Problem Statement

Testing sustainable alternatives to traditional concrete use

SU 18-05

Sustainability

Problem Description

Question	Response
Description of the problem and purpose of the proposed research	Transport for NSW (TfNSW) is a significant consumer of concrete in its myriad of construction projects. A key constituent of concrete is cement, most commonly Portland cement. The production of Portland cement leads to the release of significant amounts of CO_2, a greenhouse gas (GHG). In fact, production of one tonne of Portland cement produces about one tonne of CO_2 in addition to other GHGs. There is a movement towards exploring sustainable alternatives to concrete usage, and in particular Portland cement, to reduce environmental impact and GHG release. Such exploration will play a leading role in the sustainability of transport infrastructure and our built environment. One way to reduce the environmental impact of concrete is to explore alternative, more sustainable materials as opposed to the current reliance on Portland cement. This can be accomplished through many methods such as the replacement of dwindling raw materials with suitable waste products, or the development of improved materials to replace less sustainable materials. The key focus of research would be: • Establish a baseline for CO_2 emissions for assets based on existing TfNSW practices and standards. • Identify innovative concrete mixes and other innovations or design options that will deliver the best sustainability outcomes and quantify reductions from baseline. • Establish a process for trialling some of these innovative concrete mixes or asset designs on low risk projects and low risk applications or asset types. Ultimately, this research will be used to build an evidence base and develop guidelines and standards that will enable innovation in concrete by measuring embodied carbon.

Hypothesis & Variables

Question	Response
For explanatory research, please describe a clear hypothesis with variables for testing **For exploratory research,** please describe how the proposed research will contribute to future explanatory research	This is initially exploratory research, so a hypothesis and variables have not been identified at this point. The exploratory research is intended to establish the baseline for CO_2 for TfNSW's current practices and standards, and identify options for innovative concrete mixes and possible design options to improve sustainability. For the final phase of the research, it is proposed that formal hypotheses are developed for the trialling of proposed initiatives that result in a measurable improvement in the sustainability of TfNSW's use of concrete.

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Strategic Criteria & Alignment

Question	Response
Alignment with strategic theme	This Problem Statement is aligned with the research theme 'Sustainability'. The research seeks to inform ways to reduce the environmental impact of TfNSW's use of concrete.
External driver of change analysis **Outline how the research will better position TfNSW to respond proactively to macro drivers of change**	We use PESTLE analysis to identify and describe the external drivers of change that this research would help TfNSW be in a better position to respond to. **Political** Environmental impact is an increasing focus of political interest. TfNSW is undergoing a period of heightened building activity. Many of the projects currently underway and planned will deliver infrastructure that will continue to use high quantities of concrete. The potential to reduce the embedded carbon in our projects will be a positive message and a public benefit. Concrete is a material that is increasingly scrutinised because of its use of cement. **Economic** The continuing broad expectation is for governments to do more with less, and strive for efficiency. Using new innovative mixes and designs may result in reduced costs. For example, an improved design may result in using less concrete as well as reducing embedded carbon. The use of a new mix may mean less cost for assets that are frequently used in transport projects. **Sustainability** Understanding our concrete use and establishing a process for innovation will allow TfNSW to minimise the CO_2 emissions. Our commitment to deliver transport projects and infrastructure provides a key opportunity to reduce their carbon footprint as well as nurture and support innovative materials and processes in industry.
Forward looking	The Problem Statement is future-orientated in that it provides a way that future transport projects can be delivered in a more sustainable manner. The lead time is beyond the current two- to three-year time frame before any implementation elements need to be considered.
Potential research impact	The proposed research has significant potential research impact. Through trialling alternatives to traditional concrete, sustainable outcomes can be achieved for TfNSW. In particular, research may result in improved standards and specifications that allow new technologies and innovations while maintaining the integrity of assets.

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Technical Criteria

Question	Response
Innovation **Outline how the proposed research will result in new knowledge**	The research would potentially establish new guidelines and incentives for our asset types that currently result in our highest GHG emissions. It would also identify innovative concrete mixes or designs that result in an overall reduction in GHG without being prescriptive. This would place TfNSW at the forefront of investigating new approaches to these issues.
Basis in completed research and/or observed practice	There are a number of standards that govern concrete use at TfNSW: • Australian Standards • Asset Standards Authority (ASA) Standards • Roads and Maritime (RMS) Standards Recent research has been undertaken by Beyond Zero Emissions which outlines how Australia could become a zero carbon cement industry in 10 years. A full report can be viewed here: http://media.bze.org.au/ZCIndustry/bze-report-rethinking-cement-web.pdf A summary of the report can be viewed here: http://media.bze.org.au/ZCIndustry/bze-report-rethinking-cement-short.pdf
Feasible data requirements	TfNSW will facilitate access to data if required.

Level of Collaboration & Resource Requirements

Question	Response
Level of collaboration **Please select the level of collaboration required to complete the proposed research**	**1. 'Quick-Fire' Research** ☐ Intense bursts of research activity (e.g. under 8 weeks). Intended to make use of 'hackathon'-type environments, where students/researchers work collaboratively and intensely on particular problems involving data interrogation and visualisation.
	2. Undergraduate Final-Year Research ☐ Suitable for final-year undergraduate students (e.g. capstone, Honours) as part of the research requirements for their undergraduate degree (i.e. 1 to 2 semesters).
	3. Higher Degree Research ☒ Project may form whole or part of a postgraduate research degree (i.e. Masters, PhD), and contribute to new knowledge (i.e. 1 to 3 years).
	4. Major Collaborations and Funded Research ☐ Project may form the basis for a significant collaboration agreement between TfNSW and the relevant research institution, including major competitive grant funding (e.g. Australian Research Council funding with TfNSW as an industry partner).
Comments	This project could form all or part of a PhD or Master of Research.
Supporting TfNSW resources	TfNSW will support the research by providing a partnership with industry and potential access to TfNSW project test sites. This will depend on project availability. TfNSW will also facilitate access to subject matter experts and project support (up to 4 hours per week).

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