INFRASTRUCTURE CLUSTER CONFERENCE

Building Sustainable and
Resilient Portal Cities

TUESDAY 8
WEDNESDAY 9
MAY 2018

Surabaya
Indonesia

The **Australia-Indonesia** *Centre*

INFRASTRUCTURE
RESEARCH
CLUSTER

An initiative of

In collaboration with

Supported by

With corporate partners

Contents

Welcome

The Australia-Indonesia Centre's Infrastructure Cluster is proud to welcome you to 'Building Sustainable and Resilient Port Cities', a conference showcasing the work of the cluster.

The cluster's research investigates the built, political, social and natural environments of Indonesian ports.

The results of this collaborative endeavour between scientists and engineers in Indonesia and Australia will inform efforts to build the large-scale maritime infrastructure needed to meet national, regional and global demand.

The Infrastructure Cluster's research focuses on three key themes that relate to the infrastructure challenges in portal cities. These are:

1. There and back again: improving transport and connectivity

2. Infrastructure policy and process

3. Technological enhancement to asset management

Over two days, the conference will bring together the Cluster's academic researchers with stakeholders in industry and government to discuss the applications and future opportunities raised by the research.

The first day of the conference presents the research achievements of the cluster. This will be followed by a panel discussion around the theme of the conference that will bring together researchers and stakeholders. The first day will close with an opportunity for networking at a conference BBQ dinner celebrating the achievements of the cluster.

The second day of the conference will focus upon solutions to infrastructure challenges and will invite relevant stakeholders from industry and government to view innovative research developed by cluster members that respond to these challenges.

Dr Hera Widyastuti
Professor Sigit Priyanto
Professor Iswandi Imran
Professor Wing Kong Chiu
Professor Colin Duffield

About the Infrastructure Cluster

The Cluster aims to establish a collaborative, two-way research model which enables holistic research approaches through location-based studies across a number of interlinked disciplines and sectors.

This research model allows for the identification of methodologies and solutions that have the potential to be up-scaled and to produce research outcomes that can be replicated across different sites.

The Cluster recognises the central role that stakeholders and end-users play in this process. Our stakeholders outside the university sector have included representatives from port and railway authorities in Australia and Indonesia, engineers, policy makers, and experts in private industry. The involvement of our stakeholders has been essential to the development of a relevant, longer-term research agenda.

The Australia-Indonesia Centre's Infrastructure Cluster wishes to express its gratitude to the researchers, industry partners and members of our advisory board who have together made this work possible.

About The Australia-Indonesia Centre

The Australia-Indonesia Centre is supported through federal funding from Australia's Department of Education and Training and Department of Foreign Affairs and Trade. Support also comes from Indonesia's Department for Research, Technology and Higher Education.

The Centre, hosted by Monash University, is a collaboration between Monash University, the Australian National University, The University of Melbourne and The University of Sydney, working with seven leading Indonesian universities.

The Indonesian academic institutions are Universitas Indonesia, Universitas Gadjah Mada, Universitas Hasanuddin, Universitas Airlangga, Institut Teknologi Bandung, Institut Teknologi Sepuluh Nopember and Institut Pertanian Bogor.

Valued corporate partners include the Pratt Foundation, ANZ and PwC.

The Australia-Indonesia Centre has three Core Objectives set in consultation with the Australian Government.

RESEARCH

Pursuing solutions to shared national challenges in areas such as Energy, Infrastructure, Health, Urban Water, and Food & Agriculture via highly collaborative research.

LEADERSHIP

Strengthening and deepening Australia-Indonesia networks, developing leadership skills and fostering the exchange of knowledge.

INSIGHT

Promoting greater understanding and cultural awareness – Australians of Indonesia, and Indonesians of Australia.

Cluster Leads

Dr Hera Widyastuti

Professor Sigit Priyanto

Professor Iswandi Imran

Professor Wing Kong Chiu

Professor Colin Duffield

Advisory Board

Leith Doody
Advisor
Australia International Business

Bernardus Djonoputro
President
Indonesian Association of Urban & Regional Planners

Vivek Dodani
Associate Director, Infrastructure and Urban Renewal
PwC

Associate Professor Bambang Trigunarsyah
Associate Professor, Construction Engineering and
Management Department
King Fahd University of Petroleum and Minerals

Dewi Sri Umi
Co-Founder and Managing Director
Penida Capital Advisors Ltd

Buntaran Gumulya
President Director
PT Steelforce Indonesia

Venket Naidu
Industry Director - Ports & Maritime
AECOM

Administration

Maria Platt
Infrastructure Cluster Coordinator
Monash University

Samantha Croy
Project Officer (Research)
Monash University

Cluster Projects

Strategic Research Projects

Seismic performance of critical infrastructures in port development

Professor Abbas Rajabifard - The University of Melbourne

Dr Hera Widyastuti - Institut Teknologi Sepuluh Nopember

Efficient facilitation of major infrastructure projects

Dr Felix Kin Peng Hui - The University of Melbourne

Dr Sari Wahyuni - Universitas Indonesia

Connectivity – from sea to rail, sea to road, road to rail

Professor Andreas Ernst - Monash University

Dr Hera Widyastuti - Institut Teknologi Sepuluh Nopember

Changing the landscape of rail through advanced asset health monitoring systems – A novel method to increase the resilience of track infrastructure

Dr Chao Chen - Monash University

Dr Hera Widyastuti - Institut Teknologi Sepuluh Nopember

Tactical Research Projects

Life-cycle structural performance assessment framework for concrete bridges

Dr Lihai Zhang - The University of Melbourne

Professor Iswandi Imran - Institut Teknologi Bandung

Development of fibre optic based sensors for critical road, railway, port, bridge and pipeline monitoring

Professor Jayantha Kodikara - Monash University

Dr Hera Widyastuti - Institut Teknologi Sepuluh Nopember

Pre-Cluster Projects

Small Projects

Asset life improvement of rail infrastructure

Professor Wing Kong Chiu - Monash University

Dr Hera Widyastuti - Institut Teknologi Sepuluh Nopember

Australia-Indonesia joint workshop on smart cities

Professor Marimuthu Swami Palaniswami - The University of Melbourne

Professor Prihatmanto Ary Setijadi - Institut Teknologi Bandung

Effective structuring and packaging of funding and financing arrangements for the delivery of infrastructure

Professor Colin Duffield - The University of Melbourne

Dr Sari Wahyuni - Universitas Indonesia

Rapid Start Projects

Improving Rail Infrastructure - rail transportation (interfacing to a port intermodal terminal)

Professor Wing Kong Chiu - Monash University

Dr Hera Widyastuti - Institut Teknologi Sepuluh Nopember

Using instrumented revenue vehicle to inspect track integrity and vehicle performance during peak times

Professor Colin Duffield - The University Of Melbourne

Professor Wing Kong Chiu - Monash University

DAY ONE: Tuesday 8 May

8.15 - 8.45	Registration Meet and Greet
8.45 - 9.30	**Welcome Addresses** **Introducing the Cluster** Research Overview and Achievements
9.30 - 11.00	**There And Back: Improving Transport and Connectivity** *Changing the Landscape of Rail through Advanced Asset Health Monitoring Systems – A Novel Method to Increase the Resilience of Track Infrastructure* *A Combined Simulation and Optimization Method for Route Selection in Intermodal Container Distribution*
11.00 - 11.30	Morning Tea Break
11.30 - 13.15	**Making It Last: Infrastructure Asset Monitoring and Durability** *Structural Performance of Critical Structures in Port Development* *Review and Development of Fibre Optic Based Sensors for Infrastructure Monitoring* *Delamination Detection of Concrete Structures Using Infrared Thermography*
13.15 - 14.15	Lunch Break
14.15 - 15.45	**Financing Infrastructure: Ports, Industry and End-Users** *Ability To Pay (ATP) and Willingness To Pay (WTP): Motorcycle Users Shifting To New Infrastructure Plans of Magelang-Yogyakarta- Bantul Urban Railway Operation* *Efficient Facilitation of Major Infrastructure Projects*
15.45 - 16.10	Afternoon Tea
16.10 - 17.00	**Building Sustainable and Resilient Port Cities: Perspectives from Government, Academia and Industry** Panel Discussion and Dialogue
18.00 - 20.00	BBQ Dinner

DAY TWO: Wednesday 9 May

10.00 - 12.00	Industry Demonstrations and Networking Session
10.00 - 10.10	**Welcome Remarks - Dr Bambang Setiadi** Chairman, National Research Council of Indonesia
10.10 - 10.40	**Presentations** *What Can Mathematical Models Tell Us About the Logistics of Container Transportation in Indonesia?* *How Can Fibre Optic Sensors Provide Monitoring of Crucial Infrastructure?* *How Can Railway Performance be Improved through the Use of Innovative Continuous Monitoring Technologies?* *How Can Structures be Assessed without Damage to Them?*
10.40 - 12.00	**Networking and Demonstrations**
12.00 - 12.30	**Closing Remarks - Mr Chris Barnes** Australian Consul-General in Surabaya
12.30 - 13.30	Lunch

DAY ONE: Tuesday 8 May

Research Overview and Achievements

Building Sustainable and Resilient Portal Cities

Hera Widyastuti [1]
S. Priyanto [2]
I. Imran [3]

[1] Centre Study of Transportation and Logistics, Institut Teknologi Sepuluh Nopember, Kota Surabaya, Indonesia

[2] Department of Civil and Environmental Engineering, Universitas Gadjah Mada, Yogyakarta, Indonesia

[3] Faculty of Civil and Environmental Engineering, Institut Teknologi Bandung, Kota Bandun, Indonesia

W.K. Chiu [1]
C. Duffield [2]

[1] Department of Mechanical and Aerospace Engineering, Monash University, Australia

[2] Department of Infrastructure Engineering, University of Melbourne, Australia

The Infrastructure Cluster is one of four research clusters funded by The Australia-Indonesia Centre. The Cluster has aimed to deliver research that will enable parallel developments on issues faced by portal cities in both Australia and Indonesia's growing maritime sectors.

The Infrastructure Cluster has sought to provide evidence-based solutions to a range of projects.

These include:

- the establishment of resilient integrated services for intermodal transport systems (road and rail) in portal cities;

- building effective infrastructure governance, policy and engagement processes which enable cities and their ports to develop and function sustainably;

- and strengthening innovation opportunities which benefit the environment, local economy and operational outcomes of portal cities.

This presentation will provide an overview of the range of research projects that have been conducted under the cluster and will discuss how these contribute towards the achievement of the cluster's aims and objectives.

There and Back: Improving Transport and Connectivity

Changing the Landscape of Rail through Advanced Asset Health Monitoring Systems – A Novel Method to Increase the Resilience of Track Infrastructure

Nithurshan Nadarajah [1]
Amir Shamdani [1]
Glenn Hardie [1]
Wing Kong Chiu [2]
Hera Widyastuti [3]

[1] Institute of Railway Technology, Monash University, Melbourne, Australia

[2] Department of Mechanical and Aerospace Engineering, Monash University, Melbourne, Australia

[3] Centre Study of Transportation and Logistics, Institut Teknologi Sepuluh Nopember, Kota Surabaya, Indonesia

Early detection of track deterioration and defects is crucial for safety and efficient maintenance of railway assets. Typically a number of track geometry parameters are measured periodically using a Track Geometry Vehicle (TGV) to determine the condition of the track and make maintenance and operational decisions. Use of track parameters to assess the condition of the track fails to highlight that the risk in operation is contributed by both the track and the rolling stock.

The distinct dynamic nature of each class of rolling stock causes variations in the induced dynamic response. Therefore, the severity of the response is the real measure of the risk in operation.

Dynamic responses in the field can be directly measured and correlated to track conditions using an Instrumented Revenue Vehicle (IRV) developed by IRT at Monash University. The dynamic response for a given track and operational condition can also be predicted from the kinematic computational models.

Prior knowledge of the dynamic response gives early warning of risks, optimises operation and maximises throughput. However, the complex nature of the dynamic system makes these models a challenge to develop. They can also be computationally costly to run.

Recent advances in machine learning and artificial intelligence algorithms provide a very attractive alternative for development of a dynamic behaviour predictive model. IRV data of rolling stocks in Indonesia and Australia were used for the development of predictive models in this project. IRV data was post processed to evaluate the track parameters. Measurement from the on-board GPS was used to spatially align the measured dynamic response to the track condition.

The responses were used to train supervised machine learning models. Both classification and regression predictive models were developed. These models were evaluated by comparing the predictions with measured responses. Results showed good agreement with the measured responses.

These tools can increase the safety, efficiency and productivity in railway operations. The predictive capability can be further improved by increasing the diversity in the training data by integrating data from similar rolling stock in different lines. These models can be utilised as quick decision making tools.

A Combined Simulation and Optimization Method for Route Selection in Intermodal Container Distribution

A. A. N. Perwira Redi [1]
Andreas T. Ernst [1]
Mohan Krishnamoorthy [2]
Hera Widyastuti [3]

[1] School of Mathematical Sciences, Monash University, Melbourne, Victoria, Australia

[2] School of Information Technology and Electrical Engineering, The University of Queensland, Brisbane, Australia

[3] Department of Civil Engineering, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia

We consider the problem of routes-selection for container distribution in an intermodal network. The problem is modeled as a variant of minimum cost multi-commodity network flow problem. The objective of the model is to select the set of routes to serve container request between various origin-destination pairs in a multimodal network, at minimum total cost. The economics of scale of transporting containers is considered using piecewise linear, concave total-cost function for each arc.

A solution method based on hybrid lagrangian particle swarm optimization (LaPSO) and Discrete Event Simulation (DES) is proposed. The LaPSO provides the selection of route and transportation mode to serve container transportation demand. Then, the DES model evaluates those routes by considering transportation costs and by incorporating transportation time and demand uncertainty. Moreover, the DES framework is also utilized to generate input data to the optimization framework based on several predetermined scenarios. Furthermore, the congestion effects on road access to the port is analyzed for each scenario.

The proposed method is tested on a real-world data set that is generated from container distribution in Indonesia.

Making it Last: Infrastructure Asset Monitoring and Durability

Structural Performance of Critical Structures in Port Development

Massoud Sofi [1]
Elisa Lumantarna [1]
Yusak Oktavianus [1]
Hera Widyastuti [2]
Abbas Rajabifard [1]

[1] Department of Infrastructure Engineering, University of Melbourne

[2] Centre Study of Transportation and Logistics, Institut Teknologi Sepululuh Nopember, Kota Surabaya, Indonesia

Seaports are very important infrastructures for local and international transportation networks and play a vital role in the economic activity of a nation. Downtime of seaports can cause significant economic loss. In most countries, including Indonesia, international trade through sea transportation is the most common mode of transportation compared to other modes such as land and air. The reliability and effectiveness of sea transportation is crucial for both regional and national economies

The aim of the research project was to assess the performance of critical structures in seaports under normal operation and in a seismic event. The assessment was based on the existing condition of these structures which are subjected to deterioration due to exposure to a marine environment.

For this study, two seaports are selected as case studies in Surabaya, Indonesia. The structural health assessments were conducted on critical elements of the ports using a series of non-destructive equipment. The outcomes of the structural health assessments were used to provide a prediction of the service life and to assess the seismic performance of the bridges based on the latest knowledge of seismic hazard levels in Indonesia.

The project has enabled the structural health conditions of critical port structures to be determined and their seismic risk to be quantified. The outcomes of the project will contribute to the development of maintenance and mitigation strategies, as well as improvement to current design provisions for port structures.

Delamination Detection of Concrete Structures using Infrared Thermography (IRT)

Lihai Zhang [1]
Babar Nasim Khan Raja [1]

[1] Department of Infrastructure Engineering, University of Melbourne

Infrared thermography (IRT) is a non-destructive evaluation (NDE) technique which can effectively detect the delamination of reinforced concrete structures. IRT is very sensitive to environmental conditions as well as to the characteristics of delamination (e.g. size and depth).

In this study, a Finite Element-based numerical model was developed to identify the critical environmental factors that govern the effectiveness of IRT in delamination detection, as well as determining the most suitable times for IRT inspection.

The results show that solar radiation and ambient temperature are two important factors that greatly affect the outcomes of IRT detection. Further, it demonstrates that IRT inspection at noon and night time may provide the best outcomes.

Review and Development of Fibre Optic Based Sensors for Infrastructure Monitoring

Leslie Wong [1]
Jayantha Kodikara [1]
Hera Widyastuti [2]
Wing Kong Chiu [3]

[1] Department of Civil Engineering, Monash University

[2] Centre Study of Transportation and Logistics, Institut Teknologi Sepuluh Nopember, Kota Surabaya, Indonesia.

[3] Department of Mechanical and Aerospace Engineering, Monash University, Melbourne, Australia

Roads, bridges, ports, railways, and pipelines are important infrastructures that underpin the economies of Australia and Indonesia. Having served communities for decades, these civil structures age and deteriorate, causing them to work beyond their original design capacity. Moreover, with the increase in demand as well as climatic changes, these structures are exposed to extreme events that can threaten their sustainability. There is a need to search for new and advanced sensing technology to perform real-time, continuous, distributed and permanent integrity monitoring strategies for these assets. In recent years, Distributed Optical Fibre Sensors (DOFS) have gained attention and successfully demonstrated their potential for structural health monitoring applications due to their unique sensing characteristics. The aim of this project was to review and develop novel applications of DOFS in monitoring these critical infrastructures.

Literature reviews on the applications of distributed optical fibre sensors - especially in monitoring structural health of railways, pavement, port structures and slope stability - were conducted. DOFS are able to measure strain, temperature and vibration of the host structure continuously over a long distance (-kms) with a reasonably high resolution (-cm). With high temporal resolution, DOFS can also perform real-time monitoring. Recent studies also show that the structural health monitoring can be performed using existing telecommunication optical fibres which are buried close to these infrastructures. In other words, it is not always necessary to spend more money in deploying new optical fibres for condition assessment purposes.

In this project, a series of laboratory-based experiments were conducted focusing on pavement and pipeline monitoring. The experimental results show that DOFS can potentially be used to study the flexural properties of different pavement designs and can even detect the location of the cracks along the pavement at an early stage. Furthermore, a submersible quasi-distributed fibre optic based device was also developed, constructed and examined for structural health monitoring of water pipelines.

The developed device is an "attachment-free" design (not attached to the pipe) and it is capable of measuring water pressure and detecting vibration. The optical device was deployed and tested inside a pressurised pipe. The experimental results showed the potential of using such proposed sensing strategies for measuring pressure transients, detecting leaks, small anomalies and for measuring the growth of the anomalies along water pipelines.

Financing Infrastructure: Ports, Industry and End-Users

Ability To Pay (ATP) and Willingness To Pay (WTP): Motorcycle Users Shifting To New Infrastructure Plans of Magelang-Yogyakarta-Bantul Urban Railway Operation

Ustadi Ridwan [1]
Ir. Sigit Priyanto [1]
Ir. Latif Budi Suparma [1]
Wing Kong Chiu [2]

[1] Department of Civil and Environmental Engineering, Gadjah Mada University, Yogyakarta, Indonesia

[2] Department of Mechanical & Aerospace Engineering, Monash University, Victoria, Australia

This study aims to analyze the ability to pay (ATP) and willingness to pay (WTP) of prospective urban rail users in the region of Daerah Istimewa Yogyakarta related to the operation plan of the Magelang-Yogyakarta-Bantul urban railway.

The research was conducted through a survey of motorcycle users in the area of Magelang-Yogyakarta-Bantul railway route plan. The survey data were processed with a travel cost method to obtain the ATP value, while the WTP value was obtained by analysing the preferences of prospective users in different fare and train service scenarios. Ordered probit modeling using Limdep 7.0 software was employed to obtain the utility function. This utility function was then used to calculate the probability of motorcycle riders using the train.

Based on the analysis, the average ATP was Rp. 494.28 / Km, while the lowest and highest ATPs were Rp. 181.82 / km and Rp. 986.84 / Km respectively. The optimum WTP, if applied to service scenario 1, is the tariff of Rp. 6,000, 2.5 hours travel time and arrival scheduled every 15 minutes, where the probability that motorcycle users will use the train is 27.4787%.

Knowing ATP and WTP values facilitates planning the appropriate fare, which in turn can optimise services along the Magelang-Yogyakarta-Bantul urban train route.

Efficient Facilitation of Major Infrastructure Project

Colin Duffield [1]
Felix Kin Peng Hui [1]
Sally Wilson [1]
Hanif Wisesa [1]
Lydwina Anhistry [1]
Sari Wahyuni [1]
Alif Azadi Taufik [1]
Ruslan Prijadi [2]
Waskitha Galih [3]
Haya Daghlas [1]

[1] Department of Infrastructure Engineering, University of Melbourne

[2] Universitas Indonesia, Department of Management

[3] Universitas Indonesia, Magister of Management

Infrastructure projects are usually nationally significant investments that provide much needed social and economic benefits. Decision makers are often faced with challenging tasks of prioritising and allocating scarce financial resources. In the case of significant infrastructure investments such as port projects, specific guidance on the critical issues will help with decision making to ensure that value is delivered.

In this project, the international team conducted both qualitative and quantitative research employing online surveys, focus group discussions and in-depth interviews to identify projects and initiatives that are critical to the competitiveness and survival of international ports in Australia and Indonesia.

Our findings thus far point to a few interesting and critical areas that will be discussed separately in five short presentations. There are never sufficient funds to meet the expectations associated with the large capital expenditure required for infrastructure development. Countries like Australia can readily raise the finance for such investments provided the investment is underwritten by an AAA credit rated government but balancing the level of debt with the ongoing cost of finance remains a challenge. Emerging nations such as Indonesia face additional challenges in raising finance due to sovereign risk, perceptions of governance and the depth of their in-country financial market.

The first paper introduces the options available to decision makers. The second paper looks at the financing options that are available for infrastructure projects in Indonesia and offers a case study comparing the different finance strategy decisions taken at a port in Indonesia with one in Australia. The third paper looks at the use of the asset sale model as a financing mechanism for infrastructure projects in Australia and Indonesia. The fourth paper looks at one of the critical issues in Australian port infrastructure decisions i.e. the enabling effects of directing investment to land-side transport as a means of improving port operations. The final paper looks at issues that are critical to Indonesian port competitiveness.

DAY TWO: Wednesday 9 May

Industry Demonstrations

What Can Mathematical Models Tell Us About the Logistics of Container Transportation in Indonesia?

This presentation demonstrates the use of mathematical modelling to assist with route selection for the intermodal transport of containers to and from ports. It will show how using mathematical models along with the optimisation approach can assist in assessing port access options. This will help to reduce congestion in container transportation, especially at port gates.

How Can Fibre Optic Sensors Provide Monitoring of Crucial Infrastructure?

This presentation provides an overview of the application of distributed optical fibre sensors for monitoring the condition of infrastructure. Fibre-optic-based sensors can be used to monitor the structural health of pipelines, as well as assess pavement and slope stability. They have also been shown to be effective in monitoring infrastructure such as tunnels, dams and bridges.

How Can Railway Performance be Improved through the Use of Innovative Continuous Monitoring Technologies?

Railway networks are growing steadily globally. Significant amounts of capital are invested in modernising railway infrastructure to meet the demands of a growing customer base with changing needs. Increasingly, railway operators are on the lookout for methods that will allow them to meet these needs efficiently. This presentation presents two innovative approaches, developed by Monash University's Institute of Railway Technology, that will improve railway operations and allow railway operators to meet growing demand.

How Can Structures be Assessed without Damage to Them?

This presentation introduces Non-Destructive Testing (NDT) and assessment techniques. NDT is the method of examining structures and components for defects without damaging the integrity of the system itself. NDT techniques are especially useful for assessing civil infrastructure such as roads, bridges, ports and tunnels. This hands-on demonstration will provide you with the opportunity to test small concrete samples using common NDT equipment such as a profometer, a Schmidt hammer and a resipod.

The
Australia-Indonesia
Centre