

Climate Change Adaptation Research Grants Program

- Settlements and Infrastructure Projects

Project title:

Enhancing the resilience of seaports to a changing climate

Principal investigators: Professor Darryn McEvoy

Lead organisation: RMIT University

Objectives:

To better understand the vulnerability of critical seaport infrastructure (structural and functional), and to develop new knowledge and methodologies for enhancing port resilience to future climate change. The proposed research will adopt a multi-disciplinary approach and employ a range of different methodologies to address three discrete research objectives:

- 1) to gain a better understanding of the complex mix of climate and non-climate drivers that are likely to affect future port operations;
- 2) to assess the vulnerability of core port infrastructure and identify appropriate adaptation measures for enhancing resilience; and,
- 3) to assess the vulnerability of other elements at risk in the wider port environs and identify appropriate adaptation measures. Close engagement with a range of policy and practitioner stakeholders will ensure that the deliverables will be 'fit for purpose'.

Project design and methods:

Work package 1: Understanding future risks (climate and non-climate)

The purpose of WPI is to use integrated assessment methodologies to better understand the complexity (and uncertainty) of future risks facing Victorian seaports, and to use the findings from this analysis as quantitative and qualitative data inputs to work packages 2 and 3 (structural and functional resilience). Climate change scenarios, including the latest estimates of sea level rise, will be integral to the research and it is intended that there will be close liaison with the Australian Climate Change Science Programme to ensure that modelling efforts (both averages and extreme events) are informed by user needs (with relevant downscaling where feasible). Furthermore, recognising that climate change is only one of a set of multiple stressors likely to impact on future port operations, analysis will also consider other social, political, economic and institutional drivers with the potential to influence change. WPI (and later WP4) will also provide a management function for the project overall and will be led by Associate Professor Darryn McEvoy, with support from staff (Mullett and others as required) at the Climate Change Adaptation Programme (CCAP), Global Cities Institute (GCI), RMIT University.

Work package 2: Structural resilience of core port infrastructure

As highlighted in the S&I NARP, major infrastructure managers (such as Port Authorities) need to make strategic decisions in advance of tipping points being reached to avoid 'catastrophic failure of essential physical assets'. Whilst simulation techniques are commonly used to estimate future degradation and service of critical infrastructure - e.g. concrete, metal and wood structures - according to their sensitivity to various environmental parameters (such as depth of high tide, temperature, wetting and drying cycles etc), there has been no consideration of the altered levels of vulnerability and exposure that will result from a changing climate. This knowledge deficiency also applies to life cycle modelling which provides an important evidence base for decisions affecting the protection and maintenance of different forms of seaport infrastructure. WP2 will make a valuable contribution to overcoming some of these limitations; ultimately producing a suite of software models, management tools (including consideration of costs and benefits), and design specification guidance, which will be developed taking explicit account of a range of key climate parameters. Activity is comprised of three main components: 1) mapping and characterising the vulnerability of different port infrastructure according to a system hierarchy; 2) undertaking detailed predictive modelling of the deterioration of key infrastructure (software models plus 3D visualisation capacity to allow strategic targeting of hot

spots); 3) developing resilience metrics (and data for the development of composite resilience indices). The three main investigators, Molyneaux, Setunge, and Zhang, all have prior research experience in infrastructure management and modelling the durability of materials and structures under extreme conditions. The work carried out will introduce climate parameters to model development currently being carried out as part of the ARC Linkage project LP0883290: Improved management of Australian Port Infrastructure by development of predictive ageing simulation (Geelong and Sydney).

Work package 3: Functional resilience of wider port environs

Ports not only perform basic loading and unloading functions for shipping, they are also highly integrated operations often with complex sets of logistics functions. Major ports, for instance, are responsible for a wide range of value added services, providing essential supply chain and freight distribution services to rapidly expanding economies in both regional and national hinterlands. As such, any climate-related disruption to the functioning of the wider port environs could have significant socio-economic repercussions downstream. Based on the need to promote adaptive and agile ports which are adequately climate proofed, WP3 will first develop a methodology for systematically identifying the vulnerability of different elements at risk in the wider port environs. Issues of functional resilience will then be addressed according to: 1) land use patterns; 2) port operation and freight distribution; 3) organisational structure and institutional adaptive management; 4) employment, skills and work-force preparedness. Research activity for this WP will be undertaken by Chhetri (management of WP, supply chain modelling), Corcoran (GIS mapping of asset vulnerability), Gekara (adaptive capacity of workforce), and Wickramasinghe and Corbitt (development of adaptation strategies). All are experienced in logistics, information systems and knowledge management, and are backed up by advanced computing facilities at the School of Business IT and Logistics.

Work package 4: Synthesis

The final WP will perform a synthesis role, pulling together findings from WP's 1-3 and tailoring scientific output in a format suitable for a variety of policy and practitioner end-users (a series of workshops will contribute to this agenda). A final integrated report on vulnerability assessment and adapting seaports to future climate change (including consideration of costs and benefits) will be produced as part of this high level synthesis. McEvoy and members of the Climate Change Adaptation Programme will be responsible for this process of final integration. As well as practical relevance, numerous peer-reviewed journal articles for an international audience are envisaged.