



**Sustainable
Built Environment**
National Research Centre

2011 Annual Report

Sustainable Built Environment National Research Centre (SBEnrc)

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Executive Summary

2011 Annual Report Executive Summary

The natural disasters in our region at the start of 2011 – floods, cyclones and the devastating earthquake in Christchurch – provided us with a timely reminder that we, as researchers and infrastructure and building professionals, have a responsibility to our communities to seek solutions so that natural disasters have less of an impact. Future applied research projects to be undertaken by our Centre will play an important role in helping improve sustainability and resilience, and to seek solutions that will mitigate the social, environmental and economic impact of unpredictable and severe weather patterns.

Our Centre would not be able to continue growing without the commitment and support of our core partners, and we thank you wholeheartedly. Additionally, international participation (formally through VTT Technical Research Centre of Finland; BRANZ in New Zealand; CIB – the International Council for Research and Innovation in Building and Construction; and informally through a variety of leading university and other research institutions) provides important global perspectives on our research.

Our research projects have had success due to our strong focus on industry and government collaboration, and we actively encourage our partners to have a close involvement in projects that are relevant and of interest to them. Consequently we attract partners who are committed to collaborating with leading research teams to achieve significant results in the short term, while bringing real value to our partners and to the built environment industry in the long term.

As we continue to position ourselves in the independent research space, we are drawing greater strength from all of our partners and we welcome genuine involvement from other research groups outside our current partnership family.

We are proud of the valuable research outcomes our projects have delivered throughout 2011. Program Leaders: Professor Peter Newman, Curtin University (Program 1: Greening the Built Environment); Professor Russell Kenley, Swinburne University of Technology (Program 2: Developing Innovation and Safety Cultures) and Professor Robin Drogemuller, QUT (Program 3: Driving Productivity Through Procurement) have provided key research leadership roles. Their energies and the in-kind commitment from their respective universities will continue to be fundamental in ensuring the success of our research programs.

Centre highlights of 2011 include:

- Partnering with industry groups such as Built Environment Industry Innovation Council (BEIIC), buildingSMART, Australian Constructors Association (ACA), Australian Green Infrastructure Council (AGIC), Australian Procurement and Construction Council (APCC), Austroads, Civil Contractors Federation (CCF), Engineers Australia (EA), Green Building Council of Australia (GBCA), Master Builders Australia (MBA), Australian Workers' Union (AWU), Construction, Forestry, Mining and Energy Union (CFMEU), Office of the Federal Safety Commissioner and The Warren Centre for Advanced Engineering to target industry research outcomes and run dissemination seminars.

- Our Chair, John V. McCarthy AO, continued as the International President of the CIB, the first Australian to hold this position since the CIB was established in 1953. This role includes hosting the triennial World Building Congress in Brisbane, 5-9 May 2013. (The CIB is a worldwide network of over 5,000 experts from about 500 member organisations across 80 countries active in the research community, in industry or in education, who cooperate and exchange information in building and construction research and innovation).
- The CIB Board appointed Professor Keith Hampson and Dr Judy Kraatz to a new Task Group TG85 on R&D Investment and Impact, as Joint Coordinators. This international recognition will help our Centre increase its understanding of how public and private sector policy and practice can be enhanced to better leverage R&D investments.
- Research teams from the Greening the Built Environment; Developing Innovation and Safety Cultures; and Driving Productivity Through Procurement programs conducted a comprehensive round of national stakeholder engagement workshops to seek fresh input into project scoping for the second stage of our Centre beyond 2012.

Our challenge now is to grow the value and impact of our applied research more deeply and broadly across Australia. We look forward to welcoming new partners, as we grow in the property, planning, design, construction and facilities management sectors and extend our Centre beyond 2012 with a fresh raft of industry-driven research projects.

We look forward to maintaining our joint commitment and working with core members, project partners and other industry stakeholders growing the industry value of SBEnrc research into the future.



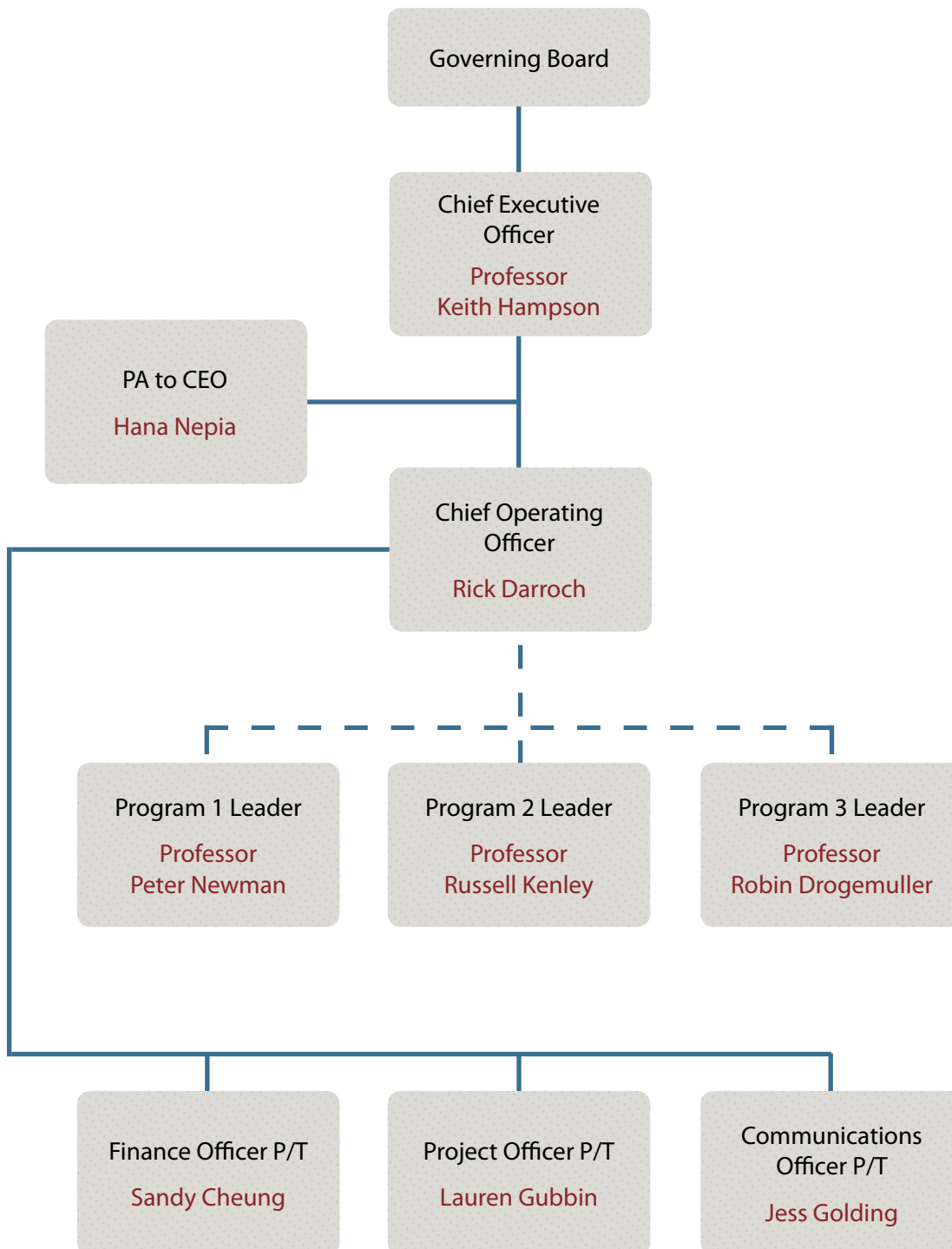
John V. McCarthy AO, Chairman

Keith D. Hampson, Chief Executive Officer

A blue ink signature of John V. McCarthy AO.

A green ink signature of Keith D. Hampson.

Organisational Chart for 2012



Team Members

SBEnc Board

1. John V. McCarthy AO (Chair)
2. Max Smith, Queensland Department of Public Works (to 25 May 2011)
Graham Atkins, Queensland Department of Public Works (from 26 May 2011)
3. Angelo Conte, John Holland
4. Richard Mann, Western Australia Department of Treasury
5. Tony Tate, Curtin University (to 31 August 2011)
Charlie Thorn, Curtin University (from 1 September 2011)
6. Darren Bilsborough, Parsons Brincknerhoff (to 4 May 2011)
Shaun Nugent, Parsons Brincknerhoff (from 5 May 2011)
7. Andy Flitman, Swinburne University of Technology (Alternate: Bruce Whan, Seth Jones)
8. Martin Betts, Queensland University of Technology
9. Keith Hampson, CEO, SBEnc
10. Rick Darroch, COO, SBEnc (Secretariat)
11. Lyn O'Connell, Australian Department of Infrastructure and Transport (Observer)

Research and Utilisation Committee

1. Ross Guppy, Queensland Department of Transport & Main Roads (Chair from 5 May 2011))
2. Darren Bilsborough, Parsons Brincknerhoff (Chair to 4 May 2011)
Shaun Nugent, Parsons Brincknerhoff (from 5 May 2011)
3. Angelo Conte, John Holland
4. Carolyn Marshall, Western Australia Department of Finance -
Building Management and Works (Alternate: Anna Evers)
5. Program 1 Leader: Peter Newman, Curtin University (Alternate: Charlie Hargroves)
6. Program 2 Leader: Russell Kenley, Swinburne University of Technology
7. Program 3 Leader: Robin Drogemuller, Queensland University of Technology
8. Keith Hampson, CEO, SBEnc
9. Rick Darroch, COO, SBEnc

Finance and Audit Committee

1. Tony Tate, Curtin University (Chair, to 31 August 2011)
Charlie Thorn, Curtin University (Chair, from 1 September 2011)
2. Richard Mann, Western Australia Department of Treasury
3. Max Smith, Queensland Department of Public Works (to 25 May 2011)
Graham Atkins, Queensland Department of Public Works (from 26 May 2011)
4. Martin Betts, Queensland University of Technology (Alternate: Gudrun Seynsche)

Remuneration and Performance Committee

1. John McCarthy AO (Chair)
2. Angelo Conte, John Holland
3. Martin Betts, Queensland University of Technology
4. Tony Tate, Curtin University (to 31 August 2011)
Charlie Thorn, Curtin University (from 1 September 2011)



Team Members



John V. McCarthy AO

Chair, Sustainable Built Environment National Research Centre

FRICS, FAPI, FREI, FREAV

John is a recognised industry leader, with a breadth of experience across various commercial and industry disciplines. He served as inaugural Chair on the Australian Sustainable Built Environment Council (ASBEC), as Chair of the Australian Construction Industry Forum (ACIF), President of Property Council of Australia (PCA) and member of the Australian Building Codes Board (ABCB). He is Australia's first industry representative on the Board of the International Council for Research and Innovation in Building and Construction (CIB) - an organisation he now serves as global President.



Keith Hampson

CEO, Sustainable Built Environment National Research Centre

BEng (Hons), MBA, PhD, RPEQ

FIEAust, FAICD, FAIM

Keith Hampson is an energetic senior leader with a blend of strong technical and management skills and formal qualifications gained through international experience in industry, government and university environments. He is committed to building an internationally competitive Australia by promoting access to better education, technology and innovative practices. At the industry level, Keith is a registered civil engineer and project manager with extensive experience in operating in multi-disciplinary environments in planning, design, construction and maintenance.



Graham Atkins

Queensland Department of Public Works

BASc (Quality Surveying), AssocDip Bldg

Graham brings with him over 30 years experience in the building and construction industry. He is committed to building strong relationships with key stakeholders and departmental clients to ensure that DPE provides responsive and flexible client focussed services. Graham held senior roles in the Department of Education and Training (DET) being responsible for all infrastructure planning and delivery. During his 10 years with DET he was instrumental in leading the delivery of record capital and maintenance programs.



Angelo Conte

John Holland

BE (Civil) (Hons), FIEAust, RPEQ

Angelo is the Strategic Development Director at John Holland and has had over 30 years experience in the construction industry. He has been involved in numerous projects throughout Australia in the civil, structural and mechanical disciplines. Angelo provides strategic advice to assist the Managing Director and Executive Management Team to formulate the strategic direction of the Company.



Richard Mann

Western Australia Department of Treasury and Finance

BE, CPEng, FIEAust

Richard is a civil engineer with more than 20 years experience in building and infrastructure projects throughout Western Australia. He heads Treasury's Strategic Projects division and oversees the delivery of a \$8 billion portfolio of 18 major projects, including the \$2.0 billion Fiona Stanley Hospital, \$1.2 billion New Children's Hospital and \$550 million Perth Arena indoor entertainment and sports stadium.



Charlie Thorn

Curtin University

BSc (Agric) (Hons)

Curtin University recently appointed Australian Sustainable Development Institute (ASDI) Director, Charlie Thorn to the position of Director Research and Development. Charlie has more than 30 years experience in research management, commercialisation and technology transfer in agriculture, fisheries and University research institutions. During his time as ASDI Director he led, developed and grew Curtin's sustainability research in the areas of energy, climate change, water, sustainable resources, urban and regional development, sustainable communities and food.

Team Members



Shaun Nugent

Parsons Brinckerhoff
BE (Civil), GAICD, CPEng, RPEQ

As Director for Operations and Capability, Shaun has been instrumental in the prosperity of PB's Business Groups within Australia and New Zealand. He brings 21 years of hands-on engineering experience in civil infrastructure, structural, materials handling, coastal, ocean and systems engineering. He has extensive experience in the design and delivery of power and industrial sector projects. Shaun has been involved in some of Queensland's most notable engineering projects as a member of alliance leadership teams and project boards.



Andrew Flitman

Swinburne University of Technology
BSc (Hons), PhD, FACS, FORS

In 2011 Andrew was Deputy Vice-Chancellor (Research) at Swinburne University of Technology. He has several years experience in industry - Deloitte Haskins and Sells (London), Coopers and Lybrand Deloitte (UK) and Price Waterhouse (Melbourne) - and an academic career with positions at Warwick (UK), Deakin and Monash Universities. He is an internationally recognised expert in financial and strategic computer modelling. Andrew holds many senior professional memberships and is Fellow of the Australian Computer Society and the Operations Research Society, UK.



Bruce Whan

Swinburne University of Technology
BE (Mech), PhD, FAIC

Bruce has been involved in innovation for over 20 years. He is currently the Director of Swinburne Knowledge and CEO of Swinburne Ventures Ltd and is currently a director of several of its start up companies based on research outputs. He is a member of the Commercialisation Australia board. Bruce was Chairman of INNOVIC for nine years and was the General Manager (Training and Innovation) for the Strategic Industry Research Foundation, where he developed and delivered innovative industry training and consulting. He also worked with Swinburne's AGSE and has a wide range of industry experience.



Martin Betts

Queensland University of Technology
BSc (Hons), PhD
CNAA, FCIQB, FRICS, FIEAust, CPEng, FRSA

Martin is Executive Dean of the Built Environment and Engineering Faculty, QUT. He is Fellow of numerous institutions and societies including the Royal Institution of Chartered Surveyors and was recognised by Engineers Australia in 2007 as one of Australia's 100 most influential engineers. Martin was founding director of the Construct IT for Business Centre of Excellence in the UK, which he received the Queen's Anniversary Prize for Further and Higher Education in 2000.



Rick Darroch

COO, Sustainable Built Environment National Research Centre
BEc, GradDipAcc, MBA, GAICD, FCPA

Rick Darroch joined the SBEnrc in June 2010 after serving as the Business Manager for the CRC for Irrigation Futures for its seven year term, with primary responsibility for the everyday functions of the Centre. Prior to working in the University / Research Management sector Rick held senior Finance Manager positions at Grainco Australia and Defiance Mills Limited. Rick has a Bachelor of Economics, Grad Dip in Accounting, MBA and is a Fellow CPA.



Peter Newman

Curtin University
PhD, Dip.ES&T, BSc (Hons), FTSE

Peter Newman is the Professor of Sustainability at Curtin University and is the Leader of the Greening the Built Environment Program. He was appointed as a Lead Author for Transport on the next Intergovernmental Panel on Climate Change Report. He is on the Board of Infrastructure Australia and has published more than ten books and 200 academic publications. In 2011 he was awarded the Sidney Luker medal for his contribution to the science and practice of town planning.

Team Members



Russell Kenley

Swinburne University of Technology
BBLdg (QS) (Hons), PhD, MAIB, AAIQS

Russell is Professor of Management at Swinburne University of Technology and Visiting Professor of Construction at Unitec, NZ. His research interests involve the built environment including: project financial management; lean management of production in construction; and strategic management of property portfolios. He has co-developed the location-based management system and is working with industry to introduce new model-based production systems to improve productivity.



Robin Drogemuller

Queensland University of Technology
BArch, BAppSc (Maths&Comp)

Robin is Professor of Digital Design, QUT. He leads a multidisciplinary team who examine the use of information technology to support decision-making within the built environment. Together they developed national and international standards for the exchange of information for building and infrastructure; and commercial and prototype software to support integrated design, construction and operation of constructed facilities.



Ross Guppy

Queensland Department of Transport and Main Roads
BEng, RPEQ

Ross leads Queensland Department of Transport and Main Roads' liaison with industry bodies including Australian Asphalt Pavement Association (AAPA), Consult Australia, Civil Contractors Federation, Queensland Major Contractors Association and Institute of Public Works Engineers Australia Queensland Division and is chair of the TMR Prequalification committee. Ross was a Board Member of the CRC for Construction Innovation, currently Chair for SBEnrc's Research & Utilisation Committee and on the Austroads Project Delivery Panel. Ross also manages the Strategic Alliance with the ARRB Group.



Carolyn Marshall

Western Australia Department of Treasury & Finance, Building Management and Works
Architect, MA World Heritage

Carolyn Marshall is Assistant Director of the Building Research and Technical Services team in Building Management and Works, WA Department of Finance. Carolyn is a registered architect with post graduate qualifications in building sustainability and heritage, and a Green Building Council of Australia Green Star Accredited Professional.



Hana Nepia

PA to the CEO
Sustainable Built Environment National Research Centre



Lauren Gubbin

Project Officer
Sustainable Built Environment National Research Centre



Sandy Cheung

Finance Officer
Sustainable Built Environment National Research Centre

Core Partners



**PARSONS
BRINCKERHOFF**



Project Partners/Affiliates



Research Program 1

● Greening the Built Environment

Program 1 will deliver improved environmental performance by the built environment through enhanced ecological efficiencies, including carbon emission reductions and climate change adaptation of new and existing infrastructure and buildings.

As one of the nation's major carbon-emitting sectors, the built environment industry requires cost-effective strategies to reduce emission and climate change adaptation costs and to support Australians in the sustainable modernisation of their infrastructure and buildings. Australia's buildings currently account for 23% of the nation's greenhouse gas emissions, and energy efficiency gains delivered by the building sector could reduce the costs of greenhouse gas abatement across the whole national economy by 14% by 2050. New technologies, knowledge and skills are needed now by the industry to realise this potential and to quantify sustainability targets and benefits to demonstrate positive risk-returns for sustainability practices. Despite the clear relevance to end-users of improved environmental performance to the built environment, the industry is currently lacking much-needed climate change adaptation strategies, including: a scientifically-proven basis for defining sustainability targets and for measuring sustainability across regional climatic and environmental contexts.

Research Program 1 will target the following outcomes for the built environment industry:

- Cost savings in policy making and data collection for government
- Increased productivity from sustainability designers
- Reduction in environmental costs for re-lived infrastructure and buildings
- Increased worker productivity from improved design
- Reduced greenhouse gas emissions in the built environment industry
- Reduced water consumption and waste
- Increased sustainability skills capacity in the industry.

The projects underway in Program 1 are described in the Fact Sheets following.



Project 1.1

Design and Performance Assessment of Commercial Green Buildings

RESEARCH PROGRAM 1: GREENING THE BUILT ENVIRONMENT

Efforts to reduce carbon emissions in the buildings sector have been focused on encouraging green design, construction, and building operation; however, the business case is not very compelling if considering the energy cost savings alone. In recent years green building has been driven by a sense that it will improve the productivity of occupants, something with even greater economic returns. However reducing energy demand in existing commercial buildings in a holistic way that supports an ongoing productive workplace is not yet well understood, and involves a set of complex and interdependent factors. The focus of this project is to provide a low complexity guiding framework to assist efforts to understand such factors and support efforts to undertake upgrades to existing office buildings.

The framework is being developed in 5 key areas to form the 'Energy Performance Nexus', namely:

- The buildings' energy-related design elements,
- The building occupants' experience,
- The indoor environment conditions,
- The scope of tenancy agreements (including leasing arrangements), and
- The building management systems.

In collaboration with project partners, the research team from Curtin University and Queensland University of Technology (QUT) are focusing on assessing a range of case studies and undertaking direct data collection, across the five nodes of the 'Energy Performance Nexus'. The investigations build on other studies associated with the performance of green commercial buildings to provide an in-depth level of enquiry, to investigate the inherent complexity of greening commercial buildings and to create a platform for further performance improvement.

The final report for the project will focus on outlining the findings across each of the five nodes of the 'Energy Performance Nexus' and exploring how an understanding of their interactions will provide value to industry and government. This will include: the comprehensive data collection methodologies; outlining specific findings from the data collection; summaries of case study analysis; and making a series of recommendations to industry and government.

Project partners include: Queensland Department of Public Works, Western Australia Department of Finance, Parsons Brinckerhoff, and John Holland, with in-kind support from the Green Building Council of Australia, QED Environmental Services, and HFM Asset Management.

Project Outputs for 2011

Stakeholder Engagement

A series of stakeholder meetings were held along with three stakeholder workshops involving over 50 participants, in Perth, Brisbane, and Townsville. The workshops were facilitated using the 'Community Social Learning' methodology designed by Emeritus Professor Valerie Brown, ANU. Participants were asked to imagine their ideal green commercial building and then consider the enablers and disablers to achieving this vision. Participants then identified what could occur to enhance the enablers, and reduce the disablers, that were relevant to the research project. Key findings included the basis for considering a wider scope than just energy performance and building management to include indoor environment quality, occupant experience, and tenant agreements.

Development of a New Model

Based on the findings of the literature review and stakeholder engagement a new model was developed to consider the performance of green commercial buildings, namely 'The Energy Performance Nexus'. This model provides a sound structure for a low cost, low complexity multivariate consideration of the complexity involved in understanding the performance of green buildings. The model has included the development of data collection and assessment methodologies for each of the five areas: energy performance of green design elements, indoor environmental quality, occupant experience (based on occupant survey), tenant/leasing agreements, and building management.



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Project 1.3

The Future of Roads: The Role of Road Building in Reducing Environmental Pressures and both Mitigating and Adapting to Climate Change

RESEARCH PROGRAM 1: GREENING THE BUILT ENVIRONMENT

In the coming decades the design, construction and maintenance of roads will face a range of new challenges and as such will require a number of new approaches. Such challenges will result from a growing number of interconnected environmental, social, and economic factors, which are set to apply significant pressure on the future of roads. For instance, environmental pressures will include the impacts of climate change on rainfall patterns and temperature profiles; economic pressure will be affected by materials and resources shortages, along with predicted increases in energy and resource prices globally, and social pressures will include potential shifts to lighter vehicles, reduced use of cars due to higher fuel costs, and political pressure to respond to climate change.

To inform the response to such challenges this project is focusing on three key areas:

- Identifying ways to reduce environmental pressures from road building;
- Enhancing the management of carbon by road agencies; and
- Investigating future trends and scenarios that will affect roads.

The research team from Curtin University and QUT are focused on delivering: a report on current efforts to reduce the environmental pressures from roads; a carbon management guidance report for Australian road agencies; and a report on a series of future trends and potential scenarios (including the results of stakeholder workshops). Each of the outcomes will be focused on providing value to partners and will continue to be developed in close collaboration with stakeholders. Project partners include: Parsons Brinckerhoff, John Holland, Queensland Transport and Main Roads, Main Roads Western Australia, Australian Green Infrastructure Council,

Brisbane. Participants were asked to review selected outcomes from the literature review related to reducing the environmental pressures from road building, and then asked to identify critical indicators for roads in the future based on a discussion of potential future considerations, risks and pressures. The final session then focused on how scenarios might be developed to deliver tangible benefit to stakeholders.

Carbon Management Guidance for Road Agencies

Based on the findings of the literature review and stakeholder engagement, the proposed sustainability assessment framework was reconfigured to provide an overarching platform to streamline the consideration of carbon management within road agencies, covering the core existing tools and processes in each of the main steps in road planning, funding, procurement, delivery, and maintenance.

Future Trends and Scenarios

Based on the findings of the literature review and stakeholder engagement (which identified climate change and resource shortages as key trends), the team has developed a series of trend summaries that will be explored in a second round of stakeholder workshops in Perth and Brisbane, including:

- Increase in the cost of road maintenance,
- Increase in extreme weather events,
- Oil based road surfacing unfeasible,
- Trips by walking, cycling and public transport increase,
- Resource shortages: aggregate shortages, fresh water scarcity,
- Freight vehicles increase in size and frequency, and
- Funding constraints on new projects and on maintenance of existing infrastructure.

Project Outputs for 2011

Stakeholder Engagement

A series of stakeholder meetings have been held along with the facilitation of two stakeholder workshops involving over 25 participants, in Perth and



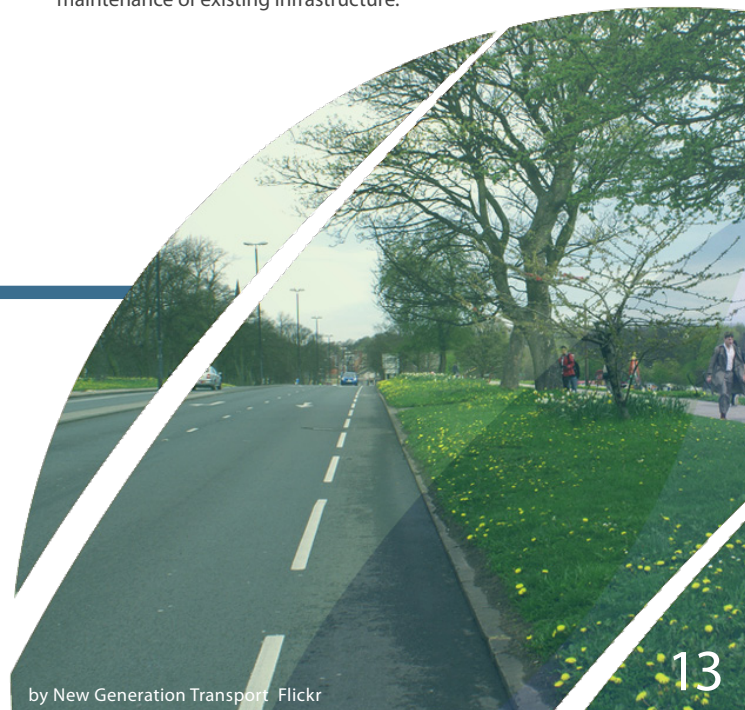
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Project 1.5

Harnessing the Potential of Biophilic Urbanism in Australian Cities

RESEARCH PROGRAM 1: GREENING THE BUILT ENVIRONMENT

The concept of 'Biophilic Urbanism', championed by Tim Beatley and Peter Newman for decades, has been used widely to create more liveable and pleasant cities. This field is about to get a significant boost in activity as the realisation grows that natural features can be used as design elements in cities to help respond to climate change. The concept of biophilic urbanism is inspired by E. O. Wilson's concept of 'biophilia' that suggests we have an innate affinity with nature and that increasing nature in cities can lead to many benefits. Studies show that a connection with nature tends to lead to reductions in depression, anger, tension and fatigue.

Having been applied to a number of aspects of psychology and interior design, the concept is now receiving strong interest as an urban design principle, not only for the human well-being benefits, but a range of direct and indirect economic and environmental benefits. Biophilic urbanism has the potential to make significant contributions to a range of national, state and local government policies related to climate change mitigation and adaptation: reducing urban energy consumption, enhancing urban biodiversity, improving resilience to natural disasters, improving worker productivity, and responding to pressures related to densification and revitalisation of cities.

In collaboration with project partners, the research team from Curtin University and Queensland University of Technology (QUT) are investigating how natural elements can be used in cities as design features and will produce a report on the key elements and aspects of biophilic urbanism, especially related to building landscaping; a report on the economic considerations of the use of biophilic elements; and a report on the policy considerations to underpin the wider uptake of biophilic elements (both based on case study research and interviews). Each of the outcomes will be focused on providing value to partners and will continue to be developed in close collaboration with stakeholders.

Project partners include: Parsons Brinckerhoff, Western Australia Department of Finance, Townsville City Council (CitySolar Program), and PlantUp. The project will be advised by Professor Tim Beatley (University of Virginia, USA), a world leading biophilic urbanism expert and author of the new book 'Biophilic Cities'.

Project Outputs for 2011

Stakeholder Engagement Report

A series of stakeholder meetings and discussions have been held along with the facilitation of two stakeholder workshops involving over 25 participants, in Perth and Brisbane. The workshops were based on the methodology of 'Collective Social Learning', created by Emeritus Professor Valerie Brown, to guide participants through a process to consider first their vision for a biophilic (nature loving) city and the aspects that enable and disable achieving such vision. Following this a brainstorm was undertaken with each workshop group, to inform the research team's consideration of the various elements of an economic consideration of both direct and in-direct economic benefits and costs of the use of biophilic elements in cities and other urban areas.

Case Study Assessment

The team is mid-way through a case study investigation of key biophilic urbanism examples in Australia and overseas, to consider both the economic and policy considerations that can inform future use of biophilic elements in Australian cities. This investigation is informed through a number of policy and economic analysis related questions that will ensure a consistent evaluation of what is possible and what precedents can inform future development in Australian cities.



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by donabelandewen Flickr

Project 1.8

Sustainable Infrastructure Procurement

RESEARCH PROGRAM 1: GREENING THE BUILT ENVIRONMENT

The community's concern with environmental cost of the built environment is growing, so there is a pressing need for industry to identify and reduce the environmental cost of production. One significant contributor to greenhouse gases (GHGs) including CO₂ is the handling and haulage of mass materials such as earth and rock on road and rail projects.

Project partners Queensland Department of Transport and Main Roads, Main Roads Western Australia, New South Wales Roads and Maritime Services, Parsons Brinckerhoff, and John Holland are working with Swinburne University of Technology and Queensland University of Technology to find better ways to plan and manage infrastructure construction to reduce the environmental impact of mass material movements.

This project will add value for clients and producers (designers and contractors) of infrastructure by identifying methods for measuring, minimising and controlling mass haul.

The research design is in 5 phases:

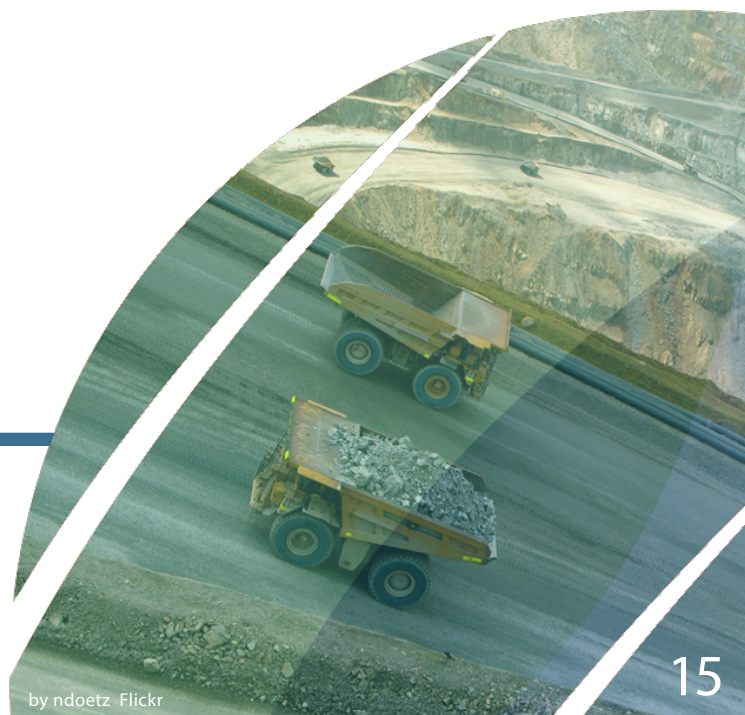
- 1 A review of industry practices, existing research, best practice, software and technology for optimisation of mass haul operations. This will form the basis for theoretical models for Australian projects.
- 2 Evaluate green procurement processes in Australia against international benchmarks, with a focus on how GHG emissions from mass haul operations are calculated.
- 3 Develop methodologies for minimising (a) mass haul costs and (b) GHG emissions.
- 4 Develop non-financial assessment criteria for motivating reduction in GHG emissions associated with earthworks on infrastructure projects to fit in with current tender processes for participating state road authorities.
- 5 Develop a methodology for monitoring and controlling conformance with tender submissions. This will ensure accountability in the delivery of performance improvements and ensure that incentives for non-financial criteria are tied to real deliverables.

Project Outputs for 2011

- ARC Linkage Projects
Success of the ARC Linkage Projects leveraged the SBEnc \$450,000 with Commonwealth funding of \$340,000
- Research Report
Project 1.8 Research Report, November 2011 includes lists of publicly available spreadsheets and calculators of GHG emissions as part of the preliminary literature review.
- Industry Presentations
Over the course of the year the Project Leader, Russell Kenley has conferred with individual industry and university partners to progress the negotiations of merging the SBEnc Project 1.8 Sustainable Infrastructure Procurement with the ARC Linkage Project: Greening Procurement of Infrastructure construction: Optimising Mass-haul Operations to Reduce Greenhouse Gas Emissions.
- Refereed Conference Papers
Two refereed conference papers were published in 2011 - Greening Procurement: A Research Agenda for Optimising Mass-haul During Linear Infrastructure Construction (July) and Greening Procurement of Infrastructure Construction: Optimising Mass-haul Operations to Reduce Greenhouse Gas Emissions (October)



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Research Program 2

● Developing Innovation and Safety Cultures

Program 2 will deliver improved social outcomes for built environment workers through increased uptake of innovative and sustainable practices and minimising environmental health and safety risks.

Greater levels of innovation risk-taking by built environment SMEs offer the most significant flow-on benefit to the national economy of all Australian industries. At the same time, poor risk management practices around environmental health and safety, particularly in relation to construction, mean that the industry remains one of the four most dangerous industries in which to work. A better understanding of the interplay between risk taking and risk mitigation at the individual, organisational and institutional levels of this industry has clear relevance to the industry to improve sustainability outcomes, increase productivity rates, and decrease personal and industry costs.

Research Program 2 will target the following outcomes for the built environment industry:

- Better value from R&D Activities
- Research roadmap for the built environment industry
- Increased GDP from increased SME adoption of sustainable technologies
- Reduced national GDP lost due to workplace injury
- Reduced direct costs of construction workplace injuries
- Reduced costs from drug and alcohol-related injuries.

The projects underway in Program 2 are described in the Fact Sheets following.



Project 2.1

Safety Impacts of Alcohol and Other Drugs in Construction

RESEARCH PROGRAM 2: DEVELOPING INNOVATION AND SAFETY CULTURES

Project Outputs for 2011

The overarching goal of this project is to enhance the safety of all workers engaged in the Australian infrastructure and building construction workforce by reducing the risk of accidents resulting from impaired performance caused by the use of alcohol and other drugs.

A nationally consistent collaborative approach across the construction workforce - involving employers and employees, unions, clients, contractors, and sub-contractors is required to engender a cultural change in the construction workforce - in a similar manner to the on-going initiative in securing a cultural change to drink-driving in our society where peer intervention and support is encouraged.

Project partners include: John Holland, Queensland University of Technology, Swinburne University of Technology and Curtin University. This project has active participation from leaders in applied research in the evaluation of drugs and alcohol impacts in mining, energy, aviation and rail sectors: Professor Jeremy Davey, Centre for Accident Research and Road Safety - Queensland (CARRS-Q, QUT) and Professor Steve Allsop, Director of the National Drug Research Institute (NDRI, Curtin University).

The challenge is to build safer workplaces through working together on this key national project. The project will be led in a strategic sense by an Industry Steering Committee chaired by a high-profile industry leader, with membership comprising representatives from:

- Office of the Federal Safety Commissioner
- Australian Constructors Association
- Austroads
- Engineers Australia
- Australian Procurement and Construction Council
- Civil Contractors Federation
- Master Builders Australia
- The Australian Workers Union
- Construction Forestry Mining Energy Union
- NSW Roads and Maritime Services

- Bert Biggs presented at the 10th National Conference on Injury Prevention and Safety Promotion. Alcohol and other drugs in construction: Safety impacts and roads to the right approach. November 2011, Brisbane.
- Bert Biggs presented at the Safety in Construction Conference. Safety Impacts of Alcohol and Other Drugs in Construction: A mid-term report. November 2011, Sydney.
- Article published in the Engineers Australia Magazine, October 2011 "A Safer Construction Industry".
- A Refereed Conference Paper, "Alcohol and other drugs in construction: Safety impacts and roads to the right approach" was published in the Proceedings of "The 1st International Conference on Safety and Crisis Management in the Construction, Tourism and SMEs Sectors" held in Cyprus, June 2011.
- A Refereed Journal Article, "The role of education and awareness in workplace alcohol and drug use in the Australian construction industry: Proposed program and preliminary results" was submitted for peer review in December 2011.
- Data collection commenced in September 2011 with site visits in Victoria and South Australia. Further site visits in early 2012 are planned in the Northern Territory and South Australia.



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Project 2.2

Offsite Fabrication and Product and Process Innovation

RESEARCH PROGRAM 2: DEVELOPING INNOVATION AND SAFETY CULTURES

The goal of this project is to find ways to improve stakeholder confidence in off-site manufacturing (OSM) and its associated technologies, and to develop better supply-chain workflow processes to support increased technological adoption for OSM.

This project will tackle three complementary issues:

- 1 Stakeholder Confidence (Domestic Capacity): Australian industry indicates a lack of confidence in the promise of OSM solutions. To improve this confidence, this project will identify and track workflow intervention points that have the potential to deliver real resource savings. Creating prototype construction process models will provide support for OSM adoption.
- 2 Baseline Model of OSM Processes: Industry claims the principle requirement of an integrated OSM project is for everybody to be 'talking the same language'. Thus identifying As-Is construction processes can provide a base-line process model. This model can then frame guide-line processes such as design, procurement and build to deliver accurate documentation and construction processes.
- 3 Business Processes Management (BPM): Some parts of industry are beginning to understand the importance of Business Process Management. BPM is a tool to facilitate systematic planning, execution and control of business processes. To assist industry stakeholders to implement BPM, this project aims to build associated prototype workflows as the basis for To-Be OSM Business Process Models. Increased business process maturity awareness has the potential to increase OSM adoption.

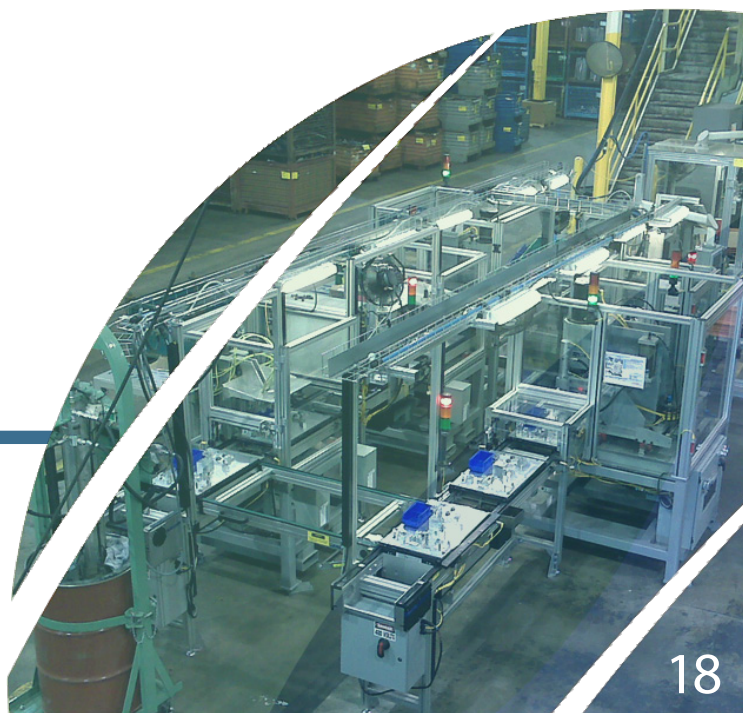
Project partners Queensland Department of Public Works, Western Australia Department of Treasury and Finance, John Holland, SurePoint Australia Pty. Ltd. and PrefabNZ have all used OSM as a component of individual projects. They are working with Swinburne University of Technology and Queensland University of Technology to increase OSM domestic capacity to support government's infrastructure and commercial projects.

Project Outcomes

- Phase 1 Stakeholder Confidence (Domestic Capacity) The OSM stakeholders' confidence gap analysis, business process maturity and OSM infrastructure evaluation need to be carried out. This will provide a snapshot of the current OSM practices.
- Phase 2 Base-line Model of OSM Processes: As-Is OSM base-line processes are expected to provide a framework for infrastructure projects focused on design, procurement and build processes.
- Phase 3 Business Processes Management (BPM): The process outcome will be workable pro-type automated OSM Business Process Models (To-Be BPM) which will feature identified intervention points to increase OSM process efficiency leading to growth in domestic capacity.

Project Outputs for 2011

- The gap analysis and evaluation of OSM process maturity had been carried out in Adelaide and Perth. The results of the BPM review of two major hospitals and three infrastructure projects, indicates that the industry is currently not aware of business process maturity.
- An archetypical OSM base-line process model has been created to be utilised in the development for all stages in the OSM construction value chain.



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Project 2.7

Leveraging R&D for the Australian Built Environment

RESEARCH PROGRAM 2: DEVELOPING INNOVATION AND SAFETY CULTURES

The overarching goal of this project is to better match funding strategies to industry needs to maximise the benefits of R&D to Australia's infrastructure and building industry.

Project partners are: Queensland Department of Public Works; Queensland Transport and Main Roads; Western Australia Department of Treasury and Finance; John Holland; Queensland University of Technology; Swinburne University of Technology; and VTT Technical Research Centre of Finland (Prof Göran Roos). This project has been endorsed by the Australian Built Environment Industry Innovation Council (BEIIC) with Council member Professor Catherin Bull serving on this project's Steering Committee.

This project seeks to: (i) maximise the value of R&D investment in this sector through improved understanding of future industry research needs; and (ii) address the perceived problem of a disproportionately low R&D investment in this sector, relative to the size and national importance of the sector.

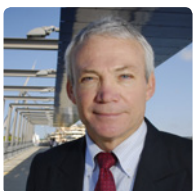
This research will develop new theory built on open innovation, dynamic capabilities and absorptive capacity theories in the context of strategic foresighting and roadmapping activities.

Four project phases have been designed to address this research:

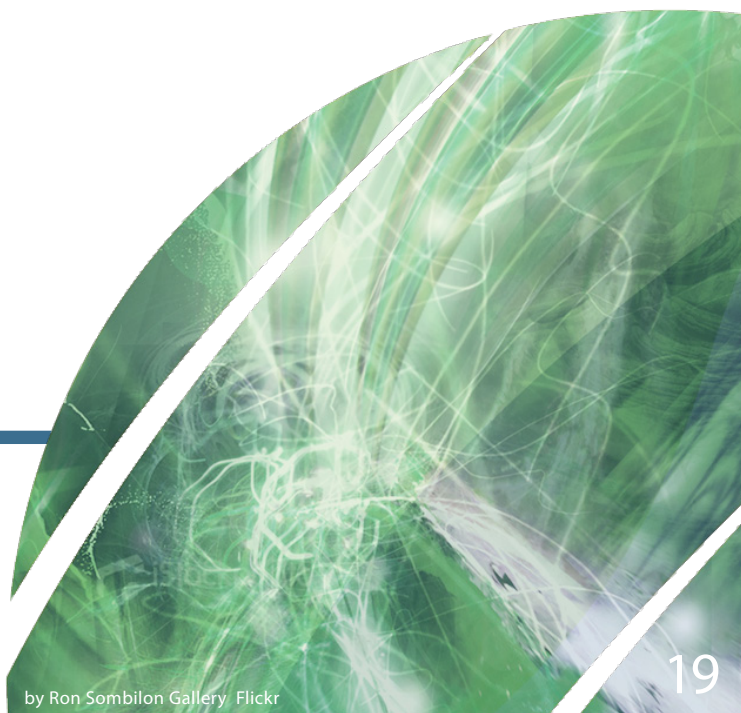
- 1 Audit and analysis of R&D investment in the Australian built environment since 1990 - of publically available data of investment by public and private organisations to understand past trends.
- 2 Examine diffusion mechanisms of research and innovation and its impact on public and private organisations - investigate specific R&D investments to determine the process of realising research support, direction-setting, project engagement, impacts and pathways to adoption.
- 3 Develop a strategic roadmap for the future of the Australian industry - assess the likely future landscapes that R&D investment will both respond to and anticipate.
- 4 Develop policy guidelines to maximise the value of R&D investments to public and private organisations - through translating project learnings into policy guidelines.

Project Outputs for 2011

- ARC Linkage Project grant won
- Thomas Barlow report "The built environment sector in Australia: R&D Investment Study 1992-2008"
- Three case studies completed on road construction safety; green buildings; Computer-aided Design and Drafting (CADD), Building Information Modeling (BIM) and IPD
- Foresighting workshops in Perth, Brisbane, Sydney and Melbourne
- CIB Task Group TG85 R&D Investment and Impact established - 21 members from 10 countries
- Hampson K.D., Kraatz J.A. "Leveraging R&D investment for the Australian built environment." 6th Nordic Conference on Construction Economics and Organisation.
- Hampson K.D., Kraatz J.A. "Leveraging R&D to advance digital modelling practice in Australian construction." Modern Methods and Advances in Structural Engineering and Construction, ISEC-6.
- Hampson K.D., Kraatz J.A. "Retrospective evaluation and prospective value-add: a review of R&D investment in Australia." SB11 World Sustainable Building Conference.
- Presentation to Australian Academy of Technological Sciences and Engineering Increasing the Innovation Dividend from Emerging Technologies forum.
- Paper accepted - Hampson, K.D., Kraatz J.A. R&D investment in green initiatives in Western Australia Healthy Building 2012
- Invitation to present at the International Workshop on Integrated Design and Delivery Solutions in Washington - April 2012.



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Research Program 3

● Driving Productivity Through Procurement

Program 3 will deliver economic as well as environmental and social benefits to the built environment industry through reductions in risks and costs and improved productivity associated with complex information management and procurement processes on infrastructure and building projects.

Procurement practices in Australia do not encourage best-for-project or best-for-community behaviours – the urgent economic imperative is to develop new ways to improve the service and balance of risk and return in procurement on infrastructure and building projects. Many of these issues are beyond the control of individual organisations and can only be solved through coordinated industry R&D involving small and large organisations across the national supply chain. New integrated protocols for dealing with the risk, security and IP issues that arise during procurement are relevant to end-users to reduce costs and identify new ways of allocating and assessing KPIs on projects. This program will contribute in a significant way to an emerging body of research being undertaken in other parts of the world that is aimed at developing better ways of sharing and managing digital information models. This program will also investigate commercial, legal and security barriers to implementation of digital modelling technology by industry.

Research Program 3 will target the following outcomes for the built environment industry:

- Increased revenue to digital modelling software developers
- GDP and industry impact of productivity and efficiency improvements
- Contribute to nationally standardised infrastructure tender requirements
- Savings from improved industry interoperability
- Environmental benefits from application of digital modelling technology
- Increased digital skills capacity in the industry.

The projects underway in Program 3 are described in the Fact Sheets following.



Project 3.1

Collaborative Object Libraries

Supporting the Facility Lifecycle

RESEARCH PROGRAM 3: DRIVING PRODUCTIVITY THROUGH PROCUREMENT

The aim of this project is to improve industry productivity by extending the current paradigm of computer-aided design (CAD) libraries to support the design, construction, facilities management and demolition/re-use information across disciplines and throughout the building lifecycle.

A fundamental problem faced by industry is that CAD library objects created and included in electronic models are duplicated by each discipline and most cannot be effectively shared between practices and projects. The CAD library objects are expensive to create and maintain. The current position significantly compromises interoperability and efficiency of the industry.

The problem affects all areas of infrastructure and building construction. It is most acute for building projects, where design professionals rely on software libraries to maintain standardisation of object definitions, to increase productivity, and improve quality throughout the development lifecycle thereby reducing costs and improving delivery times for projects.

Each construction project uses libraries of products and processes. These capture information about the project that is used across multiple projects (industry wide) or within a single project (project specific). The current range of computer software used for design and analysis each address these libraries in individual ways, with no indication from the vendors of a neutral approach to libraries. This:

- Prevents rationalisation and re-use within organisations, within projects, and across the industry;
- Creates inefficiencies as businesses are hindered in the transfer of data between systems;
- Creates a barrier to SME adoption of this more productive technology;
- Results in a loss of productivity to designers and constructors; and
- Becomes costly to maintain object libraries in facility management systems using current industry practices and tools.

The efficiency of digital modelling processes will improve enormously if it becomes possible:

- To share object libraries across different software, thereby reducing effort required by individual organisations to exploit the capabilities of digital modelling;
- For SMEs within this industry to adopt and benefit from the digital technology available; and
- For object libraries to be adopted within the procurement supply chain process and in facility management systems.

Project Outputs for 2011

- BIMTools demonstration system funded by SBEnrc.
 - Exports to Revit (Autodesk) and ArchiCAD (Graphisoft).
 - Small number of objects for demonstration purposes.
- Demonstration of property set management using web-based interface.
- Experiments conducted with a range of user interfaces.
- A presentation was made to BPIC in September 2011.
- A presentation "Object Libraries" was made to the Brisbane ArchiCAD users group in Brisbane.
- A refereed conference paper, "Domain-Specific Model Transformation in Building Quantity Takeoff" was presented in June at the 49th International Conference on Objects, Models, Components and Patterns in Zurich.
- An abstract was submitted and accepted, "The story of a door", ECPPM, July 2012.



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