Sustainable
Built Environment
National Research Centre

2010 Annual Report

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Executive Summary

Year 2010 has marked a very significant and successful transformation for our Centre. After 12 months of formative efforts and critical commitments from our industry, government and research partners nationally, the Sustainable Built Environment National Research Centre (SBEnrc) is in business delivering valuable research outcomes. The leadership and reputation of the CRC for Construction Innovation has been effectively captured and strengthened in our new Centre. We have emerged in a stronger and more resilient form, able to engage in more proactive ways than previously. Throughout this transformation three issues have been paramount.

First, our industry values collaborative applied research. The property, planning, design, construction and facilities management industry values an independent national applied research centre. The vacuum that would have been created in this space would have signalled the end of a decade's growth of collaboration and relationship building that has endured the boom industry period of the early part of this past decade as well as the global financial crisis. As we emerge from the GFC, the need for ensuring our industry is adopting more progressive sustainability practices is higher than ever. Industry driven research programs across environmental, social and economic sustainability provides for a continuation of research value. The vital positioning of SBEnrc for 2011 and beyond is clear.

Second, leadership breeds commitment. Our lead industry and government partners – Queensland Government, Western Australia Government, Parsons Brinckerhoff, John Holland, Queensland University of Technology (QUT), Curtin University and Swinburne University of Technology – have delivered the commitment required to underpin the Centre's transformation. In particular, QUT has provided essential underwriting of the Centre's future and provided the central headquarters accommodation and business support necessary to maintain our enterprise. As the Centre grows in 2011 and beyond, the early and strong commitment of these seven core members deserves recognition.

Third, delivery is key. Shaping the industry-driven projects throughout 2010 and delivering results through our project teams across Australia is the current challenge leading into 2011. Program Leaders in 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) provide the key distributed research leadership roles. Their energies and in-kind commitment from their respective universities will continue to be fundamental in ensuring the success of our research programs and the future development of our industry research leadership. As the project teams are staffed and the results of our engagement in university-led ARC Linkage projects become clear from mid-2011, our research student support (Masters and PhDs) will add a fresh dimension to the SBEnrc teams. Additionally, international participation (through VTT Technical Research Centre of Finland and BRANZ in New Zealand in the first instance) provides an important global quality review and engagement mechanism. Reinforcing this is the Presidency of the CIB (International Council for Research and Innovation in Building and Construction) by our Governing Board Chair, John V. McCarthy AO provides ready access to a worldwide network of over 5,000 experts from about 500 member organisations across 80 countries.

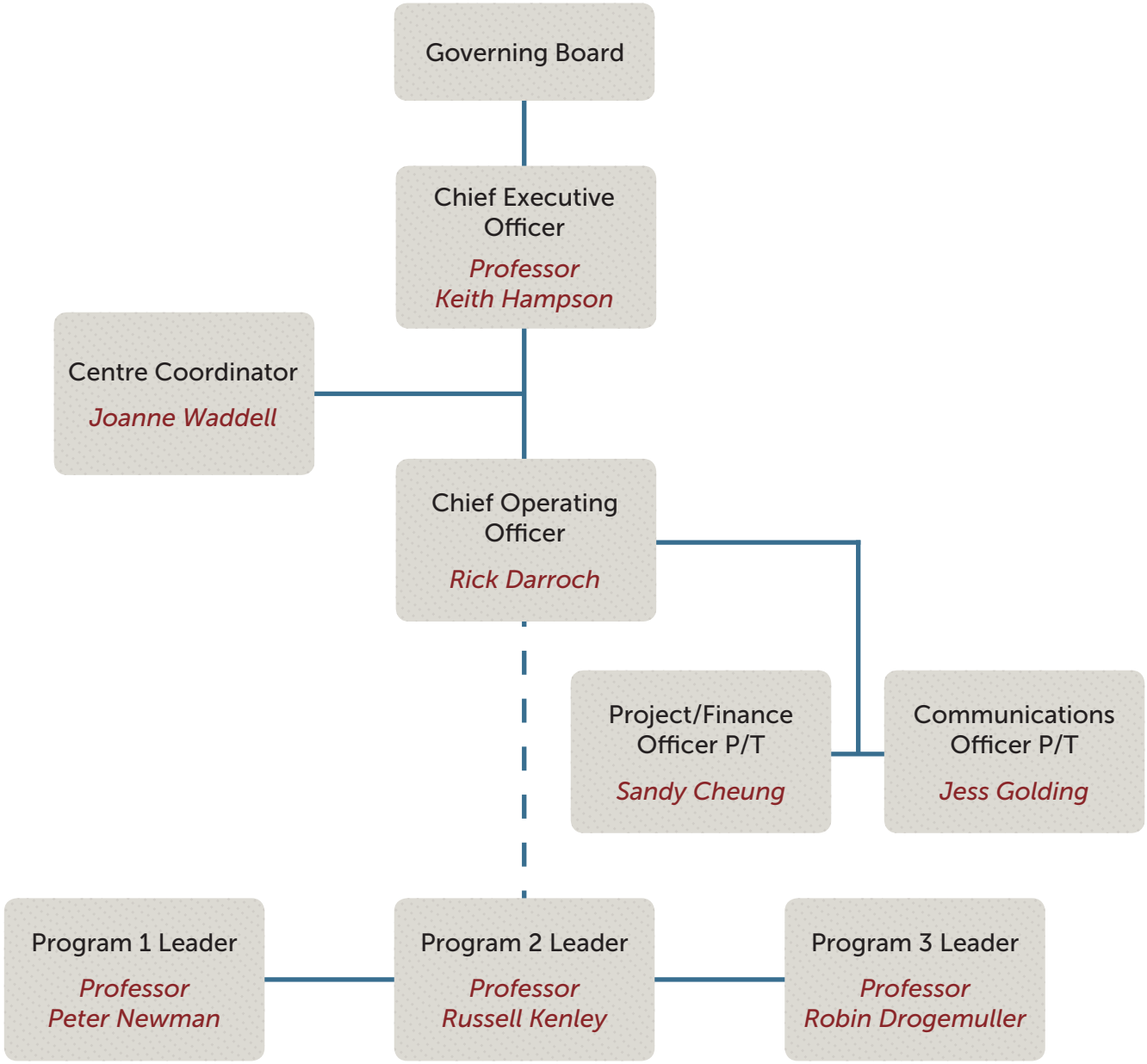
Year 2011 provides the opportunity to deliver on the promise our investing partners are seeking. Value-adding research with clear benefits in environmental, social and economic sustainability is key. Multi-disciplinary research teams from across our research institutions complemented by international leaders with input from our industry and government end-users provides the best prescription for shaping this. Our challenge is to grow the value and impact of our applied research more deeply and more broadly across Australia. 2011 will see our Centre target stronger involvement across Western Australia and Victoria complemented by growth in New South Wales, South Australia and Tasmania. Our private sector partner network will grow in the property, planning, design, construction and facilities management sectors. A broad base of national partners across the entire supply-chain of our industry is the way forward.

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

John V. McCarthy AO

Keith D. Hampson

Organisational Chart



Team Members

SBEnrc Board

1. John V. McCarthy AO (Chair)
2. Max Smith, Queensland Department of Public Works
3. Glenn Palin, John Holland (Alternate: Angelo Conte)
4. Richard Mann, Western Australia Department of Treasury and Finance
5. Tony Tate, Curtin University
6. Darren Bilsborough, Parsons Brinckerhoff
7. Andy Flitman, Swinburne University of Technology (Alternate: Bruce Whan)
8. Martin Betts, Queensland University of Technology
9. Keith Hampson, CEO, SBEnrc
10. Rick Darroch, COO, SBEnrc (Secretariat)
11. Lyn O'Connell, Australian Department of Infrastructure and Transport (Observer)

Research and Utilisation Committee

1. Darren Bilsborough, Parsons Brinckerhoff (Chair)
2. Program 1 Leader: Peter Newman, Curtin University
3. Program 2 Leader: Russell Kenley, Swinburne University of Technology
4. Program 3 Leader: Robin Drogemuller, Queensland University of Technology
5. Ross Guppy, Queensland Department of Transport & Main Roads
6. Angelo Conte, John Holland
7. Carolyn Marshall, Western Australia Department of Treasury and Finance - Building Management and Works
8. Keith Hampson, CEO, SBEnrc
9. Rick Darroch, COO, SBEnrc

Finance and Audit Committee

1. Tony Tate, Curtin University (Chair)
2. Richard Mann, Western Australia Department of Treasury and Finance
3. Max Smith, Queensland Department of Public Works
4. Angelo Conte, John Holland

John V. McCarthy AO

Chair, SBEnrc
FRICS, FAPI, FREI, FREAV

John is a recognised industry leader, with a breadth of experience across various commercial and industry disciplines. He has a close working relationship with major banks, superannuation funds, institutional investors, financiers, property analysts, and many industry bodies. 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 - an organisation he now serves as global President.

Keith Hampson

CEO, SBEnrc
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.

Team Members

Glenn Palin

John Holland
BAppSc, GradDipBuild, GradDipAppFin&Invest

Glenn Palin the Managing Director of John Holland and has more than 30 years of experience in the construction industry. Glenn is responsible for all construction and services operations of the Group, totalling $4.0bn annually. Glenn has played a major role in the development of the Company's People Development Programmes with a focus on the career development of younger employees and is a key player in developing and driving the company's 4P culture of People, Performance, Partnerships and Profit.

Angelo Conte

John Holland
BE (Civil) (Hons), FIEAust, RPEQ

Angelo is the Strategic Development Director 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.

Darren Bilsborough

Parsons Brinckerhoff
BE (Mech)

Darren is an Adjunct Professor of Sustainability at Curtin University and the Director of Sustainability at Parsons Brinckerhoff responsible for development of policy and strategy in delivery of sustainable infrastructure solutions in Australasia. He is a board member of the Green Building Council of Australia a director of Environment Business Australia and serves on the Development Assessment Commission in SA as a specialist member with expertise in environment and sustainability.

Max Smith

Queensland Department of Public Works
BE (Civil), DipCompDirec
FIEAust, CP Eng, FAICD, FAIB

Max is the Deputy Director-General, Works, Department of Public Works. He has extensive experience in public works administration, including the management of Commercialised Business Units. Max is a Civil Engineer, a Fellow of the Institute of Engineers - Australia, a Registered Practising Engineer in Queensland, a Fellow of the Australian Institute of Company Directors and a Fellow of the Australian Institute of Building.

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 the Strategic Projects division and oversees the delivery of a $6 billion portfolio of 15 major projects, including the $2.0 billion Fiona Stanley Hospital, $1.2 billion New Children's Hospital and $500 million Perth Arena indoor entertainment and sports stadium.

Martin Betts

Queensland University of Technology
BSc (Hons), PhD
CNAA, FCIOB, 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.

Team Members

Tony Tate

Curtin University
BSc, DipMet, GradDipAdmin, GAICD

Tony is Director of Research and Development at Curtin University. He has spent the past 16 years in senior management roles within the education sector. Prior to that, Tony led science and engineering based consultancies, primarily servicing the resources and energy sectors for 15 years building upon his 13 years of professional experience as meteorologist with the Bureau of Meteorology. Throughout his career Tony has worked internationally in collaboration with other companies and universities.

Andrew Flitman

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

Andrew is 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, FAICD

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.

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. Ross was a Board Member of the CRC for Construction Innovation, currently Deputy Chair for SBEnrc's Research & Utilisation Committee and on the Austroads Project Delivery Panel. Ross manages a number of agreements including the Strategic Alliance with AAPA and 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 Treasury and Finance, and a member of the WA Architects Board. 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.

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 recently 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.

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.

Rick Darroch

COO, SBEnrc
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.

Joanne Waddell

Centre Coordinator, SBEnrc

Joanne is the Centre Coordinator providing administrative and finance support to the CEO, COO and the Centre. She is the primary contact for enquiries from members, administrative and research staff. Joanne has over 25 years experience in administrative roles in private companies, research and academic institutions.

Core Partners

Queensland Government
Department of **Transport and Main Roads**
Department of **Public Works**
Department of **Infrastructure and Planning**
Building Codes Queensland

Government of **Western Australia**
Department of **Treasury and Finance**
Building Management and Works

QUT

SWINBURNE UNIVERSITY OF TECHNOLOGY

Curtin University

PARSONS BRINCKERHOFF

John Holland

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-lifed 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.

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Project 1.1
Design and Performance Assessment of Commercial Green Buildings

RESEARCH PROGRAM 1: GREENING THE BUILT ENVIRONMENT

The aim of this project is to investigate ways to enhance the performance of commercial green buildings by considering the post occupancy performance of selected green design elements on energy and water conservation, and improvements to health and productivity of occupants.

The focus of the research will be to:

1. Investigate the relationship between selected green design elements and actual performance (energy and water efficiency, occupant health and productivity) for commercial green buildings;

2. Investigate additional measures to improve the health and productivity of occupants of green buildings, with consideration of their contribution to energy and water efficiency.

The project will select key commercial building green design elements (identified in collaboration with partners and stakeholders) as to their potential for energy and water consumption reductions, as well as improved health and productivity of occupants. In doing so, this project will inform designers to: support the further integration of such design elements in building design; inform building managers as to methods to harness existing such elements; and inform green benchmarking and accreditation initiatives.

In collaboration with project partners, the project will conduct high level analysis of a number of case studies across Australia. The strength of the project is based on industry collaborations which will allow the research team to undertake context relevant and timely research to further the understanding of methods to enhance the performance of commercial green buildings, while providing robust and rigorous tools for industry, accreditation bodies and government.

Project partners include: Parsons Brinckerhoff, John Holland, Western Australian Department of Treasury and Finance, Queensland Department of Public Works, Victorian Department of Education and Early Childhood Development, Green Building Council of Australia, Curtin University, and QUT.

Project Outcomes

The project team will:

- Collaborate with SBEnrc partners, other key stakeholders, and experts to identify key design elements and methods that impact a building's energy and water efficiency and health/human performance;

- Undertake an assessment of key design elements (considering aspects related to operation and management) to identify the potential contribution to the energy/water and human performance of green buildings;

- Select and monitor a series of national case studies to investigate the relative contribution of key design elements on a building's energy/water efficiency and human performance;

- Analyse and interrogate post-occupancy building performance data to investigate the relative contribution of each element to building efficiency and performance and compare to the potential contribution;

- Identify opportunities to enhance and inform design practices, building performance rating schemes, and building management practices - to further improve energy, water and human performance of green buildings; and

- Develop recommendations to Industry, Government and Industry Bodies related to the selection of design elements, design processes and standards, building maintenance and management procedures, and third party building performance accreditation processes.

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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

Roads are a national and economic necessity and provide significant economic benefits to societies. Roads are also significant greenhouse gas contributors due to emissions from mining, transporting, earthworks, paving work and vehicles. The aim of this project is to:

1. Identify materials, technologies and processes for the delivery of roads that reduce environmental pressures from road building;
2. Investigate the potential for adaptation to climate change and peak oil of material use, construction, maintenance and disaster management processes in road building; and
3. Investigate the opportunity for using road reserves to contribute to the mitigation of climate change and strengthening infrastructure resilience.

Project Outcomes

To investigate ways to reduce environmental pressures from road building, the project aims to:

- Undertake a literature review, complimented by selected semi-structured interviews;
- Investigate best practices in reducing toxic and greenhouse gas emissions, protecting watersheds, reducing landfill use, and protecting adjacent ecosystems; and
- Investigate the potential for improvements in road construction practices to result in greater fuel efficiency of road users.

To investigate the potential for adaptation to climate change and peak oil, the project will:

- Undertake a literature review, complemented by selected semi-structured interviews to form the development of a base framework for 'Sustainability Assessment Framework for Road Infrastructure' (SAFRI);
- Investigate impacts on road building from climate change, including changes to average storm frequency and intensity, increase in average temperatures, and potential for coastal inundation of road infrastructure;
- Investigate the impacts on road building from peak oil, including increases to fuel costs, vehicle fuel switching, and modal shifts in freight transportation; and
- Using SAFRI, undertake a comparison to current national practices to identify opportunities for improvement.

To investigate the opportunity for utilising road areas to contribute to the mitigation of climate change and strengthening infrastructure resilience, the project aims to:

- Undertake a literature review, complemented by selected semi-structured interviews, and informed by AGIC, to form the development of a base framework for 'Sustainability Assessment Framework for Road Infrastructure' (SAFRI);
- Investigate the role of roads through improving the resilience of socio-ecological systems, including an interrogation of the fundamental assumptions driving road design, delivery and use;
- Investigate and assess the potential for roads to act as carbon sinks, areas for generation of renewable energy, and spaces that can be retrofitted to accommodate modes of public transport; and
- Using the ISSRI scenario planning methodology, interrogate a range of innovative scenarios to consider the availability, reliability and cost of existing and emerging options, considering the likelihood of adoption and appropriateness of each scenario in the context of various socio-economic and environmental conditions.

Project partners include: Parsons Brinckerhoff, John Holland, Queensland Transport and Main Roads, Main Roads Western Australia, Australian Green Infrastructure Council, Curtin University, and QUT.

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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 comes E. O. Wilson's concept of 'biophilia' that suggests we have an innate affinity with nature. 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 human well-being benefits, but a range of direct and indirect economic and environmental benefits. This project will investigate options for landscaping buildings, roads and other civil infrastructure to reduce urban heat island effects, reduce energy consumption, improve water management, and increase urban biodiversity.

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.

Project partners include: Parsons Brinckerhoff, Western Australian Department of Treasury and Finance, Townsville City Council (CitySolar Program), Curtin University, and QUT. 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 Outcomes

Biophilic design is an urban design principle that identifies how cities can be planned for and/or retrofitted to incorporate a greater degree of the natural environment (i.e. green roofs, living walls, urban streams). When these principles are integrated into city planning there can be significant benefits, such as mitigating heat island effects and improving thermal comfort, improving social outcomes and well-being, improvements to business and productivity outcomes, and improved water cycle management.

The project team will:

1. Identify key aspects of Biophilic Urbanism and undertake an assessment to identify the potential for application in Australian Cities.

2. Consider the costs and benefits associated with Biophilic Urbanism in Australian Cities, considering economic, social and environmental benefits of combining biophilic design with built environment planning and design.

3. Develop a planning and policy framework to inform the application of Biophilic Urbanism in Australian cities, considering potential barriers, limitations, and constraints.

When biophilic design and green infrastructure plans are coupled the resulting urban form can promote energy security through decentralised embedded generation (and less reliance on fossil fuels), water security through greater ability to capture runoff (and less reliance on groundwater, which in many cities is being impacted by saline intrusion) and food security through the introduction of urban agriculture.

Biophilic design and green infrastructure planning will be significant contributors to Australia's commitment to climate change mitigation and adaptation, and align well with government's vision of addressing population, participation and productivity related phenomena through more appropriate planning of our cities. This project will contribute to the understanding of key measures to harness the potential of biophilic urbanism in Australian cities, considering potential building and infrastructure practices and guidelines, appropriate policy mechanisms and associated barriers, limitations, and constraints.

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Program Leader, Curtin University

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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 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 Public Works, Western Australian Department of Treasury and Finance, 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, for the first time, identifying rigorous methods for measuring, minimising and controlling the environmental cost of mass haul.

The following phases have been designed to deliver valuable outcomes from this research:

1. A review of existing research and best practice software and technology for earthworks management, mass haul analysis and construction fleet management. This will form the basis for theoretical models for Australian projects.

2. Develop a methodology for calculating carbon consumption of fleet. This will provide a method for clearly and rigorously calculating the impact of mass haul operations.

3. Develop a methodology for minimising mass haul costs and carbon footprint. This will allow contractors to identify better strategies that will minimise their environmental cost and to communicate the result clearly and effectively.

4. Develop non-financial assessment criteria for carbon consumption associated with earthworks on infrastructure projects. This will allow clients to improve the environmental performance of their projects through directed procurement mechanisms. This will also facilitate long-term performance improvement through recognition and rewarding non-financial criteria.

5. Develop a methodology for monitoring and controlling conformance with submissions. This will ensure accountability in the delivery of performance improvements and ensure that non-financial criteria are tied to incentives for real deliverables.

Project Outcomes

This research fills an important gap between environmental research and production efficiency research, and targets an emerging need for optimisation to reduce environmental impact of infrastructure construction.

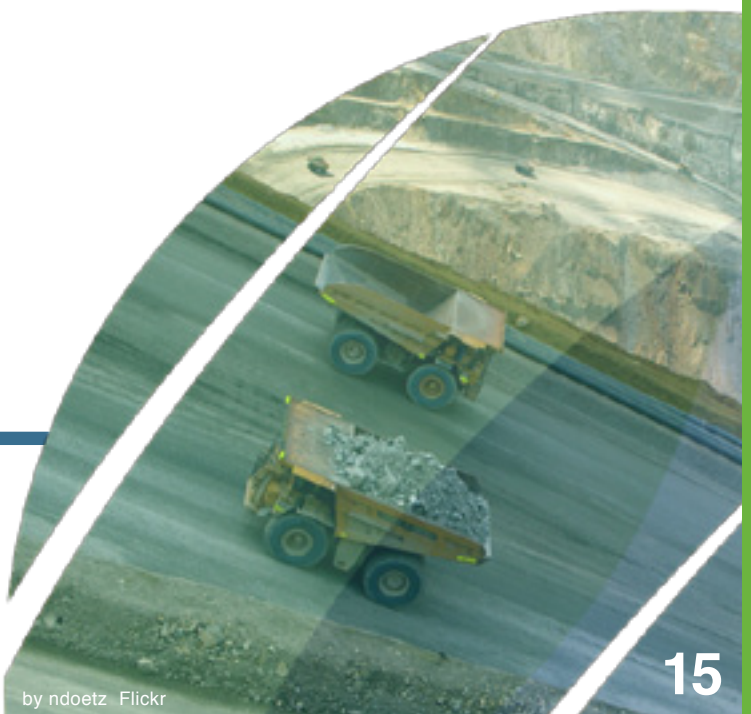
- **Phase 1** outcomes will include understanding international research and best practice in the domain of mass haul analysis and carbon impact. It will add to existing work which has been undertaken in understanding the environmental impact of infrastructure generally.

- **Phase 2** outcomes will contribute internationally significant models for carbon impact of mass haul operations.

- **Phase 3** will deliver models for optimisation of carbon impact and introduce new methods into the Australian industry for mass haul optimisation from both financial and carbon perspectives.

- **Phase 4** will produce strategies for Australian clients of infrastructure projects and enhance the procurement methods toward improved environmental and financial performance.

- **Phase 5** outcomes will contribute internationally significant models for monitoring and reporting compliance with environmental targets associated with mass haul operations.



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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

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

Project Outcomes

This project will fundamentally contribute to a greater understanding of the impact of alcohol and other drugs in the Australian infrastructure and building industry and, critically, bring together the employer, employee, and representative groups nationally. Never before has this level of collaboration been possible at a national level. Project outcomes will include:

1. Drugs and alcohol consumption and behaviour audit.
   A national qualitative and quantitative assessment of the use of drugs and alcohol within the industry. This will build upon similar studies carried out in the Australian energy and mining sectors.

2. Development of an appropriate industry policy.
   This will adopt a non-punitive and rehabilitative approach developed in consultation with employers and employees across the infrastructure and building sectors, with the aim it be applied nationally for adoption at the construction workplace.

3. Development of a cultural change management program.
   Together with the Office of the Federal Safety Commissioner, lead industry associations and key stakeholder groups, this project will initiate an industry-wide nationally consistent collaborative approach to reducing the risk of impaired performance on construction sites and increasing workers' commitment to drugs and alcohol safety.

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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 supply chain confidence in off-site manufacturing (OSM) and its associated technologies, and to develop better supply-chain processes to support increased technological adoption for OSM.

This project will tackle three complementary issues:

1. **Client Confidence:** Australian industry indicates a lack of confidence in the promise of OSM solutions. To improve this confidence, this project will identify and track intervention points that ensure work-flows can deliver real resource savings. Creating project evaluation benchmarks will provide on-going methods to support OSM sustainable practice.

2. **Project Knowledge:** Industry claims the principle requirement of an integrated OSM project is for everybody to be 'talking the same language'. Thus a focus on communication issues to define OSM tasks will assist in identifying decision-making processes to model a common OSM project language. This language model can frame knowledge management and knowledge transfer processes such as procurement and statutory approvals to deliver accurate documentation.

3. **Supply-Chain Processes:** Supply chains are 'only as good' as their individual processes. This project will verify knowledge management systems for OSM task and supply flows through a series of identified process interventions. Thus value will be created through knowledge transfer using a common language by projects being able to utilise intervention checklists for real-time OSM learning.

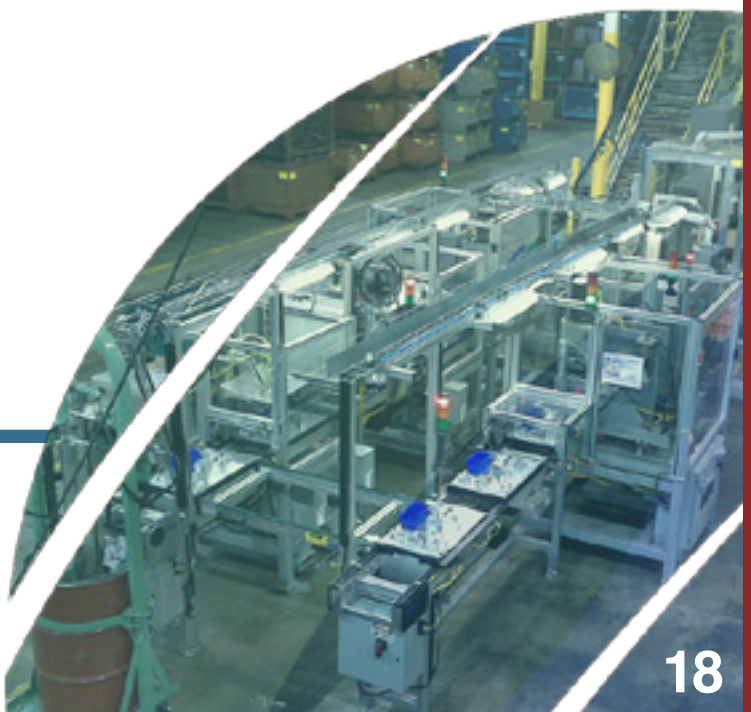
Project partners Queensland Departments of Public Works and Western Australian Department of Treasury and Finance have used OSM as a component of individual projects. However, the up-take of OSM has been limited. They are working with Swinburne University of Technology and Queensland University of Technology to increase client confidence in having OSM as a principle infrastructure project component; assist with connectivity of project knowledge for integrated OSM projects; and identify supply-chain processes for increased OSM productivity interventions and value creation.

Project Outcomes

- **Phase 1** Client Confidence outcomes will identify ways to improve confidence in the uptake of OSM for infrastructure projects through OSM project benchmarks to support increased confidence with manufactured products.

- **Phase 2** Project Knowledge outcomes will develop a common language to frame knowledge management and knowledge transfer processes such as procurement and statutory approvals. Models of information flows will provide frameworks for communication to support an integrated approach to infrastructure projects.

- **Phase 3** Supply Chain Processes outcomes will identify and map process interventions to ensure accurate knowledge transfer in all process management systems. Project outcomes will develop intervention checklists for real-time OSM learning while processing multi-level supply chain tasks.



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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 Australian 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 Prof 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** - access publically available data relating to R&D investments across Australia from 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 this critical Australian industry** - assess the likely future landscapes that R&D investment will both respond to and anticipate.
4. **Develop policy to maximise the value of R&D investments to public and private organisations** – through translating project learnings into policy guidelines.

Project Outcomes

- **Phase 1** outcomes will include: (i) a map of the existing research investments; (ii) an audit of R&D investment in this sector through interrogating Australian Bureau of Statistics, Australian Tax Office and Australian and state-based data; and (iii) a strategic assessment of the above inputs to inform the following project phases.
- **Phase 2** outcomes will include national case studies of specific themes of investment, highlighting lessons learned, success criteria and critical challenges.
- **Phase 3** will include: (i) an industry R&D roadmap, responding to likely futures; and (ii) a comprehensive update to the CRC for Construction Innovation's landmark Construction 2020 report published in 2004.
- **Phase 4** outcomes will include a set of strategies to allow public and private sector organisations to more profitably engage in research to secure business advantages.

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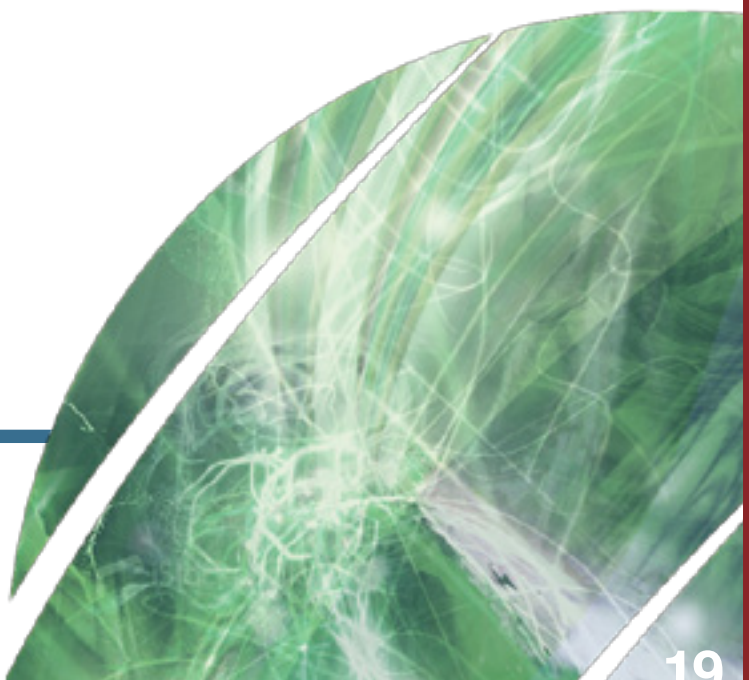

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Research Program 3

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.

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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 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 softwares 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 softwares, 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 Outcomes

This project will:

- Define and implement a neutral format for the storage of product library data that interacts directly with proprietary software systems;
- Make it possible for product manufacturers to have a single source of information on their products;
- Reduce the effort required by construction industry personnel to use software;
- Reduce duplication of effort across companies;
- Reduce transcription errors in documentation;
- Reduce use of out-of-date information;
- Increase sharing of information along the supply chain;
- Increase reliability of analyses due to access to up-to-date information; and
- Provide potential access to more reliable (certified) information.

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Project 3.2
Supporting Infrastructure Management by Combining Sensors and Asset Information Models

RESEARCH PROGRAM 3: DRIVING PRODUCTIVITY THROUGH PROCUREMENT

Undertaken in collaboration with the Capability and Optimisation Program run by the Australian Cooperative Research Centre for Infrastructure and Engineering Asset Management (CIEAM), this project will improve the management of constructed assets throughout their working life by providing improved information about physical performance as measured against as designed performance. This will support a move from as scheduled maintenance to as required maintenance.

Additionally, due to financial constraints, infrastructure is being expected to perform at levels and for durations that often exceed original design goals. The question then becomes what effect on expected lifetime and maintenance schedule will the changes in usage have?

The information gathered and the results of the data analysis also need to be presented in ways that are easy to understand and add maximum value to decision making.

Many constructed assets (bridges, roads, buildings) are monitored in some way to ensure their continued operation within required performance parameters. The key questions for the asset owners are *How does the asset perform against requirements?* and *How can I maximise the benefits gained from this data?* Asset owners who are considering the installation of sensors need to ask themselves *What information do I need to make best use of the asset?* and *What sensor system will provide me with this information?*

The technical questions that will be addressed in this research project are, for selected asset types:

1. How do we assess performance and durability?
2. What data and algorithms are necessary?
3. What sensors placed where will provide this data?
4. How do we display the base and calculated information in the most understandable and useful manner?
5. Are there other value-adding opportunities from the same data?

Project Outcomes

The project will examine bridges and buildings in the first instance, with the opportunity to extend the project outcomes to other types of infrastructure in the future.

For bridges, the results will be:

- A model of structural performance over time for two types of bridge, considering issues such as aging and creep;
- Instantaneous data gathered from a number of bridges measuring number and load of traffic axles, and the structural behaviour under these loads;
- Data for the long term structural behaviour of the bridges; and
- Proof-of-concept software that displays the information in an easily interpreted manner.

For buildings the results will be:

- Models of the performance of buildings for both energy and environmental performance;
- Data on the energy and environmental performance of a number of buildings across Australia;
- Comparison of actual versus designed performance;
- Identification of possible reasons for variance between actual and designed performance; and
- Proof-of-concept software that displays the information in an easily interpretable manner.

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Financial Report

Summary

The 2010 Financial Summary for the SBEnrc reflects the operations of the new Centre over the first year of our initial term. Cash flows are characterised by agreed revenues being received from Core Members offset by early low levels of expenditure on Research Programs and baseline Centre Establishment, Management and Business Development costs. The financial effect of these items during 2010 was a cash surplus in excess of $1 million.

The Core Members committed to funding the Initial Term of the Centre which is a period of three years to 31 December 2012. Over this time management are charged with (a) establishing the centre, (b) launching the research projects, (c) delivering the outcomes from the initial Research Projects and (d) growing the Centre's membership base. These headline activities are reflected in the 2010 Financial Summary below:

2010 Financial Summary

Activity	Funds ($ '000s)
Revenue	
Core Member Cash Contributions	1,800
Other	46
Total Revenue	**1,846**
Expenses	
Research Activities *(including delivering the outcomes)*	58
Establishment and Management	689
Business Development	90
Total Expenses	**837**
Surplus	**1,009**

The opening cash balances in 2011 of over $1 million which have significantly increased in January 2011 with further Core Member cash contributions being received by the Centre. In accordance with the Centre's Business Plan, most of these funds will be released in the near future for Research and Business Development activities.