





Robots are not going to create mass unemployment

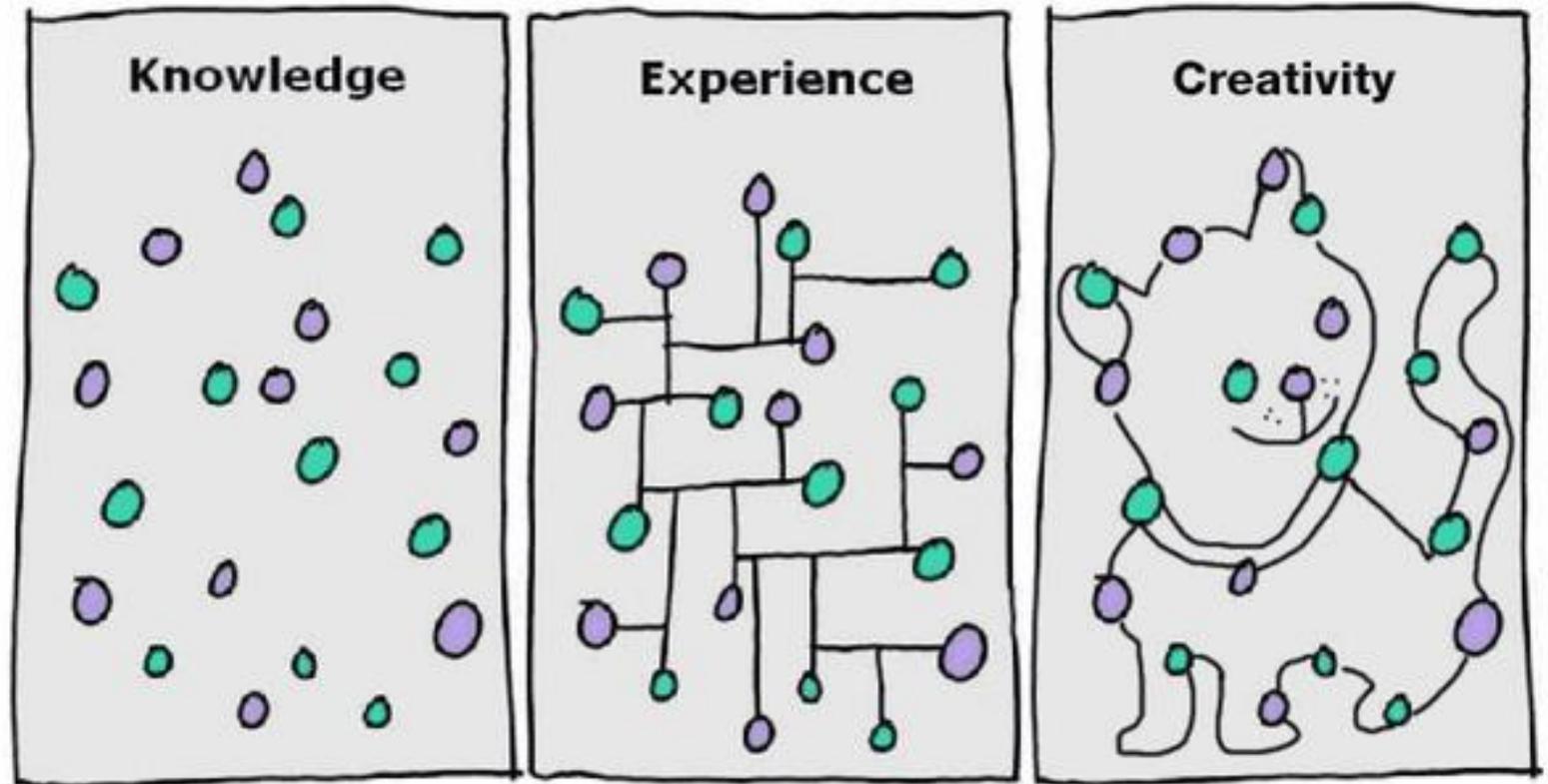
The future of work is human

“For every problem there is a job, and we are not running out of problems”

- Deloitte (2019)

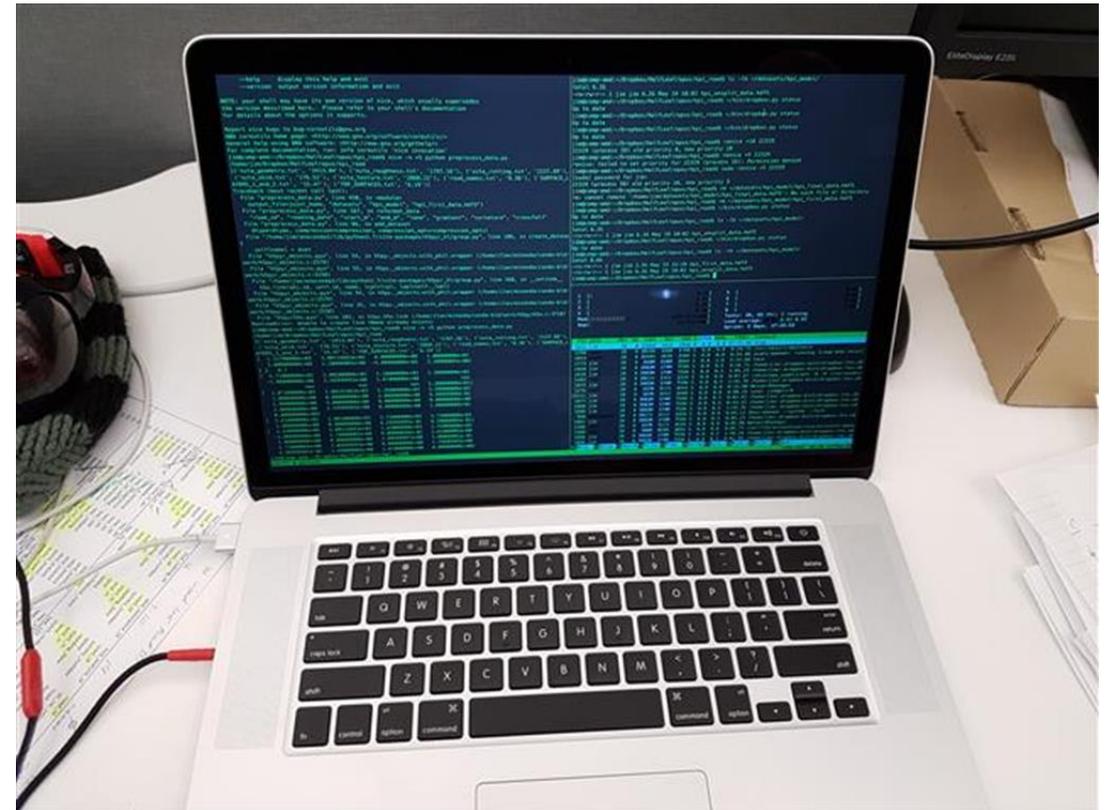
“There is a need for highly skilled employees to perform higher value job responsibilities”

- Hays Recruitment (2019)



Skills needed in Pavement engineering

- Making the new materials deliver
- Predicting pavement performance
 - Mechanistic design algorithms go beyond the past empirical ones
 - By measuring the inputs we can model the outputs
 - We can input new properties when they emerge, and predict the performance



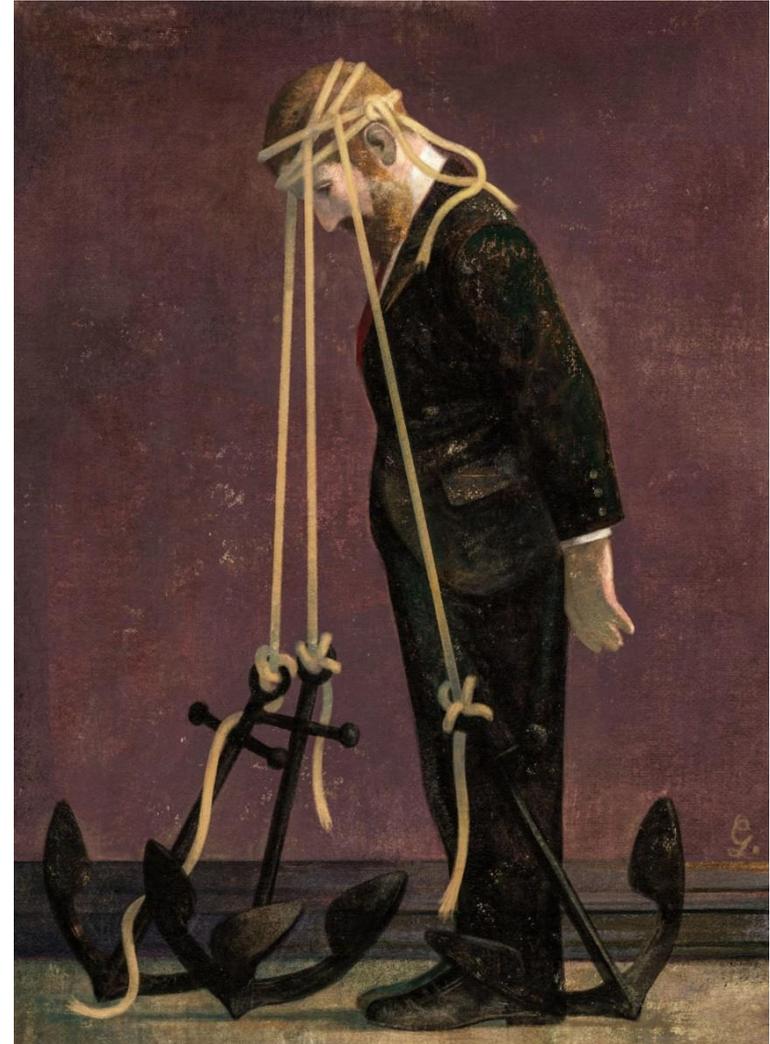
Upskilling & surviving

“The illiterate of the 21st century will not be those that cannot read and write, but those who cannot learn, unlearn, and relearn”

- Alvin Toffler, Futureshock

“Think through the possibilities and keep managing the future as you go..... **that skill, not to be stuck in one way of thinking, is very important**”

- An Australian university



Preconceptions – Gerard DuBois

.....there are no shortcuts



The CPEE approach

- Formed to fill the pavements gap left by traditional universities
- Foundation members were Austroads and the Australian Asphalt Pavement Association
- A not-for-profit private education provider
- Accredited by the Commonwealth's Tertiary Education Quality and Standards Agency as a private provider of Higher Education
- Many connections with industry



Australian Government
Tertiary Education Quality
and Standards Agency



Postgraduate online study

- Online learning is the opposite to distance learning
- Offers the ability to study anywhere in the world
- Dedicated online learning management system
- Complements current employment needs
- Access to experts
- Work based projects



Specialised short courses

- One and two day events
 - Expert presenters
 - Face to face interaction
 - Real-time Q&A with an expert
 - Tutorials with on-site coaching
 - ‘Workshop’ sharing approach encouraged
 - Learn from each other
 - Topics more aligned with practical aspects
- Rural areas not neglected



Pavement Preservation Initiative

Australia wide independent non-commercial initiative

- Information sessions
- Workshops
- Self paced learning modules
- Short courses
- Higher education with partners
- Dedicated website

www.pavementeducation.edu.au/ppi



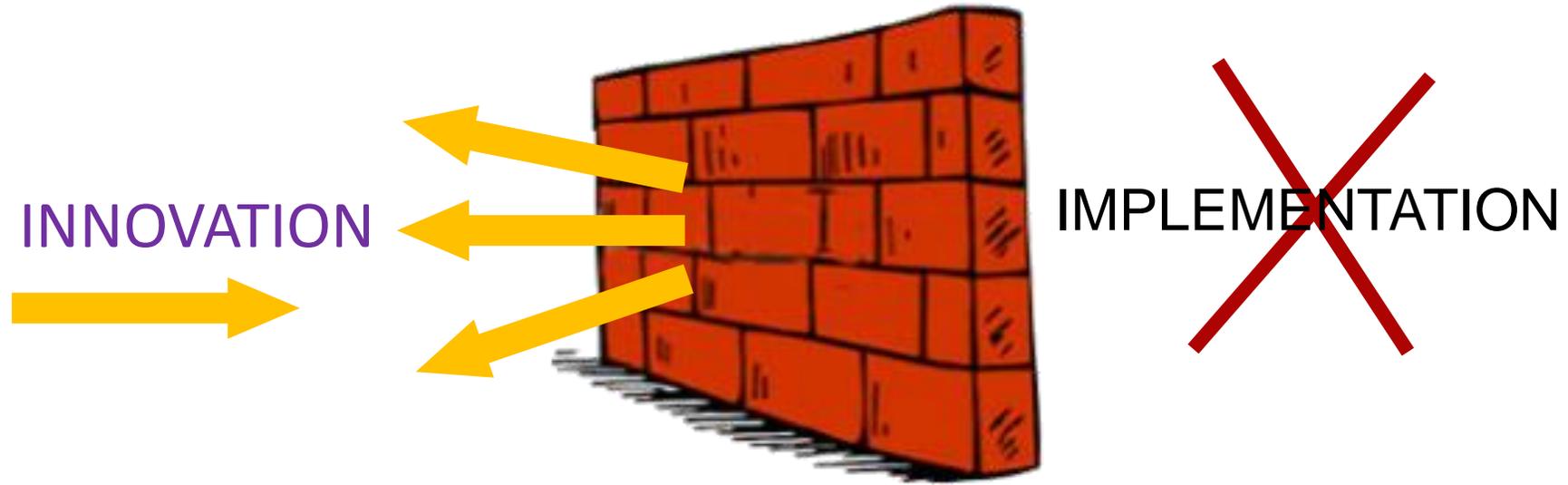
PAVEMENT PRESERVATION INITIATIVE

Driving stakeholder collaboration, information sharing, education and training to support lifetime pavement preservation

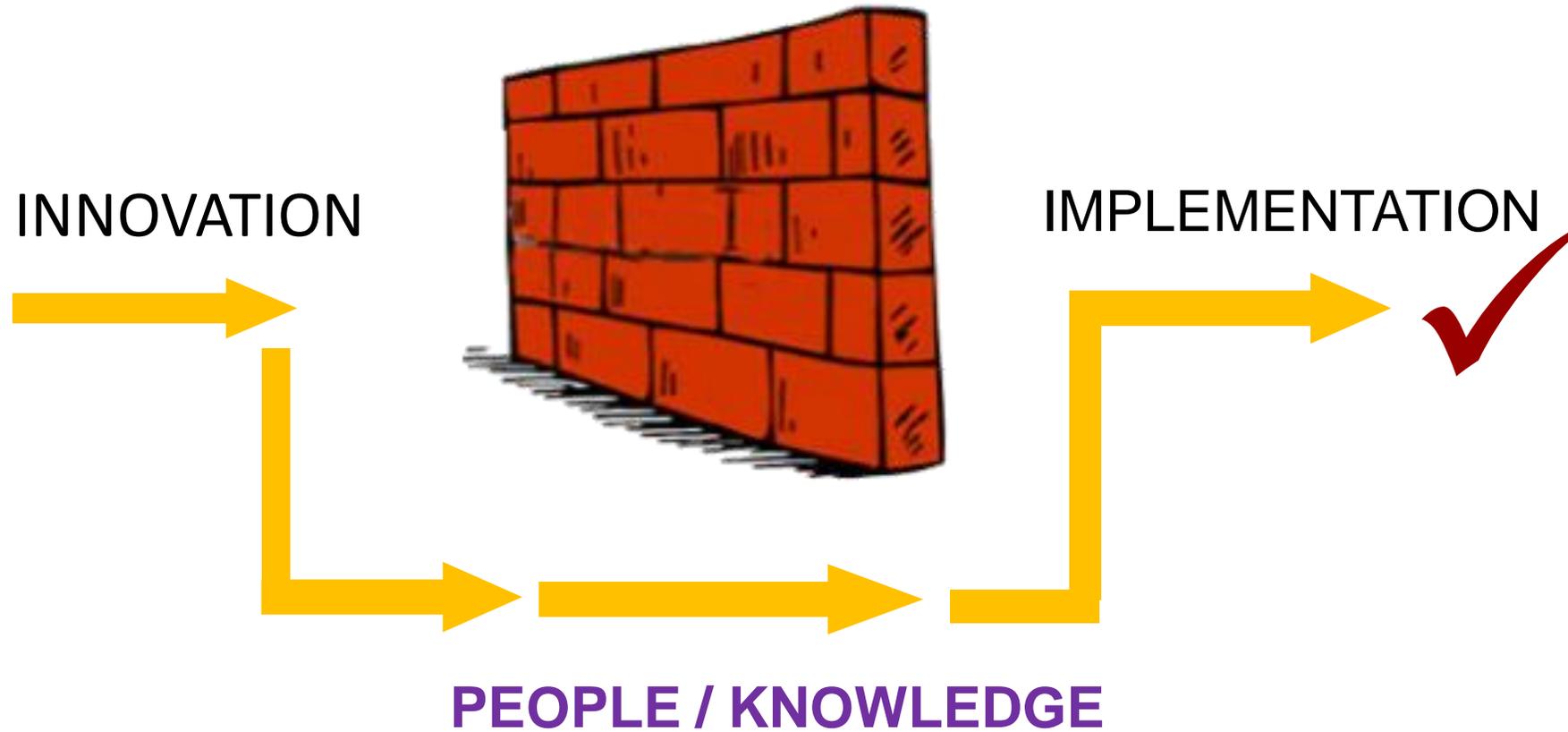
PAVEMENTEDUCATION.EDU.AU/PPI
Suite 9, 935 Station Street, Box Hill North
Victoria AUSTRALIA

“
Pavement Preservation is the practice of applying the right treatment on a road at the right time to extend pavement service life and longevity
”

Conclusion



Conclusion



The future?



Prototype hydrogen-powered aircraft
– Alaka'i Industries (2019)

For further details...

Centre for Pavement Engineering Education

www.pavementeducation.edu.au

contactus@pavementeducation.edu.au

Ph 03 9890 5155

Ray Farrelly, CEO

Kym Neaylon, Exec Manager Professional Development



Centre for Pavement Engineering Education

@CPEEAus



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