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Australia-Indonesia Centre Megatrends:
INFRASTRUCTURE

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The Australia-Indonesia Centre

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THE CONTEXT: Indonesia and Australia

In spite of their close proximity and the sharing of an international maritime border, Indonesia and Australia are very different nations. Geographically, politically, culturally and economically they bear some similarities, but also some stark differences. As well as presenting results of the Australia Indonesia Centre Foresighting Project's megatrend analysis, this report summarises some of the key characteristics of the two nations and their connections. Nonetheless, both nations are located in the Asian economic region which is transforming rapidly, presenting opportunities and necessities for greater collaboration on shared issues.

Notable facts are:

- Indonesia consists of over 17,000 islands, while Australia is predominately an arid continent.
- More than 75% of the Indonesian population lives within 100 km of a Holocene volcano (active within the last 11,700 years), while the Australian mainland has no active volcanoes.
- Indonesia has one of the highest population densities in the world (126 people per km^2), while Australia has one of the lowest (2.9 people per km^2).
- In 2014 the Human Development Index (HDI) of Indonesia was 0.684, ranking 108th in the world, while Australia's HDI was 0.933, ranking 2nd in the world.
- Indonesia has the world's largest Muslim population, while Australia has inherited predominately Judeo-Christian cultural values.
- 49% of Indonesians are urban residents, compared to 89% of Australians.

The Australia-Indonesia Centre

The Australia-Indonesia Centre (AIC) was formed in 2014 to strengthen and deepen Australia-Indonesia business, government, education, research, and community links. It has the goal of *'building greater research collaboration between Australia and Indonesia in areas of shared challenge'*. The Australian Government is providing $15 million in 2014-2017 to support the AIC. In Australia, there are five research partners: Monash University, the University of Melbourne, the

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University of Sydney, the Australian National University and CSIRO. In Indonesia, there are seven partners: the Technical Institute of Bandung (ITB), the Bogor Agricultural Institute (IPB), the University of Indonesia, Hasanuddin University (UNHAS), the Institut Teknologi Sepuluh Nopember (ITS), Airlangga University (UNAIR), and the University of Gadjah Mada (UGM). The Indonesian partners coordinating committee is supported by the Indonesian Ministry for Research, Technology and Higher Education – formerly supported by the Ministry for Education and Culture, Department of Higher Education (DIKTI).

The AIC will collaboratively research solutions to shared national challenges in four Clusters:

- **ENERGY**
- **INFRASTRUCTURE**
- **AGRICULTURE AND FOOD**
- **HEALTH**

Groups of Australian and Indonesian universities are being formed around each Cluster. A Cluster Investment Plan (CLIP) to guide longer term research collaboration will be developed by June 2015 for each Cluster. This is being undertaken through planning workshops held in Australia and Indonesia with Cluster researchers and consultation with government, industry, business and civil society stakeholders.

The AIC Foresighting Project

CSIRO was invited by the AIC to assist with the Cluster planning process by applying its 'foresighting' approach, which can analyse key trends in each theme towards 2030 and beyond. This was intended to assist each CLIP to be evidence-based and anticipatory, and to enable a pathway to market, adoption and application. Due to the short project time frame (November 2014 – June 2015) and the advanced stage of the Clusters' planning, the standard CSIRO method had to be accelerated. The over-arching project goal was to '*support the development of CLIPs which focus on priority research areas of shared interest between Australia and Indonesia, and to promote integration, synergy and learning amongst the Cluster teams*'.

In November 2014 – January 2015 the project engaged with Cluster teams during their planning workshops to identify shared issues, underlying drivers and potential megashocks. Potential categories of collaboration on the shared issues were as follows:

A. Australian capacity to address an Indonesian challenge

B. Indonesian capacity to address an Australian challenge

C. Shared challenge requiring collaborative skills and capacity

D. Shared challenge that has global relevance/exportable value

In February – May 2015 megatrend narratives were developed around the shared issues, and then tested and refined through discussion and validation with Cluster researchers and the AIC.

Infrastructure Cluster megatrends

A joint Indonesian-Australian researcher meeting for the Infrastructure Cluster was held in Surabaya, Indonesia in January 2015. During this meeting a horizon scanning activity was undertaken with 20 members of the Cluster and two AIC representatives. The horizon scanning exercise aggregated participant concerns into common issues, drivers and megashocks.

Shared issues were categorised into five main themes: environment, governance, sustainability, effectiveness, and issues specific to ports. Four were listed as Category C and D, and one was Category C only (Table A). Potential megashocks varied between the broad issues, but the most frequently mentioned were changing government policies or environment, climate-related events, natural disasters such as earthquakes or flooding, fuel price spikes or insecurity and global disease pandemics and health issues.

Based on these shared issues and drivers as well as the subsequent foresighting process, four overlapping megatrends were identified: Environmental Risks and Opportunities, International Gateways, Coming Ready or Not, and Technology and Innovation.

Using information and data suggested by Cluster researchers during the horizon scanning, combined with a literature review on the drivers and issues identified, narratives were collated for each megatrend. These are summarised below.

THE FOUR MEGATRENDS IDENTIFIED FOR THE INFRASTRUCTURE CLUSTER

TABLE A. THE SHARED ISSUES, DRIVERS AND MEGASHOCKS IDENTIFIED BY MEMBERS OF THE INFRASTRUCTURE CLUSTER, WHERE SHARED ISSUES HAVE BEEN CATEGORISED INTO ONE OR MORE OF FOUR CATEGORIES: A – AUSTRALIA CAPACITY HELPING INDONESIA; B – INDONESIA CAPACITY HELPING AUSTRALIA; C – SHARED ISSUE BOTH COUNTRIES HAVE A PROBLEM WITH; D – SAME AS C BUT WITH AN INTERNATIONAL MARKET POTENTIAL.

SHARED ISSUE	CATEGORY	UNDERLYING DRIVERS	POTENTIAL MEGASHOCKS
Environment	C and D	- Extreme events (e.g. flooding and extreme heat) - Pollution – air, water, soil - Disaster mitigation and recovery - Governance and human behaviour	- Climate change, climate extremes and their impacts - Geohazards and their impacts - Infrastructure failure - Epidemics - Man-made shocks (e.g. oil spills)
Governance	C and D	- Road safety - Work practices - Regulation and lack of leadership	- Geohazards (e.g. earthquakes, flash flooding) - Massive change in the socio-political environment - Withdrawal of a service (e.g. fuel crisis or energy breakdown)
Sustainability	C and D	- Aging infrastructure - Environmental change	- Infrastructure failure - Technology redundancy - Geohazard risk
Effectiveness	C and D	- Connectivity and equity - Governance and socio-politic - Remoteness - Increasing demand for access to services	- Geohazards (e.g. earthquakes) - Changes in the socio-political environment - Global economic and policy issues (e.g. controls on greenhouse gas emission, oil price)
Ports	C	- Environmental challenges (e.g. pollution, land clearing, loss of biodiversity) - Social conditions (e.g. behaviour, education, equity, changing employment, displacement, empowerment) - Infrastructure development challenges (e.g. land acquisition, financing and funding, assets, investment, politics, legal and labour, poor planning) - Infrastructure needs (e.g. services/logistics, technological advancement, lack of connectivity, transformation rather than incremental change)	- Commodity and/or price shock - Unexpected change in demand

Environmental Risks and Opportunities

This megatrend describes the increasing risks and associated costs from climate change and disasters, as well as the inevitable growth in demand for natural resources and infrastructure due to the growing global population and its mobility. These changes will increase pressure to upgrade existing and build new infrastructure in order to support development. Importantly, these must account for the projected environmental change (e.g. sea level rise), and a growing scarcity of natural resources. In both Indonesia and Australia there will be increased demand for infrastructure that is more resilient, less damaging to the environment, and supportive of low carbon emissions.

Climate change: Global warming is projected to continue into the future. There are also likely to be changes in the Australian and Indonesian climate and oceans. These will have implications for physical infrastructure, such as ports. Historically, civil engineers have relied upon past climate data to design infrastructure. Considering the risk of increased climate variability, planning based solely on historic data may create future problems, such as unreliable water supply systems. Planners must develop design and operationalise practices which can withstand future climate conditions including both extremes and gradual changes. National standards must also be reviewed to adequately benchmark infrastructure and development.

Dwindling finite resources: With 7 billion people in the world, there will be an inevitable growing demand for finite natural resources such as water, oil, natural gas, phosphorous and coal. To combat this scarcity of resources, infrastructure will need to be increasingly focused on facilitating recycling, multi-use and reducing waste as well as uptake of new technologies and innovation. Scarcity of available land, both as a result of population growth and development, will induce more contested decisions about land acquisition and control, and hence could become either a barrier to infrastructure development or an opportunity for infrastructure innovation.

The rising cost of disasters: Globally, there is a growing trend in the number of reported disasters affecting hundreds of millions of people every year. Most of these disasters are weather and climate-related, including storms, droughts, floods, wildfires, and extreme heat. With a rapid increase in urbanisation, more people will live in unsafe urban settlements, especially in coastal areas exposed to floods and storms, and hence more people will be at greater risk. The economic impacts of disasters are also expected to increase, driving demand for infrastructural support for disaster risk reduction and management.

International Gateways

This megatrend focuses on the projected rapid economic growth and shifting political power in the Asian region, and its influence on infrastructure. This will be accelerated by the formation of the ASEAN Economic Community (AEC) in 2015, which will provide enormous opportunities for trade for both Indonesia and Australia, while increasing pressure on infrastructure to take advantage of the trend.

Maritime politics: The world economy and political power is shifting from the West to a new international system shaped by the BRICS (Brazil, Russia, India, China and South Africa) and the East. The transformation of the global economic system will require the assimilation of markedly different political, cultural and trading traditions. By 2050 Indonesia is likely to become the 4th largest economy in the world, and Australia will be ranked 28th. It is uncertain how diplomatic disputes will play out in the future, but it is likely that defence and border security issues will be re-examined for both Indonesia and Australia. Risks of security emergencies are likely to rise due to unresolved intra-and extra-regional territorial disputes. Hence ports are likely to play an increasingly important role in trade and security.

On the move: Humanity is becoming increasingly mobile and global. For example, Indonesia is anticipated to have a market of 270 million airline passengers by 2034, and Australia is expecting a 107% increase in total passenger movements through all airports by 2030. Movement of goods and vessels around the region will also increase. For instance, Indonesia's economy will enter the world's top ten around 2020 and attain 6th place by 2029. In Australia, freight movement in cities is expected to grow by 50-70% by 2020. These changes will increase the pressure to upgrade existing infrastructure, and to build new transport and logistical networks in order to support these demands.

Growth in trade: There will be increasing trade opportunities for Indonesia and Australia due to the reduction of trade barriers through the AEC and new Free Trade Agreements (e.g. between Australia and China in 2014, and New Zealand and China in 2008). Both Indonesia and Australia will see an increase in bilateral trade with other Asian countries due to the increasing demand for consumer goods and services with the rise of the Asian middle class. There will be increased pressure on infrastructure, particularly maritime and connecting infrastructure, in order to trade effectively in this rapidly growing region. For example, the Master Plan on ASEAN Connectivity contains strategies to provide frameworks for both air travel and shipping services, and to achieve a single shipping market. However, this single market will not be realised without an effective logistics system that encompasses transport, warehousing, cargo consolidation, border clearance and domestic distribution and payment systems.

Regional infrastructure to support trade: Indonesia's competitiveness ranking is improving, from 80th to 56th in the world, but it is still lower than other ASEAN countries. Indonesian President Joko Widodo's $6 billion Maritime Doctrine aims to boost economic growth by improving connectivity between the islands of the Indonesian archipelago. It will not only increase domestic connectivity, but also enhance the underperforming logistics network, reducing the cost of shipping goods around the country and region. In Australia there will be growing pressure to upgrade existing infrastructure, and to build new transport infrastructure which can support and enable trade opportunities and potential. Currently very high growth rates and a lack of integration across the supply chain is reducing the competitiveness of Australia's major ports. These facilities will have to be designed to cope with potential extreme weather and environmental conditions (e.g. flooding) due to climate change in order to cope with current demand, and to attract and sustain additional business in the future.

Reaching the remote: Spatial inequity will continue to be an issue that needs to be addressed in Indonesia and Australia. New infrastructure and improvements to existing networks is likely to be a core strategy for addressing this divide and prompting growth. Indonesia's development gap between urban and rural areas is compounded by its archipelagic geography. Indonesia also has large income inequalities, with 40% of the population living on less than $2 per day. Due to an underinvestment in infrastructure, many Indonesians have only limited access to piped water, electricity, health care and education. The Indonesian Government's decentralisation program is key to addressing these issues, but local capacity and allocation of funding is inadequate, and has limited accountability. Australia also struggles with infrastructure equality in remote and regional centres, but the inequalities are not as distinct as in Indonesia. With 85% of the Australian population living within 50 km of the coast, political and economic decision-making can be inclined to focus on those living in urban Australia. The Australian Government is in the process of developing a strategic plan for the economic development of northern Australia, which will entail significant investment in road and port infrastructure to support agricultural production and exports.

Coming Ready or Not

This megatrend outlines the rapidly changing social world and the associated challenges for infrastructure. Indonesia's population is increasing, as are incomes with a rising consumer class. Urbanisation is one of the main drivers of increasing incomes. However, this rapid growth and development of urban centres has also created new challenges and new risks. Rising costs will mean that there will be an emphasis on increased efficiencies, and creating critical links between education and infrastructure for both Australia and Indonesia. This rapid social change will create new opportunities for industries and individuals, as well as magnifying geopolitical tensions and risks to health, security and the environment.

Changing demographics: By 2030 there will be a much broader distribution of income around the world, with a rising middle class across the emerging economies. Seventy-five percent of the global consuming class (estimated to be 1.8 billion people) is likely to be in Asia. This rapid growth and development of urban centres has imposed challenges relating to patterns of growth, water supply, urban congestion, patterns of social advantage and disadvantage, climate change and adaptation, and pressures on public finance. Improving urban mobility will be critical for both Australia and Indonesia in order to provide access to employment, delivery of services, health care and education.

Managing changing risks: The infrastructure sector is familiar with managing risk. However, investors and developers have become increasingly concerned about the potential risks associated with political and regulatory uncertainty. Other risks are also increasing with the growth of travel and people movements, exacerbating the possibility of pandemics, as well as regional rivalries in the crowded maritime environment.

Changing jobs and education: Rising costs will mean that many off-shore jobs are likely to exit China over time and move to other cheaper economies such as Vietnam, Bangladesh, the Philippines and Indonesia. In addition, Indonesia's savings and investments and retail sectors are expected to become large consumer markets by 2013. Appropriate human capital is a major obstacle for Indonesia in maximising these opportunities. However, in contrast to Australia and other ASEAN countries who have a rapidly aging population which is constraining economic growth, Indonesia has a young population which has enormous potential to drive rapid growth. With Australia's aging population it is expected that improved productivity will arise from 'doing things better', but this will require greater support from health, aged care and training services. Therefore, for both countries education and infrastructure will play a critical role in the potential productivity of the labour force, by enabling individuals to participate in the economy through new technologies and by enabling wider participation.

New infrastructure-driven industries: The development of Indonesia's new industries and changing social needs is likely to require the development of new infrastructure, such as mass public transport, new railways, gas transmission, and subsea electrical transmissions. An example of this is the rapid growth in the number of vehicles, which has increased by 300% in 2001-2010, while the national road network grew only by 25%, and nearly 80% of the network is in bad condition. With Indonesia's consuming class set to grow from 45 million to 135 million by 2020, middle class Indonesians in cities from Medan to Makassar will create mass markets in their own right for Indonesia's automotive sector. Growth in Australian infrastructure is likely to be driven by the services sector, currently generating over 70% of Australia's Gross Domestic Product. A key focus will be transport, ports, telecommunications and airports, especially in Australia's four largest cities: Sydney, Melbourne, Brisbane and Perth.

Technology and Innovation

This megatrend describes opportunities for economic development that also tackles emerging environmental risks. 'Going green' will be a focus for repairing and revitalising physical infrastructure, together with the rise of innovative materials and technological solutions that have the potential to transform the physical infrastructure sector. The evolution of the Internet to enable 'things to be connected anytime, anyplace, with anything and anyone' will drive this transformation, but application of the digital innovation will also introduce new risks of critical systems failure and cybercrime.

Aging infrastructure and critical systems failure risk: Repairing and revitalising physical infrastructure will become important for Indonesia and Australia, since most of their physical infrastructure is ageing. Meanwhile, critical systems failure will be a real threat as the hyper-connected world emerges. Hence there will be growing pressure to equip infrastructure with the best possible security systems. Cyber-attacks have been identified as the top technological risk, along with incidents of mass data fraud or theft, mineral resource supply vulnerability and massive digital transformation. Possible future pathways to address critical systems failure and ageing infrastructure could include the use of innovative materials and improving human capacity to manage risk.

Go green: The increasing demand for sustainable products in almost every aspect of human life will continue. Examples include demand for green buildings, environmentally-friendly transport systems, and a wide array of recycling and other enabling technologies. Therefore, 'going green' is viewed as the 6th Wave of Innovation. Green infrastructure (GI), in particular, has emerged as a planning and design concept to mitigate and adapt to environmental problems, as well as to fulfil human needs. Given that both the physical and social environment varies from one place to another, the selection of appropriate GI will need to consider the local context. In addition, GI must focus on maximizing long term savings in resources, while meeting the needs of people.

Internet of Things: The coming decades will most likely see the beginning of the Internet's next wave, the Internet of Things (IoT). The IoT enables 'things to be connected any time, any place, with anything and anyone using any network and any service'. Two illustrations include an automated irrigation system that turns the water on when plants are thirsty, based on soil moisture probes, pumps, flow meters, and the likelihood of precipitation; and people being able to turn on or off their house lights from their mobile phone. This technology offers an opportunity for innovation in the infrastructure sector. However, it may also be at risk of critical systems failure and cybercrime.

Next steps

The foresighting process was undertaken in a short timeframe in order to meet with the advanced stage of planning for the Clusters' CLIPs. However, the process of engagement and discussion across the Indonesian and Australian researchers in each Cluster enabled mutual learning about shared issues and identified many cross-cutting research priorities. The megatrends now provide a foundation for the justification of the CLIPs, and the prioritisation of future research so far not included in the CLIPs. These priorities will be of equal relevance to other research and development initiatives between Indonesia and Australia.

Introduction

The Australia-Indonesia Centre

The Australia-Indonesia Centre (AIC) was formed in 2014 to strengthen and deepen Australia-Indonesia business, government, education, research, and community links. It has the goal of '*building greater research collaboration between Australia and Indonesia in areas of shared challenge*'. The Australian Government is providing $15 million in 2014-2017 to support the AIC. In Australia, five major research partners will also contribute funding and in-kind support: Monash University, the University of Melbourne, the University of Sydney, the Australian National University and CSIRO. In Indonesia, there are seven partners: Institut Teknologi Bandung (ITB), Institut Pertanian Bogor (IPB), Universitas Airlangga (UNAIR), Universitas Gadjah Mada (UGM), the Institut Teknologi Sepuluh Nopember (ITS), Universitas Hasanuddin (UNHAS), and Universitas Indonesia (UI). The Indonesian partners coordinating committee is supported by the Indonesian Ministry for Research, Technology and Higher Education – formerly supported by the Ministry for Education and Culture, Department of Higher Education (DIKTI).

The AIC will collaboratively research solutions to shared national challenges in four major themes:

- **ENERGY**
- **INFRASTRUCTURE**
- **AGRICULTURE AND FOOD**
- **HEALTH**

Groups of Australian and Indonesian universities are being formed around each Cluster. Lead by two nominated Australian and two Indonesian institutions, and facilitated by a Cluster Coordinator, a Cluster Investment Plan (CLIP) is being developed by June 2015 for each Cluster. This is being undertaken through planning workshops held in Australia and Indonesia. Research has already begun in the Clusters, with the funding of several collaborative Small Grant Projects beginning towards the end of 2014. 23 such projects were selected and funded by the AIC, while a further 28 projects were selected and funded by DIKTI on behalf of the AIC. In addition, eight Rapid Start Projects (four funded by AIC, four by DIKTI) were set to commence in early 2015.

CSIRO was invited by the AIC to assist with the Cluster planning process by applying its 'foresighting' method, which can analyse key trends in each theme towards 2030 and beyond. This was intended to assist each CLIP to be evidence-based and anticipatory, and to enable a pathway to market, adoption and application. In addition, this process was intended to rationalise and focus the Small Grant and Rapid Start Projects towards each Cluster's more strategic directions.

The CSIRO foresighting method and process

THE VALUE OF FORESIGHTING

There are many motivations for investing in a foresighting study. In general, foresighting can help leaders identify, anticipate and proactively respond to forthcoming change which has the potential to harm or help an organisation. Foresighting adds most value by examining issues outside an organisation's control, such as social, technological, economic, environmental and geopolitical forces that will express themselves over a longer time frame.

In 2009 CSIRO established the CSIRO Futures Project to assist its strategic planning and investment for emerging areas of national research priority, summarised in the 2012 report 'Our future world: Global megatrends that will change the way we live' (see **http://www.csiro.au/Portals/Partner/Futures.aspx**). Since then, the CSIRO Futures Project has applied the method to support planning in national food security, mining, manufacture, sport, tourism, cyber security, biosecurity, water supply planning and property markets. Through this experience of working with diverse industry, government and community clients, the following benefits of foresighting have become evident:

- **STRATEGIC VISION:** developing and agreeing on a shared vision and a commitment amongst stakeholders to take tactical action.
- **STAKEHOLDER ENGAGEMENT:** providing systematic collective reflection by engaging stakeholders and building collective ownership of the long-term future.
- **THOUGHT LEADERSHIP:** providing informed and credible information of future trends that may reshape a domain, sector or parts of society.
- **WISER CHOICES:** combining evidence-based information of different futures with the judgement and intuition of decision-makers.
- **A PLATFORM FOR CHANGE:** providing the environment to analyse and decide on the best options to ensure success in coming decades.
- **RESEARCH AND INNOVATION PRIORITIES:** providing evidence of potential societal trends which require greater research investment to better understand, anticipate, manage or take advantage of their effects.

FORESIGHTING METHOD AND PROCESS

The foresighting method is flexible, but is usually based on three components: megatrends, megashocks and scenarios (Fig 1).

Megatrends are defined as 'significant shifts in social, environmental, economic, technological or geopolitical conditions that have the potential to reshape the way a company, industry or society operates over several decades into the future'. Megatrends are the combination of linked trends, defined as 'a significant pattern of activity typically occurring within an industry or societal sector, or within a localized geographic region with implications for decision-making'. When analysed in isolation, trends may have limited meaning, but when collated into megatrends they can be indicative of a broader fundamental shift in society.

Megashocks are similar to megatrends, but rather than emerging gradually they happen suddenly with little forewarning. Like megatrends they may be either positive or negative and create far-reaching and irreversible change to society. However, they are known risks and are defined by similar preceding historical events, but the timing, location, nature and magnitude of the impact is hard to predict. Examples include the 2008 Global Financial Crisis, which was preceded by the 1998 Asian Financial Crisis and the 1929 Great Depression, and natural disasters such as the 2004 Boxing Day Tsunami.

Scenarios are the range of plausible futures that may unfold, including the outcomes of megatrends and megashocks. The purpose of a scenario is not a prediction or a plan of the future, but rather it aims to challenge the mindset of the people who use them. This is usually achieved

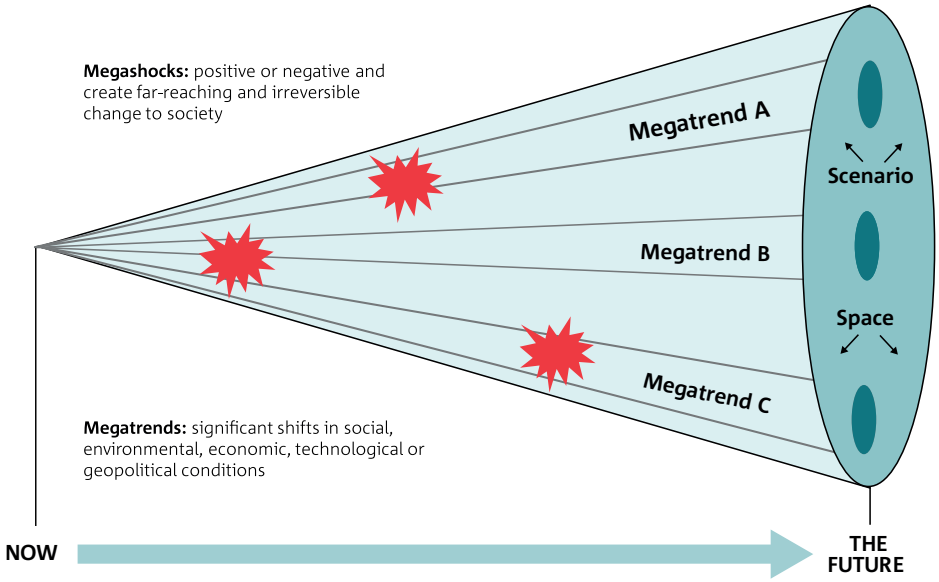

Figure 1. The scenario space and the role of megatrends and megashocks in forming future scenarios.

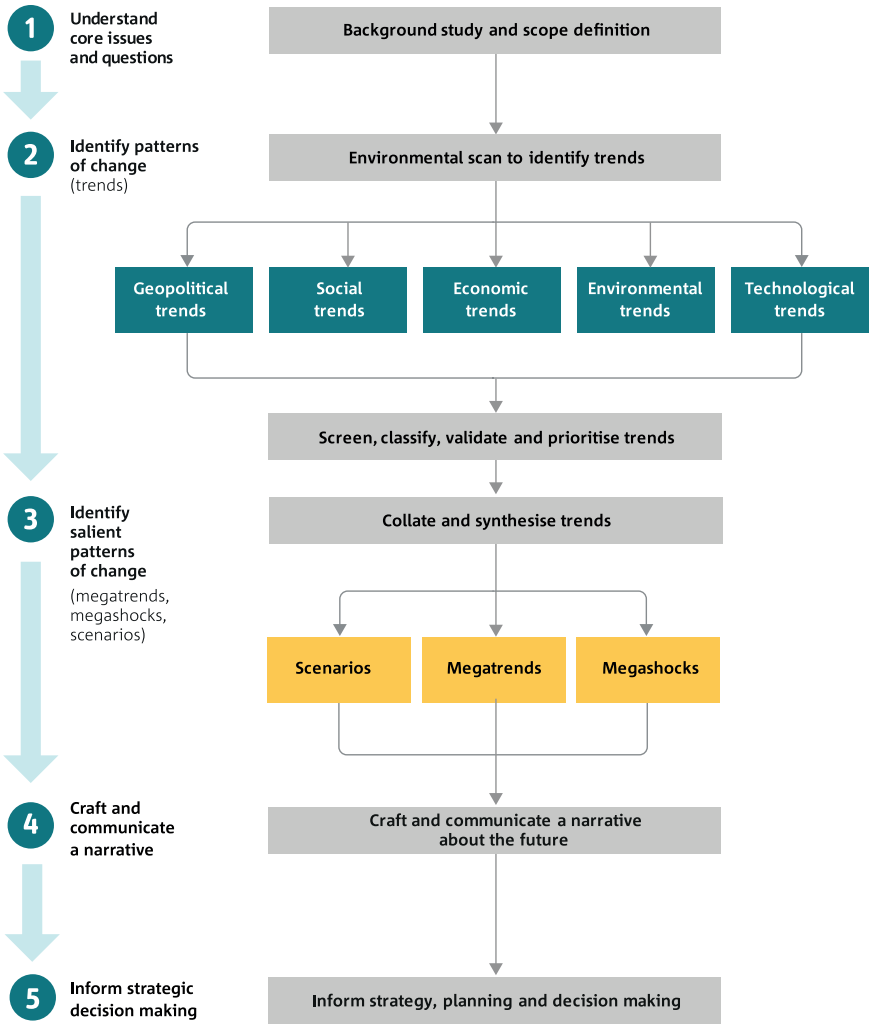

Figure 2. The CSIRO Futures foresighting process.

through a participatory planning process. In the CSIRO Futures approach megatrends and megashocks are used to identify a 'scenario space' (Fig. 1).

The foresighting process follows five steps (Fig. 2). Step 1 identifies the scope and key issues and questions of relevance to the project stakeholders. Step 2 conducts a 'horizon' or 'environmental scan' which casts a net over all potentially relevant patterns of change, usually within five groups: geopolitical, economic, environmental, social and technological. However, any patterns identified must be validated and salient to the stakeholder, and therefore have to be screened and prioritised. In Stage 3 the trends are collated and synthesised into megatrends, megashocks and scenarios, usually through some participatory processes with stakeholders. Stage 4 then crafts and communicates a narrative about the future, and Stage 5 integrates the narratives into the stakeholders' strategy or decision-making processes.

The AIC Foresighting Project

Due to the short project time frame (November 2014 – June 2015) and the advanced stage of the Clusters' planning, the standard CSIRO method had to be accelerated. The over-arching goal was '*to support the development of CLIPs which focus on priority research areas of shared interest between Australia and Indonesia, and to promote integration, synergy and learning amongst the Cluster teams*'. The design and timing of activities was dictated by each Cluster's planning process. Also, to track the learning and integration amongst the AIC researchers resulting from the project, an evaluation methodology was applied. This was developed in collaboration with UNHAS and the University of Mataram (UNRAM, Lombok), where earlier foresighting was undertaken as part of the DFAT-CSIRO Research for Development Alliance. Based on the results, the method has been refined and applied in the AIC Foresighting Project.

The objectives of the project were:

1. For each Cluster analyse megatrends and megashocks with shared relevance for Australia and Indonesia to support the development of each Cluster's CLIP;
2. Develop exploratory scenarios with AIC partners of Australian and Indonesian regional development to identify and integrate research priorities within and between Clusters;
3. Test and apply a method to assess the learning and integration achieved amongst AIC researchers as a result of the foresighting.

Five activities were undertaken to achieve these objectives (Fig. 3):

ACTIVITY 1 HORIZON SCANNING (NOVEMBER 2014-JANUARY 2015): The first step was to engage the Cluster teams in Australia and Indonesia through Cluster planning workshops and other events in November 2014 – January 2015. Horizon scanning of shared issues, drivers of those trends and potential megashocks was undertaken. Subsequent to these events the CSIRO team collated relevant data on these issues and their trends, in consultation with the Cluster researchers.

ACTIVITY 2 CLUSTER MEGATRENDS (FEBRUARY-JUNE 2015): The CSIRO team then collated megatrend narratives for each Cluster, and delivered these as draft reports to the Cluster teams for validation and screening. After discussion and review the narratives were finalised for each Cluster, and delivered as a megatrend report to the Cluster Leads and Coordinators. The Clusters then applied this information to justify and refine their research priorities, and included summaries of relevant information in the CLIPs.

ACTIVITY 3 SCENARIO PLANNING WORKSHOP (APRIL 2015): Because the planning of Small Grants and Rapid Start projects has occurred in some isolation, a more strategic exercise was required to encourage integration and synergies amongst the Clusters. A scenario planning workshop was held in Indonesia with the Cluster Leads and Coordinators to explore potential future development paths for remote and regional communities in both countries. Informed by the validated megatrends and megashocks collated in Activity 1 and 2 for each Cluster, participants developed visions and scenarios for case study locations. From the workshop, pan-Cluster synergies and research priorities were identified.

ACTIVITY 4 FORESIGHTING EVALUATION METHOD (APRIL 2015): To refine the evaluation method developed previously between CSIRO, UNHAS and UNRAM as part of the DFAT-CSIRO Research for Development Alliance, two 1-day workshops were held in Makassar and Lombok to repeat the exercise. These collaborations utilised Theory of Change and social learning indicators to evaluate the impacts of scenario planning for urban water infrastructure and rural livelihoods analysis.

ACTIVITY 5 FINAL INTEGRATION AND EVALUATION: To re-engage the Cluster teams and their CLIPs, a second scenario planning workshop will be held with all AIC researchers. This workshop will enable the revisiting of the initial scenarios developed in Activity 3 through a repeat exercise. This will promote integration and learning across the Clusters and their CLIPs, and highlight potential synergies for emerging research in 2015-2017. The evaluation methodology developed in Activity 4 will be applied at the workshop to evaluate the impacts of the project.

This report delivers Activities 1 and 2.

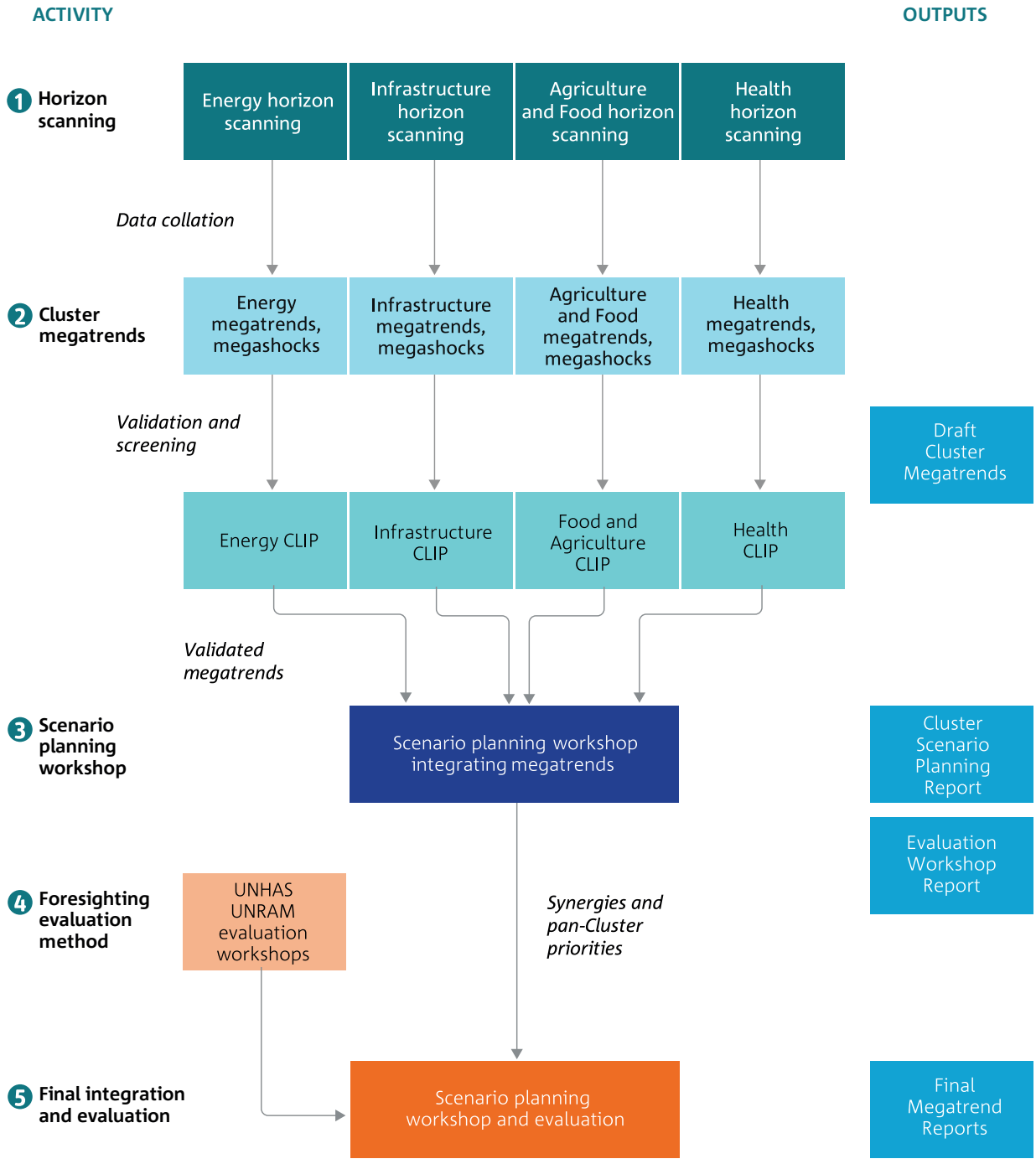

Figure 3. The AIC Foresighting Project process, showing activities and outputs.

Context:
Indonesia and Australia

In spite of their close proximity and the sharing of an international maritime border, Indonesia and Australia are very different nations. Geographically, politically, culturally and economically there are some similarities, but also some stark differences. Particular similarities are large conurbations which dominate the populations of both nations, and many remote, less developed regions. In tropical northern Australia, many of the remote regions have more in common with the eastern islands of Indonesia and Papua than the rest of Australia. This section provides a background comparison of the two nations which sets the scene for the AIC Foresighting Project.

Geography

INDONESIA

Indonesia (Fig. 4) is an equatorial archipelagic island country in Southeast Asia with over 17,000 islands of which only 6,000 are inhabited. Indonesia occupies a strategic location astride or along major sea lanes from the Indian Ocean to the Pacific Ocean extending 5,150 km east to west. The five largest islands are Sumatra, Java, Kalimantan (Indonesian Borneo), Sulawesi, and the Indonesian part of New Guinea (known as Papua) (National Geographic 2015).

Most of the larger islands are mountainous, with peaks ranging between 3,000 and 3,800 m above sea level in Sumatra, Java, Bali, Lombok, Sulawesi, and Seram. Tectonically, Indonesia is highly unstable containing the most volcanoes of any country in the world. Indonesia is located on the edges of the Pacific, Eurasian and Australian tectonic plates, part of the Pacific 'Ring of Fire'. Of the 400 volcanoes, approximately 120 are active (Marshall 2008). More than 75% of Indonesian residents live within 100 km of a Holocene volcano (active from approximately 11,700 years ago to the present day), the highest number of people of any of the world's volcanic regions. The combination of a densely-packed population in a volcano-rich country has led to Indonesia suffering the highest rate of eruptions resulting in fatalities and damage to human infrastructure in the world (Smithsonian Institute 2015).

Indonesia's climate tends to be relatively even year-round. The country experiences two seasons, a wet season and a dry season, with no extremes of summer or winter. For most of Indonesia, the wet season falls between October and April and the dry season between May and September. Some regions, such as Kalimantan and Sumatra, experience only slight differences in rainfall and temperature between the seasons, whereas others, such as Lombok and Sumbawa, experience far more pronounced differences with droughts in the dry season, and floods in the wet. Rainfall in Indonesia is plentiful, particularly in West Sumatra, northwest Kalimantan, West Java, and Papua.

The combination of recent volcanic activity, linked in many areas to highly fertile soils and abundant rainfall, means that Indonesia possesses enormous agricultural potential, and it is already a major world producer of many agricultural products.

AUSTRALIA

Australia (Fig. 4) is an Oceanian country comprising the mainland of the Australian continent, the island of Tasmania, and numerous smaller islands. It is the world's smallest continent and 6th-largest country by total area. Australia has six states: New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia and two mainland

Figure 4. Indonesia and Australia.

territories, the Australian Capital Territory and the Northern Territory.

Australia is located on the Indo-Australian Plate, surrounded by the Indian and Pacific Oceans. It is separated from Indonesia by the Arafura and Timor seas. Australia's size gives it a wide variety of landscapes, with tropical rainforests in the north-east, mountain ranges in the south-east, south-west and east, and dry desert in the centre. It is also the lowest, the flattest and (apart from Antarctica) the driest country in the world (Australian Government 2015).

Australia has some of the oldest land surface on earth, and while rich in biodiversity its soils and seas are among the most nutrient poor and unproductive in the world. This is due mainly to the country's geological stability, which is a major feature of the Australian land mass, and is characterised by, among other things, a relative lack of significant seismic activity. Only 6% of the Australian landmass is arable (Australian Government 2015).

Rainfall in Australia is highly variable with low average annual rainfall over most of the continent and intense seasonal falls in the tropics. The rainfall pattern is concentric around the extensive arid core of the continent. The wettest regions are in far north Queensland and Tasmania. The effects of this widely varied rainfall pattern and Australia's drainage system can lead to parts of

TABLE 1. A SUMMARY OF GEOGRAPHICAL CHARACTERISTICS OF INDONESIA AND AUSTRALIA (ADAPTED FROM CIA 2014)

GEOGRAPHICAL CHARACTERISTICS		AUSTRALIA	INDONESIA
CAPITAL CITY		**CANBERRA**	**JAKARTA**
Area (total)		7.7 million km^2	7.6 million km^2
	Land	7.6 million km^2	1.8 million km^2
	Sea	58,920 km^2	5.8 million km^2
Boundaries	Land	none	2,958 km, with Timor-Leste 253 km, Malaysia 1,881 km, Papua New Guinea 824 km
	Maritime	Papua New Guinea, East Timor and Indonesia to the north, Solomon Islands and Vanuatu to the north-east and New Zealand to the south east	Singapore, Malaysia, the Philippines, and Palau to the north, and Australia to the south
Coastline		25,760 km	54,716 km
Maritime claims			
	Territorial sea	12 nm	12 nm
	Exclusive Economic Zone	200 nm	200 nm
Natural resources		Bauxite, coal, iron ore, copper, tin, gold, silver, uranium, nickel, tungsten, rare earth elements, mineral sands, lead, zinc, diamonds, natural gas, petroleum	Petroleum, tin, natural gas, nickel, timber, bauxite, copper, fertile soils, coal, gold, silver
Land use		Arable land: 6.2% (includes about 27 million ha of cultivated grassland) Permanent crops: 0.1% Other: 93.8%	Arable land: 12.3% Permanent crops: 10.5% Other: 77.2%

the continent being in drought, but inundated by waters from rainfall thousands of kilometres away. This phenomena is most prevalent after heavy cyclonic rains in the north, which causes flooding in drought stricken areas in the south (Geoscience Australia 2015). Further geographical details for Indonesia and Australia are given in Table 1.

Population and demography

INDONESIA

Indonesia's population at the most recent census in 2010 was 237,641,326 people (BPS 2010), and is projected to increase by 28.6% to 303,382,000 by 2035 and 321,377,000 by 2050 (UN 2012a; Fig. 5).

The population growth rate from 2000-2010 was 1.39% per annum (UN 2012b), but this varied significantly by province, from 0.76% per annum in East Java to 5.39% per annum in Papua (BPS 2015a). The growth rate is forecast to decline to 0.26% per annum by 2045-2050 (UN 2012c) due to declining fertility rates linked to education and economic development.

Indonesia has one of the highest average population densities in the world at 126.4 people per km^2 (UN 2012d). Given the projected population growth rates, this average density will increase to 159.29 people per km^2 by 2030 and 168.74 people per km^2 by 2050. The provinces with the highest population densities are likely to be Jakarta, with a current density of 15,015 people per km^2,

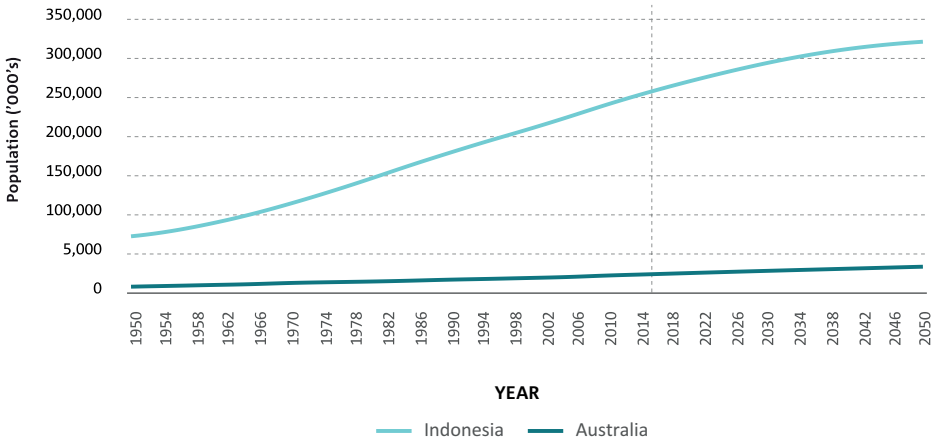

Figure 5. Historical and projected populations of Indonesia and Australia, 1950-2050 (United Nations 2012a).

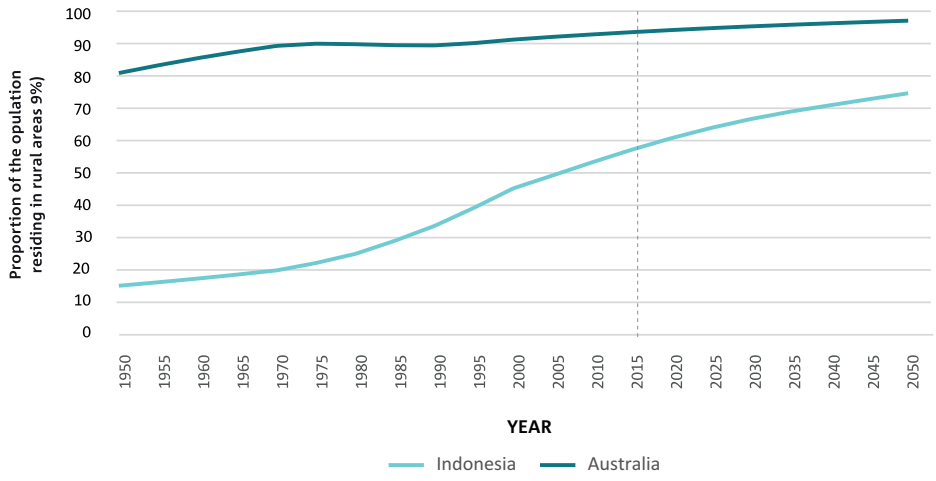

Figure 6. Historical and projected urbanization of Indonesia and Australia 1950-2050, expressed as a proportion of the population residing mid-year in Urban Areas (UN 2014).

East, Central and West Java and Banten (between 800 and 1,200 people per km^2) and Bali (currently 702 people per km^2; BPS 2013a).

As of 2010, 49% of the Indonesian population is urban, but projections suggest that this will increase to 65.2% by 2035 and 70.9% by 2050 (Fig. 6).

The population structure of Indonesia is currently heavily skewed towards the cohort of <25 years. Sixty-six percent of the Indonesian population in 2010 was in the working age years of 15-64, although there is also a significant proportion of younger people, with 28.8% aged 0-14 in 2010 (BPS 2010).

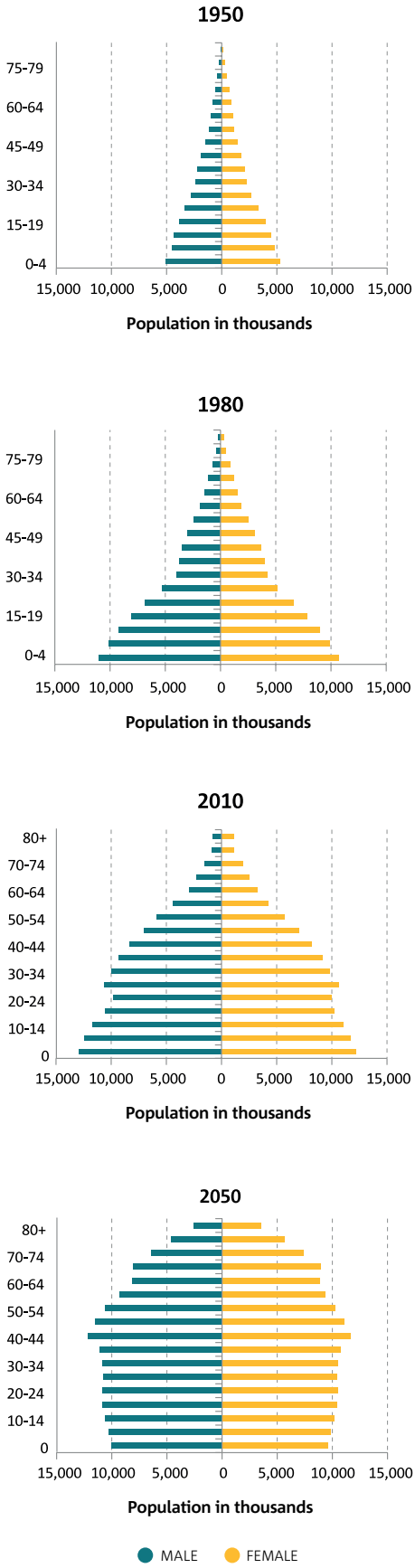

Figure 7. Population distribution of Indonesia by 5 year age group in 1950, 1980, 2010 and projected to 2050 (UN 2012e).

The future demographic structure will reflect this, with a large middle-aged population by 2030, leading to a larger elderly cohort by 2050 (Fig. 7).

AUSTRALIA

Australia's population is currently estimated to be 23,490,700 (ABS 2014a), and is projected to increase by 26.4% to 29,699,714 by 2035 and 33,735,400 by 2050 (UN 2012a; Fig. 5). The population growth rate was 1.76% per annum from 2005-2010, but is forecast to decline to 0.81% by 2045-50 (UN 2012b). Australia has one of the lowest average population densities in the world at 2.9 people per km^2 (UN 2012d). Given the projected population growth rates, this average density will increase to 3.84 people per km^2 by 2035 and 4.358 people per km^2 by 2050 (UN 2012d). The highest population densities are likely to remain in the south east cities of Melbourne and Sydney. Sydney has 114 km^2 with a population density of more than 5,000 people per km^2, while Melbourne has 34 km^2 at this density (Fig. 8). By comparison, London has 327 km^2 with a density greater than 8,000 people per km^2 (ABS 2014b). As of 2015, 89.4% of the Australian population is estimated to be urban, one of the highest in the world, and projections suggest that this will increase to 91.7% by 2030 and 92.9% by 2050 (UN 2014).

The population structure of Australia is currently heavily skewed towards the middle-aged cohort of 40-60 years. The future demographic structure will reflect this, with a population made up of predominately the retired (65-79 years of age) and the very old (aged 80 years plus) by 2050 (Fig. 9).

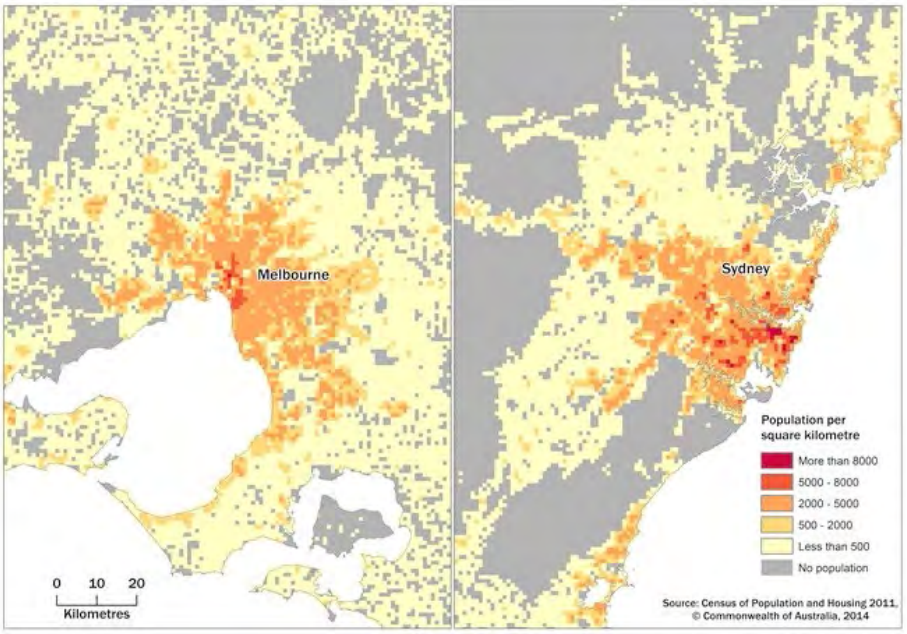

Figure 8. Population density by 1 km^2 grid, August 2011, for Melbourne (left) and Sydney (right). (ABS 2014b, used with permission under CC-BY 2.5 license).

Due to its demographic structure and falling fertility rates, between 47 and 63% of Australia's population growth each quarter is contributed by immigration (ABS 2014b). As a result, the 2011 census indicated that 26% of Australia's population was born overseas. Of the overseas-born population, 4.3% are from the United Kingdom, 2.6% from New Zealand, 1.9% from China, and 1.7% from India. Only 0.4% of Australia's population were born in Indonesia (ABS 2015a). Projections suggest that immigration will continue to be a significant source of population growth (ABS 2013a), but the levels will depend upon government policy and total population targets.

The movement of Australians to and from Indonesia is largely based on tourism to Bali, and this has increased steadily over the last few decades. Australia now represents the largest market by revenue for Indonesian tourism, with revenues from Australian tourists estimated at US$1.453 billion in 2012 (BPS 2013b). Notwithstanding a small decline following the 2002 Bali bombings, travel to Indonesia represented on average 11.7% of all overseas holiday travel and 7.7% on all international travel for Australians between 2000 and 2013 (TRA 2014; Fig. 10).

The issue of international refugees travelling through Indonesia to seek asylum in Australia, and travelling on Indonesian vessels to reach northern Australia, continues to present a shared management challenge for Indonesia and Australia (Table 2).

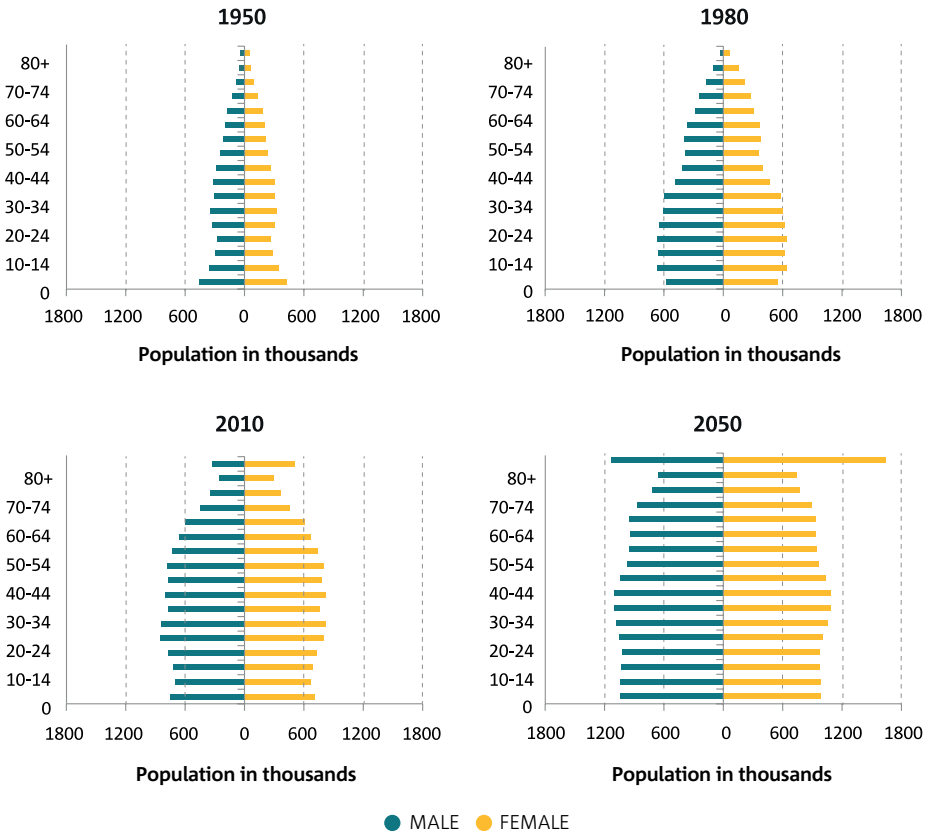

Figure 9. Population distribution of Australia by 5 year age group for 1950, 1980, 2010 and projected to 2050 (UN 2012e).

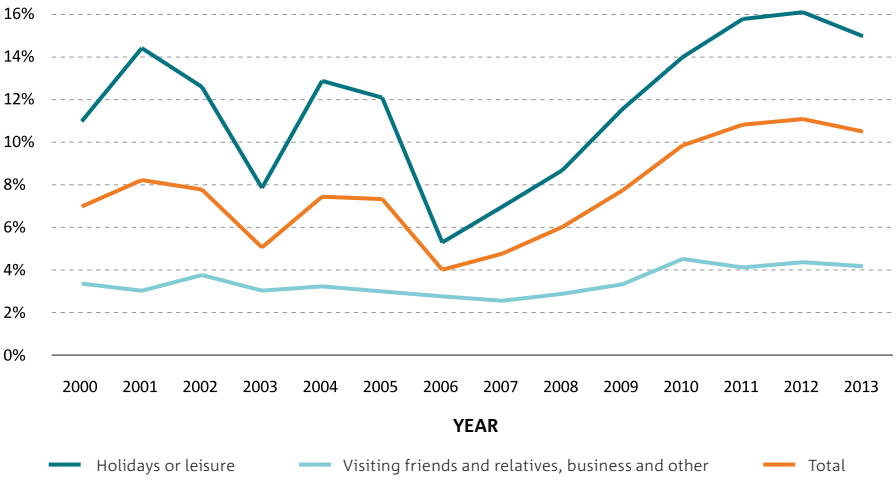

Figure 10. Overseas travel by Australians to Indonesia as a percentage of all overseas travel by Australians, 2000-2013 (TRA 2014).

TABLE 2. ILLEGAL BOAT AND PERSON ARRIVALS BY BOAT FROM INDONESIA TO AUSTRALIA, 2009-2013 (APL 2014)

YEAR	NUMBER OF BOATS	CREW	NUMBER OF PEOPLE (EXCLUDING CREW)
2009	60	141	2,726
2010	134	345	6,555
2011	69	168	4,565
2012	278	392	17,204
2013	300	644	20,587

Economies and interdependent trade

INDONESIA

Indonesia's economy is currently the 16th largest in the world (Australia ranks 12th), with a nominal GDP in 2013 of US$868 billion (The World Bank 2014a). In terms of Gross Domestic Product (GDP) based on Purchasing Power Parity, Indonesia actually ranks 8th in the world, while Australia ranks 19th (IMF 2015), and due to higher predicted growth rates in Indonesia, the nominal GDP of Indonesia is also likely to surpass Australia in the years ahead. The largest single sector in the Indonesian economy is Manufacturing (non-oil and gas), followed by Agriculture, Forestry and Fisheries, and then Trade, Hotels and Restaurants. Notwithstanding short term shocks in 1982, 1985 and the massive Asian Financial Crisis in 1998, the Indonesian economy has been growing rapidly, at more than 5% per annum since the 1970s (Fig. 11). Indonesia was relatively unaffected by the 2008 Global Financial Crisis. Projections suggest that economic growth will continue to grow at around 5% per annum over the next 2 years (The World Bank 2014b), although some authors (Johansson *et al.* 2012) have predicted that this may decline to 3.4% per annum in the long-term (2030-2060) as the population ages and becomes less productive.

Exports to Australia are a small proportion (2-3%) of Indonesia's overall exports, with Australia currently the 11th most important export destination (BPS 2015b). Australia is also a relatively small contributor to Indonesian imports and

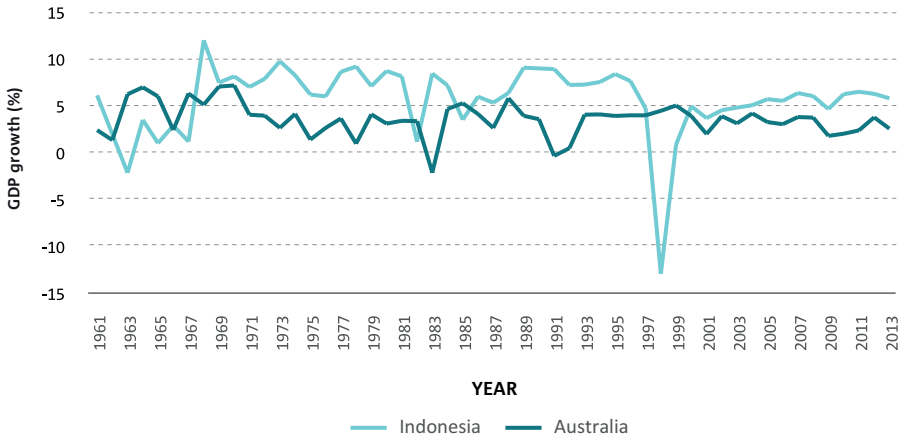

Figure 11. GDP growth per annum, Australia and Indonesia, 1961-2013 (The World Bank 2014a).

this has declined (as a share of total imports) over the last decade (Fig. 12).

AUSTRALIA

Australia's economy is currently the 12th largest in the world in terms of nominal GDP (The World Bank 2014a). In terms of Gross Value Added and GDP, the largest sector is Financial and Insurance Services ($127 billion in 2010-11), followed by Manufacturing ($107 billion), Construction ($101 billion) and Mining ($95 billion; ABS 2012). The economy has been growing steadily at 3-4% per annum since the recession of 1993 (ABS 2012). Growth fell during the 2008 Global Financial Crisis (Fig. 11), although not as drastically as other developed nations. Projections suggest that economic growth will continue (The World Bank 2014c), but rates will decline to an average of 2.2% per annum in 2030-2060 as the population ages (Johansson *et al.* 2012). Annual growth rates in Australia have generally been lower than those experienced by Indonesia (Fig. 11).

Exports to Indonesia are a very small proportion of Australia's overall exports. In 2012 they valued only $6.6 billion (Austrade n.d.). After a rise to approximately 4% of total annual trade value in 1996-1997, goods exported to Indonesia, and goods and services imported from Indonesia have halved to around 2% of value. However, since 2008 services exported to Indonesia have increased to nearly 4% of annual value (Fig. 13).

Figure 12. Indonesian trade with Australia as a percentage of total annual foreign trade by value, 2000-2013 (BPS 2015c).

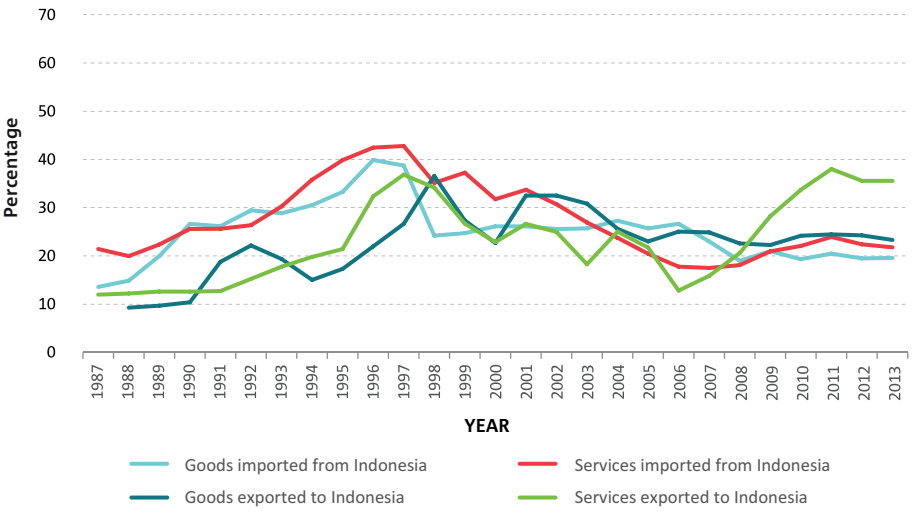

Figure 13. Australian trade with Indonesia as a percentage of total annual foreign trade by value, 1987-2013 (DFAT 2015).

Culture and society

INDONESIA

Indonesia has the world's largest Islamic population, with approximately 209.12 million Muslims in 2010, or 87.1% of the Indonesian population (Fig. 14). By comparison, India has a population of 176.2 million Muslims, Pakistan 167.4 million, Bangladesh 133.54 million, and Malaysia 18.1 million (Pew Research Center 2012). With projected population growth, Indonesia will remain home to more Muslims than any other country in the world for the foreseeable future. Minority religions in Indonesia include Christian (9.7%), Hindu (1.7%), and Buddhist (0.7%). There are higher proportions of Christians in the eastern provinces of Maluku (41.4% of the province population), Nusa Tenggara Timor (34.7%) and Papua (65.5%), as well as Sulawesi Utara (63.6%) (BPS 2012).

Since the overthrow of the Suharto regime in 1998 and the adoption of a democratic system of government, Indonesia has had five presidents and a number of peaceful transitions of power. Indonesia is consolidating itself as one of the world's largest democracies and is a beacon of democracy within Southeast Asia. The most recent election in July 2014 registered 135 million votes from over 6,000 inhabited islands with the world's largest, centralized, computerized voter registration system (IFES 2014).

Since 1999, a long term process of decentralisation has shifted government control and tax-raising powers from the national to district-level governments (Green 2005). Corruption continues to be a major impediment to transparent governance, however, and despite receiving a slightly improved score in 2014, Indonesia is still considered the 107th least corrupt country in the world (Transparency International 2014). In March 2012, the government issued the National Strategy of Corruption Prevention and Eradication, which has medium and long term plans to achieve the vision of an anti-corruption nation.

Established in 2002, the Corruption Eradication Commission (KPK) is the main public anti-corruption institution. While there are some indications that corruption is in decline, the KPK indicted a growing number of politicians, businesspeople and several judges in 2011 and 2012. Between 2004 and early 2012, a total of 1,737 members of local parliaments have been investigated for abuses ranging from corruption (29% of cases), physical harassment (11%), document forgery (11%) and fraud (11%) (Transformation Index 2014).

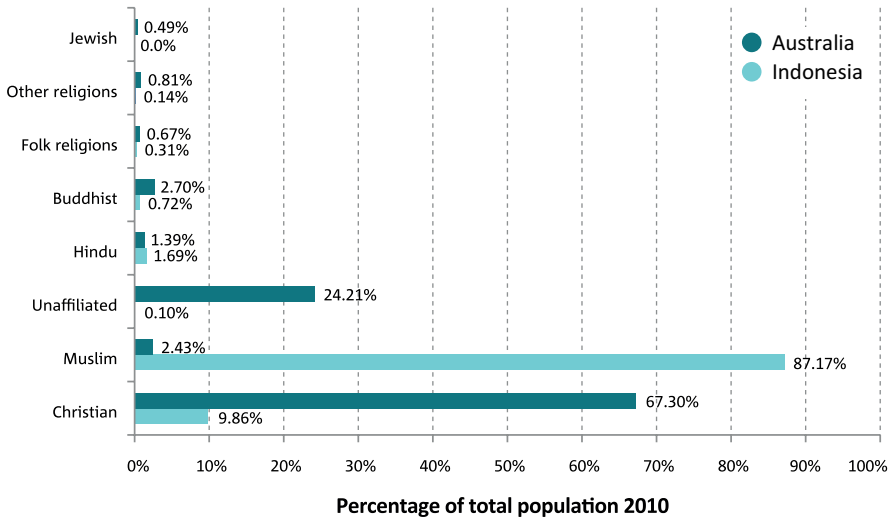

Figure 14. Religious affiliation by group as a proportion of the total population for Australia and Indonesia (Pew Research Center 2012).

AUSTRALIA

Australia has a majority Christian population, making up 67.3% of the total population (Fig. 14). Minority religions include Islam (2.4%), Hinduism (1.4%) and Buddhism (2.7%), but notably 24.2% of the population did not report any formal religious affiliation in the census (Pew Research Center 2012). There were 548,368 indigenous Australians in the 2011 census, or 2.6% of the total population, who contribute a distinct and ancient cultural identity which is recognised nationally and globally (ABS 2013b).

Since Federation in 1901, when the seven colonies of Australia agreed to form a nation under a constitutional monarchy under the British sovereign, the modern nation of Australia has grown to be a multi-cultural society. During the 1930s, 1950s and 1960s immigrants from numerous European nations arrived, followed by Vietnamese and Chinese during the 1970s and 1980s. Today, Australia is one of the most culturally diverse nations in the world, with 46% of the population either born elsewhere, or having at least one parent born elsewhere (ABS 2013b). Democratic Federal elections occur on a 3 year cycle, with the majority party or coalition electing a prime minister, and State and Territory elections occur on a 4 year cycle, electing a Premier or First Minister, respectively. Australia has a corruption index of 80, and is currently the 11th least corrupt country in the world (Transparency International 2014).

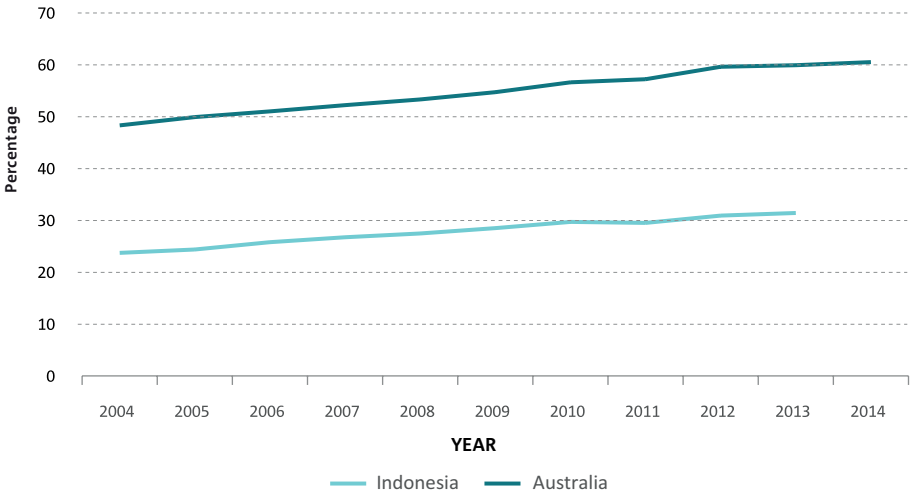

Figure 15. Proportion of Indonesian and Australian populations that had completed secondary school education or equivalent, 2004-2013 (ABS 2015b, c; BPS 2015 d, e).

Human development

INDONESIA

Indonesia's Human Development Index (HDI: a composite indicator of per capita income, life expectancy and education levels) in 2014 was 0.684, ranking 108th in the world and similar in rank to Palestine, Botswana and Egypt. The HDI for Indonesia has been increasing steadily since the first analysis in 1990, when it was 0.528 (UNDP 2014). This is reflected in the growing proportion of the population that had completed secondary school, which has risen steadily from 23% to 31% from 2004-2013 (Fig. 15).

There is wide variation within Indonesia in human development, however, with the eastern provinces of Nusa Tenggara Barat, Nusa Tenggara Timur and Papua having far lower HDIs of 0.66 to 0.68, compared to the HDI in Jakarta of 0.78 (BPS 2014). Poverty, food insecurity and lack of services is similarly high in these provinces, with 35% of rural households in Papua, or 828,000 people, living below the poverty line (BPS 2014).

AUSTRALIA

In 2014, Australia had the second-highest HDI rank in the world, with a HDI of 0.933 following only Norway on 0.944 (UNDP 2014). However, this masks a wide variation between the predominately urban population and Indigenous Australians who largely live in remote areas of the Northern Territory, Queensland, Western Australia and New South Wales. Yap and Biddle (2010) calculated HDI for Indigenous Australians to be 0.737, and Butler *et al.* (2014) estimated the HDI for Torres Strait Islanders to be 0.736. The ongoing discrepancy in the well-being of Indigenous Australians and mainstream Australian society remains a major challenge, and has been the focus of a national government policy, 'Closing the Gap', since 2008 (Productivity Commission 2014). The proportion of the Australian population completing secondary education has been growing, from 48% in 2004 to 60% in 2014 (Fig. 15).

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Megatrends

The horizon scanning method

In November 2014 the AIC Foresighting Project team developed a standard approach to engaging the Clusters for the Activity 1 Horizon scanning. During Cluster planning meetings between Indonesian and Australian Cluster researchers a 1-2 hour session was devoted to this exercise. The following questions were asked and discussed jointly:

1. For the Cluster's theme, what are the most important shared issues for Indonesia and Australia?
2. What are the underlying drivers of each shared issue?
3. What megashocks could potentially occur and change the trends in the drivers, and therefore the shared issues?
4. What data or information is available to substantiate this?

Potential categories of collaboration on the shared issues were as follows:

A. Australian capacity to address an Indonesian challenge
B. Indonesian capacity to address an Australian challenge
C. Shared challenge requiring collaborative skills and capacity
D. Shared challenge that has global relevance/exportable value

Infrastructure Cluster horizon scanning

A joint Indonesian-Australian researcher meeting for the Infrastructure Cluster was held in Surabaya, Indonesia in January 2015. A horizon scanning activity was undertaken on 22nd January with 20 members of the Cluster and two AIC representatives. Four of the representatives were from Australia, with two from Monash University and two from the University of Melbourne. The remaining 16 participants were from Indonesian institutions including ITS, IPB, ITB, UI and UGM. The horizon scanning exercise aggregated participants' concerns into common issues, drivers and megashocks.

Shared issues were identified, and were categorised around five main themes: environment, governance, sustainability and effectiveness, and a section outlining port-specific issues (Table 3). Four were listed as Category C and D, and one as Category C only. Megashocks varied between the broad issues, but the most frequently mentioned were changing government policies or environment, climate-related events, natural disasters such as earthquakes or flooding, fuel price spikes or insecurity, and global disease pandemics and health issues. The original table containing the detailed text produced at the Surabaya meeting can be found in Appendix 1.

TABLE 3. THE SHARED ISSUES, DRIVERS AND MEGASHOCKS IDENTIFIED BY MEMBERS OF THE INFRASTRUCTURE CLUSTER, WHERE SHARED ISSUES HAVE BEEN CATEGORISED INTO ONE OR MORE OF FOUR CATEGORIES: A – AUSTRALIA CAPACITY HELPING INDONESIA; B – INDONESIA CAPACITY HELPING AUSTRALIA; C – SHARED ISSUE BOTH COUNTRIES HAVE A PROBLEM WITH; D – SAME AS C BUT WITH AN INTERNATIONAL MARKET POTENTIAL.

SHARED ISSUE	CATEGORY	UNDERLYING DRIVERS	POTENTIAL MEGASHOCKS
Environment	C and D	- Extreme events (e.g. flooding and extreme heat) - Pollution – air, water, soil - Disaster mitigation and recovery - Governance and human behaviour	- Climate change, climate extremes and their impacts - Geohazards and their impacts - Infrastructure failure - Epidemics - Man-made shocks (e.g. oil spills)
Governance	C and D	- Road safety - Work practices - Regulation and lack of leadership	- Geohazards (e.g. earthquakes, flash flooding) - Massive change in the socio-political environment - Withdrawal of a service (e.g. fuel crisis or energy breakdown)
Sustainability	C and D	- Aging infrastructure - Environmental change	- Infrastructure failure - Technology redundancy - Geohazard risk
Effectiveness	C and D	- Connectivity and equity - Governance and socio-politic - Remoteness - Increasing demand for access to services	- Geohazards (e.g. earthquakes) - Changes in the socio-political environment - Global economic and policy issues (e.g. controls on greenhouse gas emission, oil price)
Ports	C	- Environmental challenges (e.g. pollution, land clearing, loss of biodiversity) - Social conditions (e.g. behaviour, education, equity, changing employment, displacement, empowerment) - Infrastructure development challenges (e.g. land acquisition, financing and funding, assets, investment, politics, legal and labour, poor planning) - Infrastructure needs (e.g. services/logistics, technological advancement, lack of connectivity, transformation rather than incremental change)	- Commodity and/or price shock - Unexpected change in demand

Infrastructure Cluster megatrends

Based on these shared issues and drivers as well as the subsequent foresighting process, four overlapping megatrends were identified: Environmental Risks and Opportunities, International Gateways, Coming Ready or Not, and Technology and Innovation. Using information and data suggested by Cluster researchers during the horizon scanning, combined with a literature review on the drivers and issues identified, narratives were collated for each megatrend.

Figure 16. The four megatrends identified for the Infrastructure Cluster.

ENVIRONMENTAL RISKS AND OPPORTUNITIES

This megatrend describes the increasing risks and associated costs from climate change and disasters, as well as the inevitable growth in demand for natural resources and infrastructure due to the growing global population and its mobility. These changes will increase pressure to upgrade existing and build new infrastructure in order to support development. Importantly, these must account for projected environmental change (e.g. sea level rise), and a growing scarcity of natural resources. In both Indonesia and Australia there will be increased demand for infrastructure that is more resilient, less damaging to the environment, and supportive of low carbon emissions.

Climate change: Global temperatures have risen by around 0.85°C in the last century, and this warming is projected to continue. Similar changes are expected in the Australian and Indonesian climate and oceans, even though projections contain wide variations (Fig. 17). Indonesia has seen a 0.5°C increase in air temperature during the 20th century, and will expect future warming of around 0.8 to 1.0°C by 2020-2050 (Bappenas, 2009). Furthermore, the country faces a risk of projected sea level rise of up to 35-40 cm and 175 cm by 2050 and 2100, respectively. These could inundate an area of thousands of hectares, as well as hundreds of kilometres of road. An example is given in Fig. 18 of the Mamminasata metropolitan region of South Sulawesi (Tamin, 2010). The different rates of sea level rise across the region may affect current patterns, erosion and sea water intrusion. During 2005-2007, Indonesia lost 24 small islands mostly due to sea water erosion (DNPI, 2010). Storm surges, tides, and extreme events such as La Niña all contribute to aggravating flood inundation over coastal regions in Indonesia (Bappenas, 2009). In addition, extreme waves will have negative impacts on inter-island goods distribution, since it is mostly conducted by sea transport. In Malang there will be a 5% increase in the probability of extreme rainfall events, which may increase the risk of future flooding, in this urban area (MoE, 2012).

In Australia, the air temperature has increased 0.9°C since 1901 and many heat-related records have been broken (CSIRO and Bureau of Meteorology, 2015). Studies also suggest that Australia is projected to experience more frequent and hotter hot days and fewer frost days, more intense extreme rainfall events, fewer but more intense tropical cyclones, harsher fire weather over southern and eastern Australia,

increases in the mean and extreme sea levels, and warmer oceans (CSIRO and Bureau of Meteorology, 2015). Changes in ocean chemistry are projected to create a risk for coastal infrastructure. A study in Port Phillip Bay, Australia, suggests that a sustained climatic shift that occurred in response to a recent prolonged drought changed the bay's capacity to dilute and flush waste discharges to the ocean (Lee *et al.*, 2012).

Performance of physical infrastructure, including seaports will be affected by changing climate and ocean conditions (Becker *et al.*, 2013). Historically, civil engineers have relied upon past climate data to design infrastructure. Considering projected future climate variability, planning which is based solely on the historic data may create unreliable water supply systems, for example (Milly *et al.*, 2008). Now engineers must develop design and operational practices to withstand future climate conditions, including both extremes and gradual changes (The Jakarta Protocol, 2013). Indeed, the Indonesian National Adaptation Action Plan calls for integrating both climate change information and local/traditional values and wisdom into any adaptation program in all sectors, including public works and maritime and fishery sectors (DNPI, 2011). Similarly, climate change is recognised as one of nine challenges that must be considered by Australia's national infrastructure planning and investment (Infrastructure Australia, 2009).

In Melbourne, it is recommended that sea level rise is considered in all planning, decision and infrastructure programs in areas likely to be affected such as the Docklands, Fisherman's

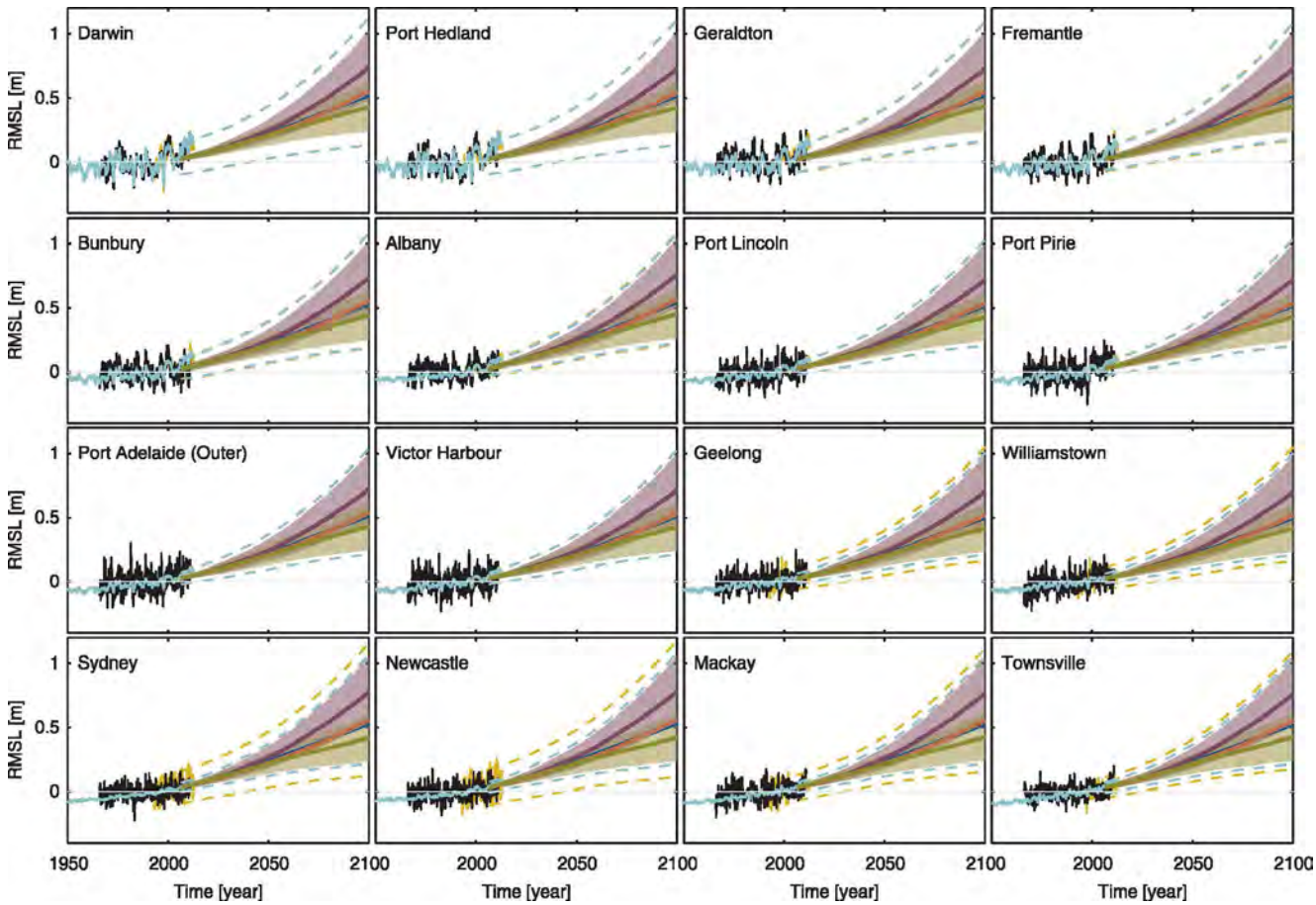

Figure 17. Observed and projected relative sea level change for selected Australian sites (CSIRO and Bureau of Meteorology, 2015).

Bend and Southbank. It is estimated that a long term strategy to address sea level rise is far more cost effective than potentially drastic and urgent measures undertaken much later when shores or piers are inundated (DCC, 2009). National standards will have to be revised to benchmark development for infrastructure. As an example, at Marion Bay on the Yorke Peninsula, South Australia, a development proposal was rejected by the District Council in September 2007 primarily on the grounds of vulnerability to coastal erosion and the threat of increased vulnerability from projected sea level rise.

Dwindling finite resources: With 7 billion people in the world, there will be an inevitable growing demand for finite natural resources such as water, oil, natural gas, phosphorous and coal (Fig. 19). The growing population has already surpassed the capacity of the Earth to supply enough essential resources to sustain the current population and level of socio-economic development (Burger *et al.*, 2012). By 2030 the world may consume 42,500 million barrels of oil per annum (Owen *et al.*, 2010), and there is a potential shortfall of 10,000 million barrels, which could have catastrophic consequences (e.g. a near doubling of real prices over the coming decade; Benes *et al.*, 2012). The contribution from alternative energy such as wind and solar energy to global energy production will rise to 25,000 TWh by 2050 (WWF in Vidal *et al.*, 2013). To meet this demand, the global supply of raw materials such as concrete, steel and aluminium will need to significantly increase (Vidal *et al.*, 2013).

Figure 18. Projected sea level rise (SLR)-induced inundation of Poatere Port, Makassar City, Indonesia by the 2050s (light green) and 2100s (light purple) (Tamin, 2010).

The Infrastructure Cluster workshop in January 2015 identified a risk of service withdrawal when a fuel crisis or energy breakdown occurs. Oil price shocks, in particular, have been seen as a potential major driver for disruptions in port services (see also www.pelindo.co.id). To combat resource scarcity, infrastructure will need to focus more on facilitating recycling, multi-use and reducing waste. Integrated water management in Melbourne is a successful example of applying a more holistic approach to delivering urban water services (see http://www.livingvictoria.vic.gov.au).

As demand for land grows, both as a result of population growth and development, there will be increasingly contested decisions about land acquisition and control. Land conflicts in Indonesia have risen over the last 10 years as private investors and the government have acquired large tracts of land without respecting the rights and interests of local users. In 2013 alone, land conflicts in Indonesia caused 22 deaths due to violent clashes and involved almost 140,000 households, according to Agrarian Reform Consortium (KPA) figures. Due to land disputes, infrastructure projects can be idle for years or cancelled altogether, such as Jakarta's east flood canal development. Social issues related to land acquisition are still the most difficult challenges faced by the government (Mudjiadi, as quoted in www.sda.pu.go.id). The legal framework involving land acquisition in Indonesia has been a serious obstacle for infrastructure projects to materialize, and renders investors hesitant to invest. As part of President Joko Widodo's plan to boost infrastructure investment in the next 5 years, the government has implemented Presidential Decree Number 2 in January 2015. This Decree governs land acquisition for development and public interest, which aims to assist Public Private Partnerships. Any development project will need to have a comprehensive plan for land acquisition, including detailed information about the area and compensation for people whose land will be affected. The compensation levels will be estimated through an independent appraisal process to reduce the risk of conflict. The successful land acquisition for the Trans Sumatra Toll Road (Palembang-Indralaya segment) Project is one of the first examples of this reform (see www.medanbisnisdaily.com).

In Australia, there are general land acquisition laws which deal with matters relating to the acquisition of land by state or territory agencies. However, as more and more major public infrastructure projects are being delivered by the private sector, this legislation might become outdated, and there is a need for reform as demonstrated by numerous gas, water, electricity and rail projects in Queensland (Clifford, 2012).

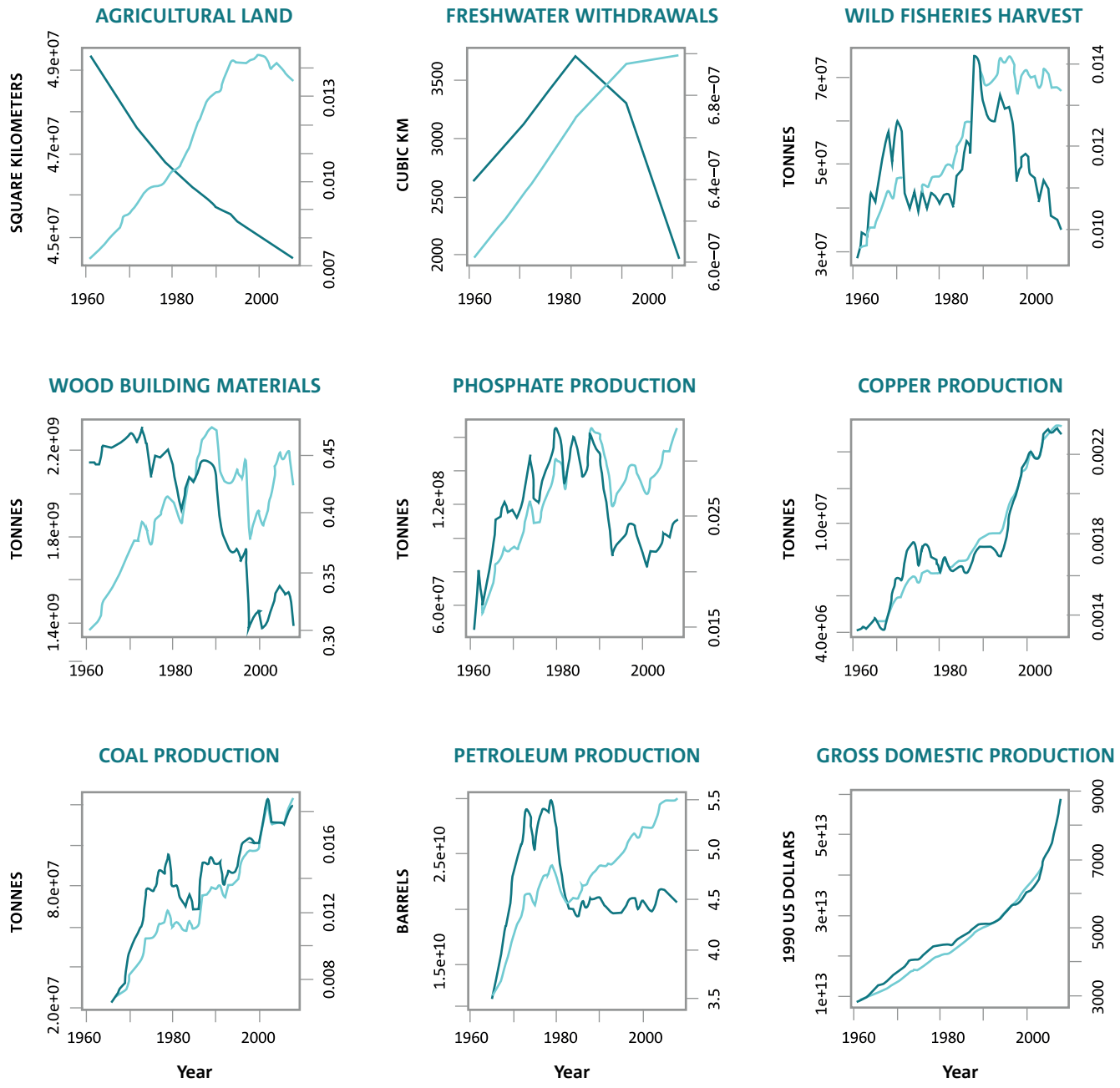

Figure 19. Global trends in total (light teal lines) and per capita (dark teal lines) consumption of resources and Gross Domestic Product, 1961-2008 (source: Burger *et al.*, 2012).

The rising cost of disasters: Globally, there is a positive trend in the number of reported disasters, which affect more than 226 million people every year (UNISDR, 2010). Most of these disasters are weather and climate-related, including storms, droughts, floods, wild fires and extreme heat (Jennings, 2011). With a sharp increase in urbanization, more people will live in unsafe urban settlements, especially in coastal areas exposed to floods, cyclones and storms, and hence more people will be at greater risk from future disasters (UNISDR, 2010). Economic impacts as a result of disasters are also expected to increase. Over the past 5 years, the financial cost of natural hazards in Australia has accounted for around $6.3 billion per annum, and is estimated to increase to over $23 billion per annum by 2050, without accounting for climate change (Deloitte Access Economics, 2013). The upward trend in the impacts of disasters in Indonesia is shown in Fig. 20.

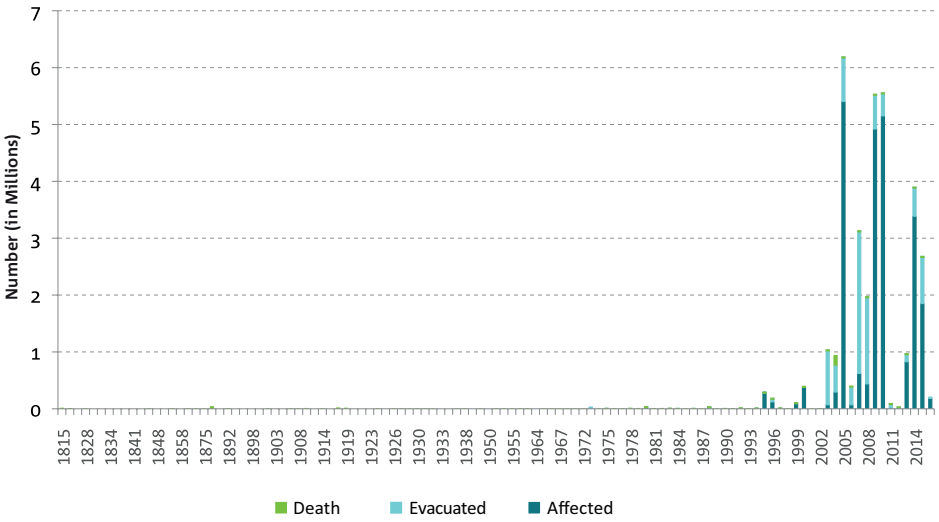

Figure 20. Number of people affected and evacuated due to disasters in Indonesia, 1815-2014 (data obtained from BNPB, 2015. http://dibi.bnpb.go.id).

Adjusting engineering designs and standards to address disaster risk is crucial to infrastructure resilience. Townsville, in northern Queensland, is among the first cities globally to use a new United Nations' Office for Disaster Risk Reduction (UNISDR, 2010) disaster resilience scorecard developed jointly by AECOM and IBM (see http://www.lgnews.com.au). The scorecard assists cities to mitigate against, and more quickly recover infrastructure and services from, natural disasters including earthquakes, tsunami, climate change, storms, floods, droughts and wild fires. The scorecard measures preparedness and ability to respond and recover from disaster in 80 assessment categories. Townsville has also joined other Australian cities signed up to the 'Making Cities Resilient Campaign', namely Adelaide, Cairns, Canberra, City of Gold Coast, Gympie, Lake Macquarie City and Sydney.

INTERNATIONAL GATEWAYS

This megatrend focuses on the projected rapid economic growth and shifting political power in the Asian region, and its influence on infrastructure. This will be accelerated by the formation of the ASEAN Economic Community (AEC) in 2015, which will provide enormous opportunities for trade for both Indonesia and Australia, while increasing pressure on infrastructure to take advantage of the trend.

Maritime politics: The world's economy and political power is shifting from the West to be replaced by a new international system shaped by the BRICS (Brazil, Russia, India, China and South Africa) and the East. The transformation of the global economic system will require the assimilation of markedly different political, cultural and trading traditions (Hoge, 2014). By 2050 Indonesia is likely to become the 4th largest economy in the world, and Australia will be ranked 28th (Hawksworth and Chan, 2015). It is uncertain how diplomatic disputes will play out in the future, but it is likely that defence and border security issues will be re-examined for both Indonesia

and Australia. Risks of security emergencies are likely to rise due to unresolved intra-and extra-regional territorial disputes (Cox, 2012). Hence ports are likely to play an increasingly important role in trade and security.

The Chinese economy will continue to grow and provide the dominant market for raw materials (oil, coal, gems and minerals, agriculture, clothing and textiles) in the Asian region. In 2015, bilateral trading between China and ASEAN, which began with a fair-trade agreement in 2010, is expected to be US$500 billion, making China ASEAN's biggest trading partner, and ASEAN China's third biggest partner (ASEAN, 2015). China will benefit from any maritime development that is undertaken in Indonesia since it is a major transit point for Chinese trade (Piesse, 2015). Indonesia's President Joko Widodo has been quoted as saying that "Indonesia is on the way of developing into a maritime power, while China proposes to build the twenty-first century Maritime Silk Road; the two initiatives highly fit with each other." Rizal Sukma, the presidential advisor for foreign policy, views Chinese and Indonesian maritime plans as complementary and has identified three areas where the aims of the two states overlap, specifically in terms of connectivity, safety and diplomacy (Piesse, 2015).

By 2030 the Indian economy will also have taken off, and with its multi-dimensional relationship with ASEAN there is a political consensus to maintain good relations for a variety of economic and strategic reasons. Trade between Indonesia and India reached $76 billion in 2012-2013, and defence and strategic ties between India and Southeast Asia have strengthened (Maini, 2014). Building a closer relationship with India has been on Jakarta's diplomatic agenda for most of the last decade and could now gather greater momentum (Piesse, 2015).

In the past it was thought that commercial or national banks would have little interest in providing development loans. However now the International Monetary Fund and the World Bank are competing for business. China and a number of other countries are becoming competitors in the business of providing development finance to poor states (Bisley, 2008). The $50 billion Asian Infrastructure Investment Bank (AIIB) established by China and 20 other nations as an alternative to the World Bank and the Asian Development Bank, was launched in October 2014. The USA has lobbied against some large economies joining the AIIB due to concerns about China extending its influence in Asia through aid and investment (Page, 2014). As of June 2015, both Australia and Indonesia are signatories to the AIIB, and Indonesia sees it as an opportunity for investment in critical infrastructure (Tiezzi, 2014).

The USA and China are engaging more positively on the climate change agenda with the two countries having recently announced unilateral measures to reduce their greenhouse gas emissions by 2030. Both sides also spoke about jointly pushing negotiations at a climate change conference in Paris in 2015, and are seeking to cooperate on clean energy and environmental protection (The Guardian, 2014).

On the move: Humanity is becoming increasingly mobile. For many reasons, people are travelling further and more frequently. Indonesia's global transport market will enter the top ten around 2020 and attain 6th place by 2029, with a market of 270 million passengers by 2034 (see www.iata.org), and a 107% increase is expected in total passenger movements through all Australian airports by 2030 (DIRD, 2014).

Another example of the increasing mobility is the rapid growth of cruise tourism in Asia, which is expected to reach 2.2 million in 2014, with the introduction of new and larger ships boosting passenger capacity by 20% per annum. This has enabled Asia to become the fourth largest market in the world in terms of passenger capacity deployment. Indonesia experienced a 54% jump in cruise ship calls in 2013, and a rise of 30.1% in the number of passengers to 147,134 (see www.cruiseandferry.net). Australian cruise passengers have also increased at an unprecedented rate (ICCA, 2011), and this trend is expected to continue, with growing pressure to upgrade existing, and build new, transport infrastructure which can support this industry.

Following trends in global trade and the establishment of the ASEAN Economic Community (AEC) in January 2015, movement of goods and vessels around the regions will also increase. The freight load in Australia's capital cities is expected to grow by 50-70% between 2003 and 2020, which will result in a 13.5% increase in national carbon emissions because 60% of freight is moved by trucks rather than trains (SBEnrc, 2012).

In Australia, total (bulk and non-bulk) domestic coastal shipping freight was 49.1 million tonnes in 2012-2013, and this has remained relatively constant with only minor fluctuations over the years. More recently, domestic coastal shipping has declined, with the Australian Government projecting a 15% growth from 2010 levels, dependent on other coastal freight off-setting the declines in coastal petroleum and iron ore movements. However, international sea freight to and from Australia has more than doubled from 420 million tonnes (bulk and non-bulk) in 1995-1996 to 1,169.2 million tonnes in 2012-13 (Australian Government, 2014). The Australian Government is anticipating that the growth in Asian demand for Australian commodities such as iron ore, coal and Liquid Natural Gas could grow by 100-160% in mass between 2010-2025 (BITRE, 2014). Containerised trade at all Australian ports is expected to almost double by 2025 to around 13.6 million units (DIRD, 2014), due to strong demand from China and Southeast Asia. At the same time, Australia's strong demand for consumer goods will grow broadly in line with the economy, increasing freight imports (Commonwealth of Australia, 2014).

As an archipelagic country, Indonesia is dependent on sea transport for much of its domestic transportation, as well as for its international trading links. Indonesia has approximately 1,700 seaports, with the total throughput of the port system estimated to be 968 million tonnes in 2009. This total is split fairly evenly between domestic and international cargo movements, with 44% of the total being domestic cargo and 56% international (OECD, 2012).

Low wage costs, an open economy and proximity to fast growing economies will make Indonesia an attractive location for manufacturing in the future. For example, bilateral trade between Indonesia and Thailand is projected to be almost five times as high in 2030 as it was in 2009 (PWC, 2011).

Indonesian President Joko Widodo is keen to take advantage of his country's connection to the sea, and to grow Indonesia's sea freight as outlined in the Maritime Doctrine (Piesse, 2015). Three out of five pillars of the doctrine relevant to such needs are:

1. Rebuild Indonesia's maritime culture. As a country consisting of 17,000 islands, Indonesia should be aware of and see the oceans as part of the nation's identity, its prosperity and its future are determined by how we manage the oceans.
2. Maintain and manage marine resources, with a focus on building marine food sovereignty through the development of the fishing industry.
3. Provide priority to the development of maritime infrastructure and connectivity by constructing sea highways along the shore of Java, establish deep seaports and logistical networks as well as developing the shipping industry and maritime tourism.

Meanwhile, Australia's third and fourth national infrastructure priorities are to develop more effective ports and associated land transport systems to more efficiently cope with imports and exports, and to develop a national rail freight network (Infrastructure Australia, 2009).

Global movement of agricultural goods and people is a well recognised contributor to the increased risk of biosecurity threats. As ASEAN countries open their internal and international markets through the AEC there is greater potential for pests, weeds and diseases from the ASEAN region to reach both Indonesia and Australia. Better infrastructure could escalate this risk, but could also potentially help mitigate the risk, for example through improved customs controls in both countries which could reduce the standing time of containers and the risk of disease spread.

Illegal fishing and illegal cross-border incursions are still occurring in the few hundred kilometres between the Indonesian archipelago and Australia. According to a strategic analysis (Supriyanto, 2014), these and other problems have become a focus of bilateral cooperation between Australia and Indonesia. In particular, the security and safety of maritime checkpoints in the Indonesian archipelago (i.e. the Malacca, Sunda and Lombok Straits) are the top priority in Canberra's security cooperation with Jakarta.

Growth in trade: The reduction of trade barriers (e.g. under the AEC, and Free Trade Agreements between China and Australia in 2014, and New Zealand and China in 2008) will increase trading opportunities for Indonesia and Australia into the region. Bilateral trade will also increase amongst other Asian countries, as the rise of the middle classes in most Asian countries will increase demand for consumer goods and services including food products (e.g. beef, wine, cheese), clothing and fashion items, and health products (Economic Outlook, 2014).

This will increase pressure on infrastructure, particularly maritime and connecting infrastructure, in order to trade effectively in the region. Physical transport and digital infrastructure, together with an effective administrative regulatory system are crucial for efficient delivery of physical goods, capital, labour, people, and ideas within and among the ASEAN countries. The Master Plan on ASEAN Connectivity provides frameworks and strategies for both air travel and shipping services, and aims to attain a single shipping market. However, this market will falter without an effective logistics system that encompasses transport, warehousing, cargo consolidation, border clearance and domestic distribution and payment systems.

The Logistics Performance Index (World Bank, 2014) indicates that there is a wide gap in logistics performance among ASEAN countries, with Indonesia ranking 53rd in the world, due to poor customs processes and quality of infrastructure, and competence and quality of its logistics services. To put this in perspective, Singapore is ranked 5th in the world, the highest ranked country in the ASEAN region, and Australia is 16th (WB LPI, 2014). Indonesia also ranks poorly (56 out of 144 economies) on the World Economic Forum Global Competitiveness Index, with the state of the country's infrastructure listed as a critical factor (World Economic Forum, 2015).

The ASEAN single shipping market will also exacerbate the risk of biosecurity issues. Currently Indonesia struggles to have the capacity to manage these risks, and therefore capacity building is important for Indonesia, both in terms of managing inward risk and capturing export markets (CSIRO, 2014). In Australia, this will stretch current surveillance mechanisms, which are already poorly funded (Australian Government, 2014).

Regional infrastructure to support trade: Indonesia must meet the infrastructural needs of its industries and households. The increased focus on infrastructure by the new government is beginning to show some results, with Indonesia's competitiveness ranking improving, but being still lower than other ASEAN countries such as Malaysia (25th), Singapore (second), and Thailand (48th; World Economic Forum, 2015). President Joko Widodo's $6 billion Maritime Doctrine to boost economic growth by improving connectivity between the islands of the Indonesian archipelago will not only enhance domestic connectivity, but will boost the underperforming logistics network, reducing the cost of shipping goods around the country and region (Bloomberg, 2014). Many of these islands remain unconnected to their neighbours, and several benefit from only loose or intermittent contact. As a result, many of these islands have acted as self-sufficient economies, not contributing to or benefitting from national economic production and distribution processes. Similarly, Indonesia's port infrastructure has suffered from neglect and financial constraints over the years. Many of the ports are in poor condition and impede the country's internal and external maritime commerce in the form of revenue losses, time-lags, procedural delays and inadequate port facilities (Shekhar and Liow, 2014). Port capacity is expected to be further exacerbated in the future by the combined adverse effects of climate change and growing urbanisation (World Economic Forum, 2013).

Further infrastructural development is also planned with more toll roads, power plants, railways, bridges and tunnels and improved harbours and airports, and water and sanitation systems. It is hoped that these initiatives will not only create employment and stimulate consumer spending, but also attract private investment. The Indonesian Government has shown commitment to tackle the problem of infrastructural shortcomings, partly demonstrated by the cut in costly fuel subsidies. At the same time, the government is aware of its own limitations and is therefore encouraging greater private sector participation in infrastructural development through Public Private Partnerships (Asian Development Bank, 2013). Indonesian Infrastructure Finance has been set up to help facilitate this (see iif.co.id).This is especially important if Indonesia is to attract further foreign investment and achieve its ambitions of becoming a regional manufacturing hub. Tim Hewett, of the Australian Trade Commission, noted that "infrastructure development is one of the key challenges facing Indonesia … this is still one of the most expensive countries in the world to move a shipping container, despite wages being incredibly low." Hewett also states that investment into airports, roads, ports and telecommunications is required to attract much-needed foreign investment (Manners, 2014).

Currently the Masterplan for the Acceleration and Expansion of Indonesia's Economic Development Plan (MP3EI, 2011-2025) comprises $468 billion of investment, with approximately 45% reserved for infrastructure development. It is projected that more than 70% of the investment needed will be contributed by the private sector through Public-Private Partnerships. To provide more assurance for private investors, the government has established the Indonesia Infrastructure Guarantee Fund (IIGF; see http://www.iigf.co.id). While plans and financing for infrastructure in Indonesia progress, land access and sovereignty are increasingly contested issues (as described above). The legal framework involving land acquisition in Indonesia has been a serious obstacle for the materialization of infrastructure projects which, along with bureaucracy, confusing regulations and corruption, has made foreign investors hesitant to invest (Danubrata and Owen, 2014). The 2012 Land Acquisition Law was passed in an attempt to address these issues, but there has been a lack of effective

implementation with disputes leading to some infrastructure projects being idle for years or cancelled altogether (PPPI, 2014). Land conflicts in Indonesia have increased over the last 10 years, as private investors and the government have acquired large tracts of land without respecting the rights and interests of local users.

President Joko Widodo has indicated that his government will start a Land Bank in 2015 to accelerate infrastructure projects. The Bank will be jointly managed by the Finance, Public Works and Transport Ministries, with all agencies involved ordered to complete procurement for infrastructure projects by the end of March 2015 (Rahadianna and Brummitt, 2015). In addition to resolving land disputes, the Widodo administration created a 'one-stop shop' in January 2015 to cut the time needed to get investment permits to 15 days, instead of a multi-stop process taking up to 3 years. This may also offer tax incentives for strategic sectors such as renewable energy (Brummitt, 2015).

It is likely that land conflicts will continue, with corruption in Indonesia a major impediment to transparent governance. The improving Indonesian corruption perception score of 34, up two points from 2013 (Transparency International, 2014), indicates that the National Strategy of Corruption Prevention and Eradication is having a positive impact. However, land-grabbing continues as national governments search for 'empty' lands. Further pressure will grow as the new Indonesian government acquires land in its plans to boost the national economy.

In Australia, there will be growing pressure to upgrade existing and to build new transport infrastructure which can support and enable the Asian trade opportunities. Australia is a major exporter of commodities, and has recently seen a rapid expansion of ports in Northern Australia to support industry growth (oil and gas; the mineral resources sector iron ore industry in Western Australia; the coal industry in Queensland; and naval and export facilities in Darwin Harbour). Australia's largest export markets are China (27% of total exports), Japan (17%), South Korea (7%), India (6%) and the European Union. To cope with current demand, and to attract and sustain additional business in the future, Infrastructure Australia has identified 'international gateways and supporting supply chains' as one of the critical areas for ensuring that Australia is able to compete in an increasingly connected global world (Fig. 22). Currently Australia's ports provide vital gateways to international trade, but very high growth rates and a lack of integration across the supply chain is reducing their competitiveness. Increasing their productivity will require governance reforms, improved strategic planning and adequate investments in airport infrastructure, and better co-ordination in port precinct and land transport planning. Key challenges identified by Infrastructure Australia include resolving inefficiencies and inconsistencies in governance that adversely impact infrastructure

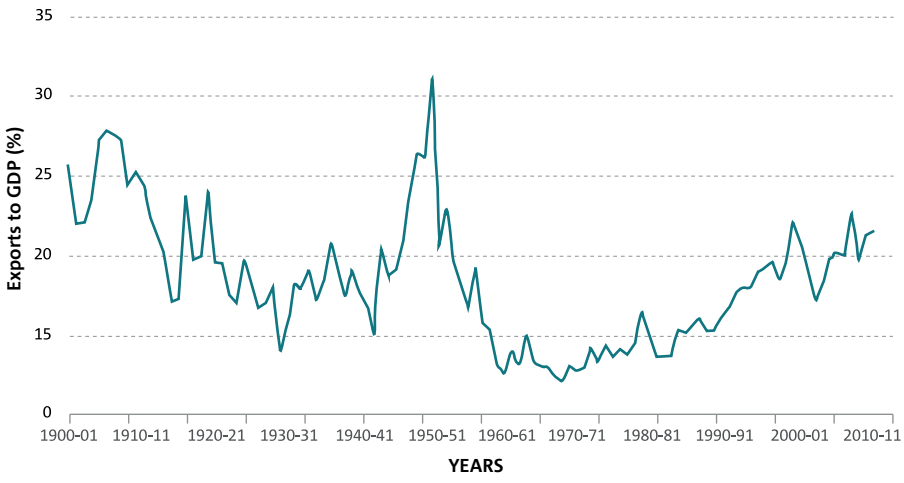

Figure 21. Australia's exports as a share of Gross Domestic Product (GDP) (source: Australian Treasury, Australian Bureau of Statistics).

operations and investment, simplifying the regulatory complexity and competitive anomalies that impede operations, and utilising existing infrastructure better (Infrastructure Australia, 2012). In addition, facilities will have to cope with potentially extreme weather and environmental conditions (e.g. flooding) due to climate change.

In 2014 the Australia Government entered into a new national partnership agreement on land transport infrastructure products with the States and Territories, in order to enhance the interconnectivity of corridors of significant economic opportunity across Australia. This partnership includes $300 million to enable pre-construction for the inland railway (Melbourne to Brisbane), and facilitating the delivery of a major intermodal facility in the southwest of Sydney to provide a rail 'port shuttle' between Port Botany and the Moorebank precinct, a separate terminal for interstate freight and warehousing (Australian Government, 2015). However, Australia's recurring political instability has raised suggestions that it may be treading a similar path to Europe, which is trapped in a cycle of political crisis-management and inability to commit and maintain strategic infrastructural planning (Burchell, 2015).

Reaching the remote: Indonesia has a development gap between urban and rural areas, compounded by its archipelagic geography, with over 17,000 islands extending 5,150 km east to west. Indonesia also has large income inequalities, with 40% of the population living on less than $2 per day (Yusuf *et al.*, 2013). Due to an underinvestment in infrastructure, many Indonesians have only limited access to piped water, electricity, health care and education. The Indonesian Government's decentralisation program is key to addressing these issues, but local capacity and allocation of funding is still limited, and accountability is lacking (OECD, 2013). Infrastructure not only increases productivity, but it also promotes personal mobility, making growth more inclusive (OECD, 2015).

Examples of the disparities between urban and rural regions include the quality of road infrastructure, with over 20% classified as damaged in Kalimantan and Maluku, while in Papua the number of roads classified as good is only 19% of the total (OECD, 2013). In a 2011 report on local economic governance, the provinces of Southeast Sulawesi, Maluku and North Maluku ranked lowest for roads, street lighting, water supply, electricity and telecommunications. Generally infrastructure in western

Indonesia, the municipalities and main islands is of a higher quality than in eastern Indonesia, regencies and smaller islands (OECD, 2013).

Australia also struggles with infrastructure equality in remote and regional centres, but this is not as distinct as in Indonesia. In Australia 86% of the overall land mass is classed as remote or very remote by the Australian Bureau of Statistics' Accessibility/Remoteness Index of Australia. With 85% of the Australian population living within 50 km of the coast, political and economic decision-making is inclined to focus on those living in urban Australia (NRRTI, 2014).

Northern Australia is anticipated to function as a 'gateway to Asia'. However, infrastructure limitations constrain growth, both in the cities and its regions. Perceptions around limited or lacking infrastructure can also act as a deterrent for investment and potential residents. Land access arrangements can be problematic with issues of overlapping tenure arrangements and inflexible conditions. Water is a critical resource for both the northern economy and the environment, but northern Australia's variable climate, together with gaps in the understanding of surface and groundwater systems, can hinder the development of new water infrastructure and more reliable access to water resources. Business groups also cite greater difficulty in attracting and retaining skilled and unskilled labour due to remoteness, climate and liveability relative to southern Australia and competitors overseas. For example, almost 25% of the mining workforce in Queensland is replaced each year (Australian Government, 2014). Northern Australia's remoteness means that factors such as higher transportation costs and costs of living can have a greater impact than elsewhere. To explore these issues further and to develop policies and strategies for the future, the Australian Government is preparing a White Paper on Developing Northern Australia, which is intended to support economic development. An interim Green Paper was presented in July 2014 (Australia Government, 2014).

COMING READY OR NOT

This megatrend outlines the rapidly changing social world and the associated challenges for infrastructure. Indonesia's population is growing rapidly (see Fig. 7), as are incomes with a rising consumer class. Urbanisation is one of the main drivers of increasing incomes. However, this rapid growth and development of urban centres has also created new challenges and new risks. Rising costs will mean that there will be an emphasis on increased efficiencies, and creating critical links between education and infrastructure for both Australia and Indonesia. This rapid social change will create new opportunities for industries and individuals, as well as magnifying geopolitical tensions, and risks to health, security and the environment.

Changing demographics: By 2030 there will be a much broader distribution of incomes around the world, with a rising middle class across the emerging economies. Seventy-five percent of the global consuming class (estimated to be 1.8 billon) is likely to be in Asia (McKinsey, 2012). Urbanisation is one of the main drivers of increasing incomes, with small cities growing at a faster rate (Fig. 22). Jakarta's economic prominence appears to have reached a plateau, and by 2030 its share of national GDP is expected to remain stable at around 20% (McKinsey, 2012). By comparison, Australia's largest city, Sydney, currently contributes 23% of Australia's GDP (RBA, 2015).

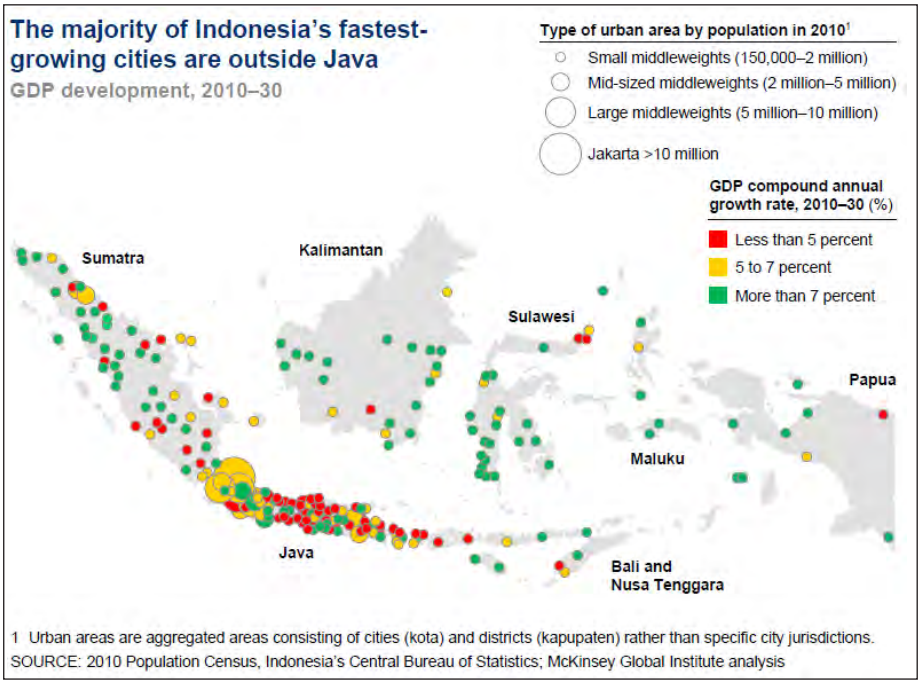

Figure 22. Rates of growth in Indonesia's cities (source: McKinsey, 2012).

The rapid growth and development of urban centres (see Fig. 6) has imposed challenges for water supply, urban congestion, patterns of social advantage and disadvantage, climate change and adaptation, and pressures on public finance. In particular, urban mobility is critical for the flow of goods, capital and people within cities, and it also provides access to employment, delivery of services, health care and education. Improving urban mobility therefore also delivers social and economic benefits beyond increased productivity and land values (KPMG, 2015).

Australia's transport systems are struggling in the face of these challenges, with public transport growing rapidly in recent years and reaching capacity limits in most major cities. The avoidable cost of congestion in Australian cities is equivalent to 1% of GDP and is forecast to more than double 2005 levels to reach $20 billion per annum by 2020 if nothing is done (Commonwealth of Australia, 2011). The Australian Government is addressing these challenges by investing in urban passenger transport, integrating planning of land use and infrastructure, improving the efficiency of existing infrastructure, and by supporting education, research and innovation (Commonwealth of Australia, 2011).

For Indonesia, the improvement in the standard of living, urbanisation and the growth of the middle class will alter demands on infrastructure. Indonesian consumers have increased spending power for discretionary goods, with fashion items being the most significant, growing by 25% from 2012 to 2013 (Credit Suisse, 2013). However, more than half of all goods and two thirds of traded goods are still transported by road in Indonesia. Congestion and high transport prices will need to be resolved to enable future retailers' requirements for improved access to products, productivity and efficiency to meet growth in consumer spending. This necessitates improved infrastructure, supply chain efficiency, regulation and technology. Indonesia's new government has laid out an ambitious development agenda, including dramatically increasing infrastructural spending and expanding social security. Funding these goals requires mobilizing more revenue in order to also meet pre-existing expenditure commitments, such as universal health coverage and funding of district governments under the 2014 Village Law (World Bank, 2014).

Managing changing risks: The infrastructure sector is familiar with managing risks, but investors and developers have become increasingly concerned about the impacts of growing political and regulatory uncertainty. This is an issue for both Australia and Indonesia, where investors have seen their projects delayed or stopped after an election, or regulation that was being relied upon change under new government priorities. This was demonstrated recently in the November 2014 Victoria State election, where the Federal Government was committed to build an 18 km tollway, but the incoming State government campaigned successfully against it (Wiki, 2014). Infrastructure development requires long lead times that do not correspond to election cycles (KPMG, 2015).

Other risks relate to the growth of travel and people movement, which increase the possibility of pandemics. An example is the Australian National Protocol for Pandemic (H1N1) 2009 on Cruise Ships, which was rapidly developed in consultation with cruise ship operators, state and territory chief human quarantine officers and Commonwealth border agencies after a cruise ship arrived in Sydney carrying 172 travellers exhibiting symptoms of human 'swine flu' (Australian Government, 2013).

Changing jobs and education: As China's economy continues to mature it is expected to transition from being an export-led to a consumption-driven economy. This process will be accelerated by a rapidly aging population and increasing real labour costs. Western companies will also see a change in the way they do business in the Asian region. Rising costs will mean that many off-shore jobs are likely to exit China over time and move to other cheaper economies such as Vietnam, Bangladesh, the Philippines and Indonesia (Hawksworth and Chan, 2015).

Indonesia's savings, investments and retail sectors are also expected to become large consumer markets by 2013. The OECD has identified a large productivity gap due to segments of the labour force still being engaged in agriculture. Currently Indonesia has the lowest export share of manufactures amongst ASEAN countries (OECD, 2015). To catch up requires Indonesia's evolving economy to build new skills to support growth, requiring significant investment. Research by the World Bank suggests that human capital is a major obstacle to the development of a vibrant Indonesian manufacturing sector, and KPMG have suggested that there is shortage of appropriately skilled project managers and engineers for infrastructure more broadly (McKinsey, 2012). However, in contrast to Australia and other ASEAN countries who have a rapidly ageing population which is constraining growth, Indonesia has a young population which has the potential to do the opposite. However, a challenge is the urban migration of younger people which will increase the need for aged care support in rural areas (Kadar *et al.*, 2014).

By 2050 the number of people in Australia aged 65-84 years is expected to more than double (see Fig. 9), and the number of people over 85 years to more than quadruple from 0.4 million to 1.8 million (Australian Government, 2010). With Australia's ageing population it is expected that improved productivity growth will arise from 'doing things better', which must support some or all of the very significant expected increases in demand for health, aged care and training services (Productivity Commission, 2013). Improving education and infrastructure will therefore need to play a critical role in the potential productivity of the labour force through allowing individuals to participate in the economy. Examples include improving public transport to encourage mature age participation, and growing health and service infrastructure needs such as aged care facilities.

New infrastructure driven by industries: While the number of vehicles in Indonesia increased threefold in 2001-2010, the national road network grew by only 25% and nearly 80% of the network is in bad condition (World Bank, 2012). In 2014, with sales of 1.3 million vehicles, Indonesia overtook Thailand in domestic automotive sales, making it ASEAN's largest automotive market. Vehicle sales in Indonesia increased 17.8% in the year to March 2014 (Business Monitor International, 2014). The potential for Indonesia's automotive industry to keep growing at rapid rates is strong, given that currently 70% of sales in the domestic automotive industry are in Java alone. With Indonesia's consuming class set to grow from 45 million to 135 million by 2020, middle class Indonesians in cities from Medan to Makassar will create mass markets in their own right for Indonesia's automotive sector (McKinsey, 2012).

Other industries will include the massive development of new infrastructure (e.g. infrastructure for enabling mass public transport, new railways, gas transmission, subsea electrical transmissions, and Carbon Capture and Storage facilities). An example of this is the 'Internet of Things', where Jakarta invested $2.4 million in its Smart City Project in 2015. Sixty percent of the funds are being spent on building an operations centre that will help monitor and respond to complaints from citizens. Residents are already using the app 'Qlue' to report complaints on traffic accidents, crime, natural disasters and sanitation by submitting location-tagged photos (http://www.qlue.co.id/). The six biggest city government units (transport, public utilities, health, sanitation, tax and local government) are expected to be integrated with the common operations centre by the end of the year (Asian Pacific Future Gov, 2015).

Growth in Australian infrastructure is likely to be driven by the services sector which is the fastest growing industry, generating over 70% of Australia's GDP. A key focus will be transport, ports, telecommunications and airports, especially in Australia's four largest capitals, Sydney, Melbourne, Brisbane and Perth. The Australian Infrastructure Audit outlines that demand for public transport will grow in the capital cities, and unless managed appropriately peak demand will exceed capacity. The audit suggests investment in smart technologies and systems that maximise the use and productivity of the existing infrastructure (Australian Government, 2015).

TECHNOLOGY AND INNOVATION

This megatrend describes opportunities for economic development that also tackles emerging environmental risks. 'Going green' will be a focus for repairing and revitalising physical infrastructure, together with the rise of innovative materials and technological solutions that have the potential to transform the physical infrastructure sector. The evolution of the Internet to enable 'things to be connected anytime, anyplace, with anything and anyone' will drive this transformation, but application of the digital innovation will also introduce new risks of critical systems failure and cybercrime.

Ageing infrastructure and critical systems failure risk: Repairing and revitalising physical infrastructure will become a major need for many countries, including Indonesia and Australia, as most of their physical infrastructure is ageing. Meanwhile, critical systems failure will be a real threat with a hyper-connected world, and hence there will be growing pressure for equipping infrastructure with the best possible security systems.

A 'critical systems failure' relates to any system whose failure could threaten human life, the system's environment or the existence of the organisation which operates the system. As an example, maritime terminal control systems are used to operate motors, pumps, valves, signals, lighting and access controls. Critical systems failure has always

been among the top ten threats to global development according to the World Economic Forum's (2015) Global Risks Report.

Ageing infrastructure also impacts the standard of living and the economy. The 2014-2015 Global Competitiveness Index ranked the Australian and Indonesian economies as 22nd and 34th, respectively, out of 144 countries. However, the ranking of Australian and Indonesian infrastructure was 35th and 72nd, respectively (Schwab, 2014), highlighting the gap in the quality and supply of infrastructure in both countries.

In Indonesia, many water treatment plants (WTP) operated by municipal companies are ageing. These include the Ngagel 1 WTP (Surabaya), Ratulangi WTP (Makassar), Badaksinga WTP (Bandung), which were built in 1922, 1924, and 1959, respectively. All of Indonesia's 284 major dams were built prior to the 1990s, and many of them are already struggling to keep their functionality due to very high rates of sedimentation. For example, the Saguling Dam became operational in 1985 for two main purposes, hydroelectric power generation and raw water supply. Current rates of sedimentation are 4.2 million m3 per annum, shortening its hydroelectric power generation life time from 31 to 27 years (www.regional.kompas.com). Another example is the Bili-Bili Dam, the largest dam in South Sulawesi, whose catchment erosion in 2012 was 121.37 tonnes per hectare per annum, which greatly exceeds the initial design value of 18 tonnes per hectare per year (Arsyad *et al.*, 2012). It is estimated that the effective age of the Bili-bili Dam might be shortened by 10 years (Arsyad *et al.*, 2012).

Indonesian rail infrastructure is largely a legacy of the colonial period, and is primarily concentrated on the two most heavily populated islands of Java and Sumatera (OECD, 2012). Indonesia has seen a 41% decrease in rail length from 1939 to 2000, mainly due to ageing factors. Attempts to address this decline include a $85 million loan provided by the World Bank aimed to support a comprehensive Railway Efficiency Project (INFID, 2008).

Similarly, significant parts of Australia's infrastructure are ageing and nearing the end of their economically useful lives, according to Engineers Australia's latest Infrastructure Report Card (Engineers Australia, 2010). As an illustration, 65% of Australia's coal-fired power stations will soon be over 40 years old (Climate Council Australia, 2014). This is also critical in the transport sector, with the 2015 Australian Infrastructure Audit report emphasizing the underinvestment in maintenance particularly for local roads, regional rail infrastructure and regional town water services. In addition, the audit recommends that all jurisdictions need to improve whole of life asset management (Australian Government, 2015). An example of the scale of the challenge can be seen in the rail sector. Australia has 44,262 km of track, making it the 6th largest rail infrastructure network in the world, with an annual turnover of more than $4 billion (Australian Government, 2014).

For Australia the issue is not only ageing infrastructure, but also the ageing workforce, with the transport industry having the second oldest industry workforce profile, and the consequential risk of skills shortages constraining productivity. Added to this, in 2010–2011 the transport

and storage workforce recorded the highest serious workplace health and safety incidence rate, nearly twice the average across all industries (Commonwealth of Australia, 2014). With rising demand for infrastructure services due to population growth and increasing expectations, infrastructure decisions will need to account for the challenges of ageing infrastructure, and the associated workforce, in order to ensure Australia's economic future.

Possible future pathways to address critical systems failure and ageing infrastructure could include the use of innovative materials and improving human capacity to manage risk. Technological solutions could include nanomaterials such as a special superhydrophobicity coating (Checco *et al.*, 2014) that can be applied to almost any surface, which then makes the surface repel liquids such as water and oil, while also preventing rust, dirt, ice or grease from affecting the material's surface. And self-healing concrete could enable concrete structures to have longer lives (see www.arup.com; Jonkers *et al.*, 2010).

Go green: There is increasing demand for sustainable products in almost every aspect of human life, and this demand will continue to rise. This involves everything from green buildings, hybrid cars, wind power, resource processing, transport systems, a wide array of recycling and other enabling technologies (TNEP, 2004). As a result, 'Going green' to achieve sustainability is regarded as the 6th Wave of Innovation, following the Digital Information Technology Wave in the 1990s (TNEP, 2004, Fig. 24).

The primary drivers of 'Going green' vary nationally (McGraw-Hill Construction, 2013). For Australia, the top three drivers are market demand, client demand and lower operating costs, and internal corporate commitment. In Asia, however, these are branding/public relations, environmental regulations, and lower operating costs. Regardless of the drivers, the demand for sustainable products is and will continue creating opportunities in the infrastructure sector. The McGraw-Hill Construction Report (2013) indicated that green building is accelerating as it also becomes viewed as a long-term business opportunity.

Through integrated approaches, sustainable infrastructure can also help provide multiple environmental, economic and social benefits. For example, investments in sustainable transport and urban planning help reduce greenhouse gas emissions and air and water pollution, while improving urban mobility, access to markets, public health and the investment climate (UN, 2012). To address climate change, the engineering profession is committed to applying the principles of sustainability, energy efficiency and innovation to the design, durable materials, construction, operation and maintenance of infrastructure (The Jakarta Protocol, 2013). Green Infrastructure (GI) emerges as a planning and design concept to address such needs through biodiversity protection, climate change adaptation, climate change mitigation, water management, food production, recreational benefits, land values and cultural benefits (EEA, 2011). However, the selection of appropriate GI will always depend on the local climate, soils, water availability as well as community norms and cultural values (Norton *et al.*, 2015).

Examples of encouraging development in 'Go green' are as follows. Firstly, the ASEAN Vision 2020 calls for "a clean and green ASEAN", and the ASEAN Leaders' Statement on Sustained Recovery and Development, adopted in April 2010, documents the leaders' determination "to promote green growth, investments in long-term environmental sustainability, and sustainable use of natural resources in order to diversify and ensure resilience of our economy". Secondly, the Organisation for Economic Co-operation and Development (OECD), whose members represent about 80% of the global economy, adopted a Green Growth Strategy in 2009 and published a series of related reports to support its implementation (UN, 2012). Thirdly, the rise of global initiatives by private foundations and think tanks, such as the World Economic Forum (WEF), the expansion and influence of transnational corporations in greening industries and promotion of socially and environmentally sustainable corporate behaviour, and the globalization of norms and standards (e.g. environmental impact assessments under ISO Standard 14011, and corporate social responsibility) (UN, 2012).

Internet of Things: The coming decades will see the beginning of the Internet's next wave, the 'Internet of Things' (IoT). The goal of IoT is to 'enable things to be connected anytime, anyplace, with anything and anyone using any network and any service'. The technology will create devices that 'think', 'feel' and 'talk' as a human does, creating a 'smart planet'. Today there are 10 billion Internet connections, and these are expected to increase to around 50 billion by 2020, with a market size of around $19 trillion by 2025 (see www.cisco.com). Not surprisingly, the largest IT company in China, Huwaei, has been investing more than $600 million into its 5G technology research and development in preparation for 2020 (Roland Slaadek, Huawei Vice President for International Media Affairs). IoT will touch nearly every part of our lives and hence will be highly relevant to infrastructure.

In Indonesia, the IoT/Machine-to-Machine (M2M) services to businesses were launched in late 2014 between Jasper and Telkomsel (see www.jasper.com/press-news/). In Australia, the Adelaide City Council and Cisco launched Australia's first IoT Innovation Hub (see http://www.theleadsouthaustralia.com.au). Through this, the city can now join other major cities including Barcelona, Chicago, Hamburg and Dubai as leading platforms for IoT innovations. The Adelaide City Council has set aside $250,000 in 2015 for two smart city trials that will focus on parking and lighting.

However, in parallel to a hyper-connected world, cyber-attacks have been identified as the top technological risk which could lead to critical systems failure, along with massive incidents of data fraud or theft, mineral resource supply vulnerability and digital transformation, and the perceived risk is growing (Fig. 23). For example, a cyber-attack has been identified as the most serious threat to the integrity of the Australian oil sector, particularly its offshore oil and gas facilities as well as land-based production (Commonwealth Australia, 2012). This will have important implications, since Australia's oil and gas industry is expected to double its economic contribution to over $51 billion (DIRD, 2014). A key initiative involves the development of the Australian Cyber Security Centre in late 2014. In addition, the Australian Signals Directorate finds that at least 85% of targeted cyber attacks can be prevented by following their mitigation strategies (see www.asd.gov.au/infose/top35mitigationstrategies.htm).

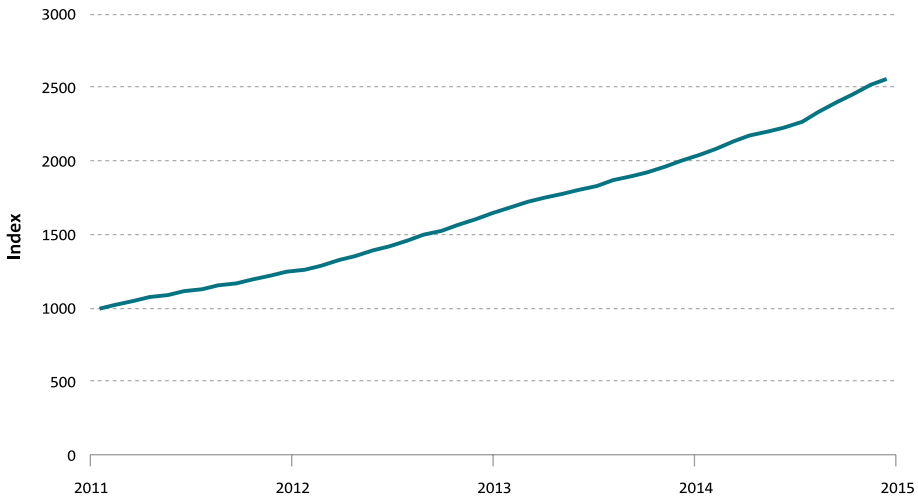

Figure 23. Trends in the Index of Cyber Security, which aggregates the views of information security professionals as expressed through monthly surveys, from March 2011 to January 2015. A higher index value indicates a perception of increasing risk (Data from www.cybersecurityindex.org).

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Next steps

The foresighting process was undertaken in a short timeframe in order to meet the advanced stage of planning for the Clusters' CLIPs. However, the process of engagement and discussion across the Indonesian and Australian researchers in each Cluster enabled mutual learning about shared issues and identified many cross-cutting research priorities.

The megatrends now provide a foundation for the justification of the CLIPs, and the prioritisation of future research so far not included in the CLIPs. In addition, the megatrends have informed Activity 3 Scenario planning. By determining the 'scenario space' for shared issues between Indonesia and Australia, research priorities were identified that cut across Clusters. These priorities will be of equal relevance to other research and development initiatives between Indonesia and Australia.

Appendix 1:

Shared issues, drivers and megashocks identified by members of the Infrastructure Cluster

22nd January 2015, Surabaya

SHARED ISSUE	CATEGORY	UNDERLYING DRIVERS	POTENTIAL MEGASHOCKS
1. Flooding	C and D	- Climate change, poor servicing of infrastructure, urbanisation, governance and institutional coordination. Loss of biodiversity	- Climate change (e.g. post-flooding impacts: lack of drinking water, clean water, epidemics) - Flood wall/sea wall failure
2. Connectivity	C and D	- Lack of funds, political will, level of coordination across institutions. Non-compliance with regulations. Social norms and peoples' attitudes (e.g. demand for cars, technology)	- Earthquakes - Major political change and governance - Global Financial Crisis - Withdrawal of services (e.g. fuel crisis or energy breakdown)
3. Road safety	C and D	- Accidents: mode of transportation and form of transport (e.g. road versus rail). Cultural choices - Incompatibility between regulations and demographics	- Earthquakes - Flash flooding and other extreme events - Massive changes in demographics
4. Pollution: air, water, soil	C and D	- Stormwater runoff. Human behaviour. Carbon emissions. Regulating emissions from cars. Diffuse versus single sources	- Major health crises. Oil spills. Forest fires. Algal blooms
5. Disaster mitigation and recovery	C and D	- Urbanisation, unregulated building management, governance and coordination. Assessment of residual structures' safety. Financing and funding. Lack of transparency. Quality of infrastructure (construction and maintenance). Planning and enforcement. Congestion	- Geohazards. Climate shocks
6. Aging infrastructure	C and D	- Lack of maintenance not meeting current codes. Corrosion and concrete degradation. Climate change. Lack of funding	- Infrastructure failure. Fire risk. Technology redundancy. Transformational options
7. Work practices	C	- Resistance to change. Adoption of new technology, risk aversion, education, cultural norms, lack of capacity	- Mass migration
8. Remoteness	C	- Equity, urbanisation	- Logistics. Access to services
9. Lack leadership – shared vision	C	- Lack of cross-organisation participation and trust (i.e. negligence in 'leaders', corruption)	- Riots – dissatisfaction with political system/decision making

SHARED ISSUE	CATEGORY	UNDERLYING DRIVERS	POTENTIAL MEGASHOCKS
10. Congestion (all transport)	C	- Economic development, subsidised oil, population, poor public transport, bad strategic planning, inability of technology to cope	- Oil price. Global emission constraints
11. Extreme heat	C	- Urbanisation, poor urban design, climate change, ENSO, urban material choices, increased wealth and subsequent technology	
12. Port services (logistics), environmental	C	- Demand, capability, economics, poor infrastructure, technological advancement, lack or mismanagement, bottlenecks, behaviour, uncertainty due to poor policy, planning and regulations - Pollution, land clearing, loss of biodiversity (e.g. mangroves), behaviour, improper design, lack of professionalism, lack of enforcement, corruption - Education, equity, labour, increasing land price, unskilled labour, cultural - mix, prostitution, land use change, type of jobs change, displacement - Land price, land rent, taxation, financing and funding, lack of empowerment, reactivation of assets (used as private land) - Poor strategy, hasty or lack of decision-making, negligence, lack of connectivity, appropriate infrastructure, labour laws, industrial conditions, weather conditions - Legacy issues, poor planning, technological advancements, professional contractors, investment, politics, prohibition of private investment, lack of foreign investment - Need for transformation rather than incremental change in some places, therefore need to keep a systems perspective/scale of planning	- Oil price shock. Commodity shock/price shock. Unexpected increase/decrease in demand

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