CRC Construction Innovation
BUILDING OUR FUTURE

# Annual Report 2006–07

## Cooperative Research Centre for *Construction Innovation*

Established and supported under the Australian Government's Cooperative Research Centres Programme

# Contents

# 1. EXECUTIVE SUMMARY

## THE CRC FOR *CONSTRUCTION INNOVATION* ENGAGES IN COLLABORATIVE RESEARCH AND IMPLEMENTATION FOR THE PROPERTY, DESIGN, CONSTRUCTION AND FACILITIES MANAGEMENT INDUSTRY. IT WORKS WITH INDUSTRY, GOVERNMENT AND RESEARCHERS TO IMPROVE PRODUCTIVITY AND SUSTAINABILITY.

Over the past 12 months, *Construction Innovation* has delivered internationally recognised outcomes for its 21 participants and for Australian industry, highlighting the valuable role research and development plays within one of Australia's most important industries.

*(L–R) Dean Cipolla, Project Leader, Construction Site Safety Culture and Group Safety Manager, John Holland Group; John McCarthy, Chair,* Construction Innovation*; the Hon Kevin Andrews MP, Minister for Employment and Workplace Relations and Keith Hampson, CEO,* Construction Innovation *at the launch of the* Construction Safety Competency Framework *in Melbourne, September 2006.*

### Fuelling industry productivity

Under the leadership of *Construction Innovation*, Australia is leading the world in the development of internationally recognised Building Information Models (BIM) and Facilities Management (FM) techniques.

A two-year exemplar project, developed from the Australian Government's Facilities Management Action Agenda to deliver an integrated solution for Australia's FM sector, was completed and the findings comprehensively disseminated to industry nationally and internationally. The Sydney Opera House FM Exemplar Project demonstrated an integrated FM solution promoting best practice and the case for FM as a business enabler. Importantly, this exemplar project was underpinned by the use of advanced digital modelling technology which enables a single, consistent and up-to-date view of all aspects of a building. We believe that these capabilities will increasingly be mandated by major clients internationally.

This research achieved widespread industry recognition and won the 2007 Facility Management Association of Australia — Rider Hunt Terotech Industry Achievement Award for advancing facility management strategy and practice. The BIM component of the project also featured in two recent international awards – the Jury's Choice category of the American Institute of Architects Technology in Architectural Practice 2007 awards, and the Bentley Awards for Excellence 2007 award for BIM in multiple disciplines.

### Tackling construction site deaths and injuries

Another example of *Construction Innovation* delivering industry value has been sector-wide collaboration on projects aimed at improving safety on construction sites. On average, one worker a week dies on construction sites in Australia and many more are seriously injured – a fatality rate five times higher than that of the mining industry.

This statistic is simply unacceptable and has led *Construction Innovation* to develop two landmark projects. Our Construction Safety Competency Framework, launched in September 2006, identifies a series of critical safety management tasks required to improve site safety and encourages a national consistency of standards. Implementation of the outcomes of this research is underway nationally, in collaboration with industry and the Office of the Federal Safety Commissioner (OFSC) through the development of industry toolkits and safety effectiveness indicators.

This project supports another major research project recently completed – Safer Construction, which has developed an industry-wide guide for best practice in safer construction. This project, delivered in collaboration with Engineers Australia, brings together the peak national associations for clients, designers and constructors in the development and dissemination of this ground-breaking industry guide. In doing so, it reinforces the unique position *Construction Innovation* occupies in its ability to provide national, independent industry R&D leadership.

### Research extended to include ICT blueprint

Another key activity over the year has been the establishment of a two-year extension program which commenced on 1 July 2007 to take full advantage of the CRC Programme's offer to extend *Construction Innovation* until 30 June 2009. The extension program was developed through extensive consultation with industry, government and research organisations. It continues implementation of safety and improved dispute management outcomes, and significantly expands upon our research in the area of digital modelling. Three new digital projects focus on the development of national guidelines for sharing digital data between

*(L–R) Stephen Ballesty, Project Leader, the Sydney Opera House FM Exemplar Project and Managing Director – Advisory, Rider Levett Bucknall; the Hon Bob Baldwin MP, Parliamentary Secretary to the Minister for Industry, Tourism and Resources; George Spink, Executive General Manager, Facilities Management, Transfield Services; Paul Akhurst, Director, Facilities, Sydney Opera House and Robin Drogemuller, QUT – at the Melbourne FM industry showcase November 2006.*

disciplines based on case-studies of projects using BIM, and the development of a collaborative ICT platform where such data can be shared. The extension program provides a key focus to improve productivity and sustainability in our industry and has significantly strengthened our private sector participation.

## Winning international acclaim

Our international industry and research collaboration has achieved significant recognition. *Construction Innovation's* Chair, John McCarthy, sits on the Board of CIB, a global network for international exchange and cooperation in research and innovation in building and construction. Mr McCarthy was appointed Chair of the CIB Marketing and Communication Committee at the Triennial CIB World Building Congress held in Capetown in May 2007.

*Construction Innovation's* CEO Keith Hampson leads the international CIB Innovation in Construction Task Group and was also invited to participate in an International Review Panel of PSIBouw (Process and System Innovation in Building and Construction) in The Netherlands, which promotes the CRC model of industry-research collaboration to deliver firms industry and national benefit.

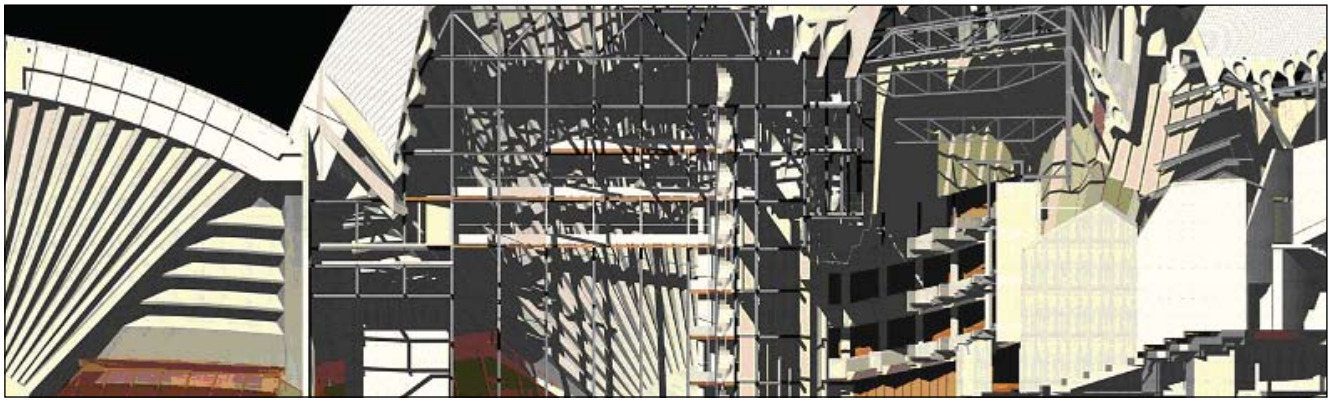
In 2006–07 *Construction Innovation* also strengthened its collaboration with buildingSMART International Alliance for Interoperability (IAI), the organisation which established the international open standard IFC for object-based software in construction and facilities management. *Construction Innovation's* Chief Operating Officer, Research and Commercialisation, Peter Scuderi, is a member of IAI Australasian Board and holds the position of International Education Coordinator and is a member of the IAI International Council. Mr Scuderi attended IAI International Council meetings in London and showcased the significant research outcomes of *Construction Innovation's* Sydney Opera House FM Exemplar Project.

## Better, faster, cheaper and safer construction

Taking into account the cluster of companies representing the construction industry such as architects, consultants and materials/components suppliers and FM, the industry's contribution to GDP is assessed as 20 per cent. That is, one in every five dollars generated in the Australian economy is generated by the construction sector. The performance of the construction industry is vital to the performance of the rest of the economy.

Effective delivery of constructed products – buildings and infrastructure – underpins our quality of life and economic growth. However, in an era where community expectations of our industry are increasing, major issues face the industry, such as safety on worksites, skills shortages, sustainability and regulation. The industry is also hampered by operating in silo-fashion, with multiple entry of data, which leads to a loss of productivity, disputes and reduced profitability. Industry innovation rates, although improving, remain low in comparison to other industry sectors, such as manufacturing.

*Construction Innovation's* future research activities will build upon our strengths in digital modelling, safety and improved project delivery. Our research will advance the industry with advanced off-site design and manufacture of components and modularisation



*© Sydney Opera House. Courtesy of Utzon Architects/Johnson Pilton Walker (Architects in collaboration) – Arup.*

# EXECUTIVE SUMMARY

and standardisation of building and infrastructure elements. The industry outcome will be improved sustainability, increased productivity and quality delivered with improved safety and at lesser costs – *better, faster, cheaper and safer* construction.

*Image © 2007 Jupiterimages Corporation.*

## 1.1 Context and major developments during the year

The Australian construction industry is currently in the grip of a resources-led boom, which has resulted in severe pressure on infrastructure delivery, particularly in the states of Queensland and Western Australia. This has impacted on the construction industry in a number of ways, through staff shortages and scarcity of materials. The mining industry has attracted tradespeople who might otherwise have worked in construction and the volume of work has resulted in fewer staff in our industry participant organisations being available to work on *Construction Innovation* projects.

The buoyant nature of the industry is also placing significant demand on resources, other than staff. There is a high nationwide demand for construction products, which places additional pressure on infrastructure and results in increased costs throughout the supply chain. To address these challenges, *Construction Innovation* has increased its focus on research to enhance the productivity of delivering national infrastructure.

Integrated digital modelling research projects in our extension program, which commenced on 1 July 2007, are as equally relevant for infrastructure as for buildings. The Interoperable Standards Development project looks at developing the current IFC international standard, which covers the building, to a standard which can apply for where the building meets the ground and with civil and external works like pavements, retaining walls, landscaping and underground services. Similarly, the Collaboration Platform project promotes the shared usage of digital tools and data for clients and contractors in building and infrastructure.

Other projects in the extension program, such as the development of Safety Effectiveness Indicators against critical safety management activities and research to improve project Dispute Avoidance and Resolution are highly applicable for building and infrastructure and have been strongly industry-driven. The extension program will build on and complement *Construction Innovation's* existing work and will run in parallel with the existing CRC to June 2008 and as a stand-alone program through to June 2009.

Six additional industry participants have joined *Construction Innovation* to assist in delivering the extension program.

In response to current industry pressures, and to maintain the critical R&D service to our growing participant-base, our Centre will submit a competitive bid to the CRC Programme's 2008 Selection Round. The focus of this bid will address these issues through digital technology, which provides the capacity for industry to be more productive and sustainable.

The offsite design and manufacturing component of the rebid will impact on industry in several ways. Work normally done onsite would be undertaken in factories, which would alleviate skill shortages on site, as less skilled labour would be required. Development of building components such as facades, bridge beams and bathroom modules, to a higher quality standard in a factory environment would also enable these materials to be produced more sustainably with less waste, more safely and economically – leading to *better, faster, cheaper and safer* construction.

With increased industry engagement and support from its partners, *Construction Innovation* is recognised for the unique role it plays in providing leadership of industry-wide research and development. Our Board and the team of 351 industry, government and research professionals who undertake and deliver our research are committed to continuing to provide valuable outcomes for Australian industry through applied research, education and technology transfer for the future.

John McCarthy
Chair – CRC *Construction Innovation* Board

Keith Hampson
CEO CRC – *Construction Innovation*

# AWARDS

2006-07

- *Construction Innovation's* Sydney Opera House FM Exemplar Project won the Facility Management Association of Australia — Rider Hunt Terotech Industry Achievement Award for facility management strategy and practice in May 2007. The BIM component of the research also featured in two international awards – the Jury's Choice category of the American Institute of Architects Technology in Architectural Practice 2007 awards, and the Bentley Awards for Excellence 2007 award for BIM in multiple disciplines.

- *Construction Innovation's* safety culture research won the Victorian Chapter of the Australian Institute of Building's (AIB) Professional Excellence in Building in June 2007.

- *Construction Innovation's* DesignCheck project won the research and development category at the AIB 2006 New South Wales Professional Excellence in Building Awards. The project also won a High Commendation in the 2006 Professional Excellence Award for Research and Development at the AIB national awards in September 2006.

- *Construction Innovation's* Project Diagnostics won the 2006 Professional Excellence Award for Research and Development at the AIB national awards in September 2006.

*(L–R) Receiving the Facility Management Association of Australia — Rider Hunt Terotech Industry Achievement Award for facility management strategy and practice in May 2007 for the Sydney Opera House FM Exemplar Project: Peter Scuderi, Chief Operating Officer, Research and Commercialisation,* Construction Innovation*; George Spink, Executive General Manager, Facilities Management, Transfield Services; Paul Akhurst, Director, Facilities, Sydney Opera House; Stephen Ballesty, Project Leader, the Sydney Opera House FM Exemplar Project and Managing Director – Advisory, Rider Levett Bucknall and David Duncan, CEO, FMA Australia.*

# 2. NATIONAL RESEARCH PRIORITIES

## 2.1 National research priority goal highlights

*CONSTRUCTION INNOVATION* RESEARCH ADDRESSES AUSTRALIA'S NATIONAL RESEARCH PRIORITY GOALS IN THE AREAS OF ENVIRONMENT, TRANSFORMING INDUSTRY, SMART INFORMATION USE, STRENGTHENING AUSTRALIA'S SOCIAL AND ECONOMIC FABRIC AND PROMOTING AN INNOVATION CULTURE AND ECONOMY.

2006-07

Water – a critical resource

### WATER EFFICIENT DESIGN

Climate change affects all aspects of the water cycle and challenges current water-management practices and policy development. Residential water use accounts for around 60% of most Australian capital cities' total mains-supplied water. Non-residential water, which is primarily commercial and industrial water, constitutes around 20-30%, with around 10-15% of water used for other purposes.

*Construction Innovation* undertook a review of water services technologies as part of its Sustainable Subdivisions: Energy and Water Efficient Design research project. The water services technologies review discusses technologies available at the household to suburban level which contribute to integrated urban water management in the form of physical systems, as well as a range of water, wastewater and stormwater management technologies that offer alternative approaches to existing water services. The options are suitable for household, cluster and subdivisional scales and are possible technologies that can be used when developing urban water management strategies.

*Above image © Claire Diaper, CSIRO. Top right image © Grace Tjandraatmadja.*

The *Sustainable subdivisions: Review of technologies for integrated water services* publication reviews existing alternative technologies in Australia and profiles eight case studies to provide an assessment of the barriers and issues associated with technology implementation. Outcomes of the project have been disseminated to industry through publications and development of an online e-learning module for design professionals which is available through The Royal Australian Institute of Architects' (RAIA) website.

2006-07

Strengthening Australia's social and economic fabric

## A NATIONAL FRAMEWORK FOR SAFETY

Construction site labour makes up 8% of the Australian workforce, yet accounts for 15% of all fatalities in the workplace. On average, one worker a week dies on construction sites in Australia and many more are seriously injured – a fatality rate five times higher than the mining industry. Labour mobility makes it difficult for any one company to consistently influence safety attitudes and behaviours because workers and sub-contractors hear different safety messages when they move to different companies, projects and sites.

*Construction Innovation* research, conducted in collaboration with the Office of the Federal Safety Commissioner (OFSC), industry, government and research partners, has developed high impact outcomes which address the issue of safety on Australian worksites. Outcomes include the development of *A construction safety competency framework* which identifies:

- which roles/positions are critical to safety
- 39 critical safety management tasks
- the skills, attitudes and behavioural competencies required to perform each task successfully.




The framework is used by safety managers, senior managers and executives and provides a guide on how to create a positive safety culture by ensuring key staff such as project managers, supervisors, OHS advisors and engineers are aware of and can effectively execute tasks needed to better manage OHS.

*Construction Innovation* has promoted the framework through a series of industry workshops held throughout Australia. Implementation of the outcomes of this research is underway nationally, in collaboration with industry and the OFSC with development of industry toolkits, safety effectiveness indicators and training modules. *Construction Innovation's* Construction Site Safety Culture project won the Victorian Chapter of the Australian Institute of Building's (AIB) Professional Excellence in Building award in June 2007.

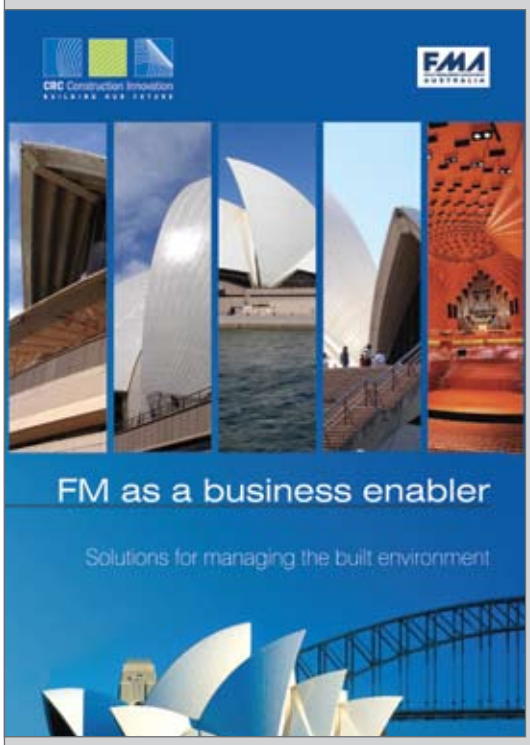
This project complements another major research project nearing completion – Safer Construction – which has developed an industry-wide *Guide to Best Practice for Safer Construction*. The Safer Construction project, delivered in collaboration with Engineers Australia, brings together the peak national associations for clients, designers and constructors in the development and dissemination of this ground-breaking industry guide. In doing so, it reinforces the unique position *Construction Innovation* occupies in its ability to provide national, independent industry-wide R&D leadership.

# NATIONAL RESEARCH PRIORITIES

Transforming existing industries

## SYDNEY OPERA HOUSE FM EXEMPLAR PROJECT

*Construction Innovation's* Sydney Opera House FM Exemplar Project was developed as a response to the Australian Government's Facilities Management Action Agenda, which aimed to develop a strategic framework for a more sustainable and internationally competitive Australian FM sector.




The uniqueness and complexity of Sydney Opera House, which attracts an estimated 4.5 million visitors and stages 2000 performances a year, was used as a template for developing knowledge to form the basis for future innovation, learning and standards – with applications for the broader FM industry.

The FM sector plays a significant role in the delivery of facilities services to the built environment. While its primary function is the provision of buildings and the minimisation of operational life cycle costs, the sector is also responsible for ensuring that services are delivered in a way that contributes to the productivity and profitability of building occupants, as well as improved returns for owners and investors.

Australia's FM sector employs more than 170,000 people and generates approximately $12 billion of Australia's GDP. By combining direct and indirect contributions, it is estimated FM accounts for over $12.4 billion in GDP, equivalent to 1.65% of Australia's GDP. The Sydney Opera House FM Exemplar Project focused on three areas of interest to the FM sector – digital modelling, services procurement and performance benchmarking. The digital modelling component of the research was based on integration of FM digital data from a range of software systems into a partial Building Information Model (BIM) of the Sydney Opera House.

Construction of the Sydney Opera House commenced nearly 50 years ago and the completed building differs from the original drawings. There is no definitive set of plans or documentation incorporating service changes made over the years. This lack of consistent data in a single source presents many challenges for management and future development of the facility.

*Construction Innovation's* research demonstrated that the BIM could be used for FM by mapping the relationship of objects such as lifts, ventilation and fire systems within the building and integrating this into a model with FM functions, such as facility condition reporting and energy consumption.

2006-07

The project demonstrated the ability of BIM software to import and share information from various data sources by means of open industry standard (IFC). Management of data about a building in a single model has the potential to revolutionise the FM industry. Sydney Opera House is now partnering with *Construction Innovation* to further implement digital management systems in Australia's most famous building, joining our extension program to June 2009 as a committed industry participant.

Research outcomes from this project were summarised in the publication *FM as a business enabler* and disseminated to industry through the Facilities Management Association of Australia, free online downloads and a series of national workshops which attracted more than 350 attendees from Australia's FM sector. This project has also been the subject of a number of international presentations and has gained global recognition for *Construction Innovation's* leading digital research.

The research also won the 2007 Facility Management Association of Australia — Rider Hunt Terotech Industry Achievement Award for facility management strategy and practice. The BIM component of the project also featured in two recent international awards – the Jury's Choice category of the American Institute of Architects Technology in Architectural Practice 2007 Building Information Model awards, and the Bentley Awards for Excellence 2007 award for BIM in multiple disciplines.


*Paul Akhurst, Director Facilities, Sydney Opera House addresses an audience of 150 FM industry professionals at the Sydney showcase of* Construction Innovation's *Sydney Opera House FM Exemplar Project in November 2006.*

# NATIONAL RESEARCH PRIORITIES

Promoting an innovation culture and economy

## INDUSTRY ADOPTION OF INNOVATION 2006-07

The benefits of innovation are well-documented. Case studies have shown construction innovations result in time-savings, cost-savings and unique solutions to difficult problems. Often these innovation examples feature large contractors, due to their involvement with high-profile projects. While large contractors may be viewed as having higher innovation rates than small contractors, it would be a mistake to assume innovation is only undertaken by large firms.

*Construction Innovation's* Building Research Innovation Technology and Environment (BRITE) project interviewed 20 contractors of various sizes across Australia to discover and share the management practices of Australia's most highly innovative construction contractors.

An example of the benefits of innovation is provided by a company of 20 employees in rural Victoria. In 2006, the company undertook construction of four two-storey townhouses in a largely built-out area in Warrnambool, Victoria. Tight time-scheduling and the need to limit OHS risks led the builder to devise an innovative partial prefabrication approach for the upper storeys. The solution, devised solely for this project, resulted in time and cost savings, greatly reduced risks from working at height, a stronger structure and a great boost to team morale – with a successfully delivered project for the client.


The challenges encountered by the company, details of the innovative response it developed and a summary of outcomes have been included as part of a series of case studies for a new *Construction Innovation* publication – *Being the Best* – which details the learning behaviours of Australia's most innovative contractors.

The *Being the Best* booklet has been distributed, with the assistance of state government departments, to a total of 1024 pre-qualified contractors in the infrastructure and building industries throughout Australia. Another 200 copies have been distributed through BRITE project partners and to policy and contracting sections of the Queensland Department of Public Works and Queensland Department of Main Roads.

*Being the Best* is also available to industry free of charge online from *Construction Innovation* and other websites.

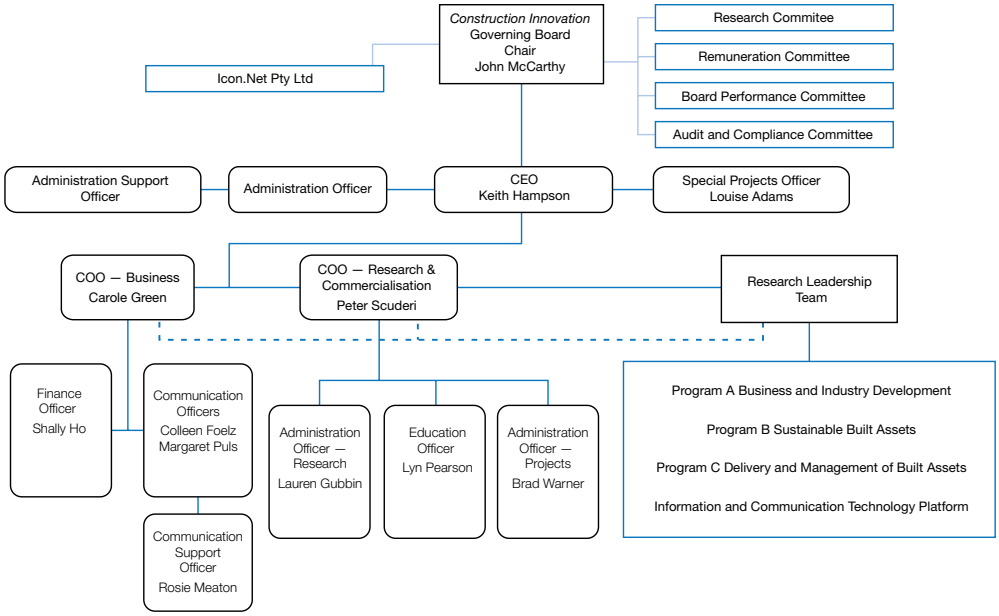
Table 1: National research priorities and *Construction Innovation* research

| NATIONAL RESEARCH PRIORITIES | CRC RESEARCH (%) |
|---|---|
| **AN ENVIRONMENTALLY SUSTAINABLE AUSTRALIA** – Transforming the way we use our land, water, mineral and energy resources through a better understanding of environmental systems and using new technologies | |
| Water – a critical resource | 5% |
| Transforming existing industries | 24% |
| Responding to climate change and variability | 15% |
| **PROMOTING AND MAINTAINING GOOD HEALTH** – Promoting good health and preventing disease, particularly among young and older Australians | |
| Strengthening Australia's social and economic fabric | 20% |
| **FRONTIER TECHNOLOGIES FOR BUILDING AND TRANSFORMING AUSTRALIAN INDUSTRIES** – Stimulating the growth of world-class Australian industries using innovative technologies developed from cutting-edge research | |
| Smart information use | 28% |
| Promoting an innovation culture and economy | 8% |

*View of Melbourne © 2007 Shutterstock.*

# 3. GOVERNANCE AND MANAGEMENT

## THE CRC FOR *CONSTRUCTION INNOVATION* IS AN UNINCORPORATED JOINT VENTURE GOVERNED BY A BOARD COMPRISING NINE NOMINEES FROM PARTICIPANTS (FIVE RESEARCH USERS AND FOUR RESEARCH) AND AN INDEPENDENT INDUSTRY CHAIR.




In 2006–07, movement of staff within our participant organisations has resulted in some changes to the role of Program Director and Deputy Program Director. A number of these positions are now vacant, though there is a reduced requirement for these roles as the majority of projects complete.

In May 2007, a variation of the Commonwealth Agreement was commenced to extend *Construction Innovation* until 30 June 2009, engage six new industry participants – Leighton Contractors Pty Ltd, Mirvac Ltd, Nexus Point Solutions Pty Ltd, Thiess Pty Ltd, Transfield Services (Australia) Pty Ltd, and Sydney Opera House – and to undertake three new research programs with a duration of two years commencing 1 July 2007 to 30 June 2009. This is still in progress.

Icon.Net Pty Ltd has been established to hold all *Construction Innovation* intellectual property on trust for our participants. The Chair of the Governing Board also chairs meetings of the directors of Icon. Net Pty Ltd. The Directors of Icon.Net met six times during the year. In 2006–07, *Construction Innovation's* regular research project review and research committee meetings continued. Four new research project agreements were signed and 25 six-monthly project reviews meetings involving industry, government and research participants were held.

Four committees facilitate decision-making by *Construction Innovation's* Governing Board.

- The Research Committee directs *Construction Innovation's* research program and makes recommendations to the Board. The Committee membership comprises representatives from *Construction Innovation* participants. The Research Committee met five times during 2006–07.

- The Remuneration Committee meets in conjunction with the Board meetings and provides advice regarding the employment conditions for the Senior Management Team. The Committee members are John McCarthy (Chair); Allen Kearns, CSIRO; John Oliver, Rider Levett Bucknall (formally Rider Hunt); David Golightly, John Holland Group; and Arun Sharma, Queensland University of Technology (QUT).

- The Board Performance Committee reviews the performance of the Board. The members are Don Allan, Queensland Department of Public Works (Chair); John Oliver, Rider Levett Bucknall; and Carole Green, Chief Operating Officer — Business for *Construction Innovation*.

- The Audit and Compliance Committee assists the Board in fulfilling its responsibilities relating to accounting and reporting practices; improving the credibility and objectivity of *Construction Innovation's* financial and other reports; and strengthen the systems of internal controls, risk management and compliance with the Centre Agreement, and applicable laws and regulations. Members of the Audit and Compliance Committee are John Oliver, Rider Levett Bucknall (Chair); Rod Wissler, QUT; Dennis Wogan, Queensland Department of Main Roads; and Carole Green, Chief Operating Officer — Business for *Construction Innovation.* The committee met five times during 2006–07.

## 3.1 Governing Board members

The Governing Board met six times in 2006–07 – twice in Sydney, twice in Brisbane, and once each in Melbourne and Canberra. The Board retains responsibility for strategic and policy matters relating to the activities of the Centre and ensures these are carried out in accordance with the provisions of the Commonwealth and Centre Agreements. John McCarthy continues to chair the Board.

### John McCarthy, Chair

John McCarthy is an internationally recognised industry leader. He is a Board member of the CIB – the International Council for Research and Innovation in Building and Construction – and Chair of CIB's Marketing and Communication Committee, Chairman of the Facilities Management Action Agenda Implementation Board and Chair of the International Organising Committee of SBO8 – the world sustainable buildings conference scheduled for Melbourne in September 2008. His other current appointments include Chairman of AEH Property Pty Ltd; Chairman of CentreCare (NSW) Property Committee; and Director of Australian Building Codes Board (ABCB). His previous professional roles have included Chief Executive of ANZ Property Investment and Advisory Services and Chief Executive of Colonial Mutual Properties.

### Noel Faulkner

Noel Faulkner has spent 25 years in management and has extensive experience in change management and organisational restructuring. He has held the position of Chief Executive Officer for many large public and private utilities and is currently the Divisional Manager of the City Business Unit, Brisbane City Council. Noel's division provides architectural, engineering, urban design, traffic and transport engineering as well as environmental and water management services to Council.

### Neil Furlong

Neil Furlong is the Pro Vice-Chancellor (Research and Innovation) at RMIT University (RMIT). Neil has been an active researcher in surface/surfactant chemistry, environmental technologies for the past 28 years in industry, universities and CSIRO in Australia and Europe. Through lead roles in the Royal Australian Chemical Institute (RACI) and the Academy of Technological Sciences and Engineering (ATSE), Neil has been an active contributor to the development of the chemistry profession in Australia.

### David Golightly

David Golightly is one of the John Holland Group's most experienced directors. He joined John Holland Group in 1979 and has held various positions in the specialist pre-contracts and risk management functions, including Construction Estimator, National Estimating Manager and General Manager, Technical Services. David's current position is General Manager, Engineering and Estimating.

### Andrew Johnson

Andrew Johnson is the Associate Director, Research Division (Business Development) at the University of Newcastle. Andrew has worked at a number of universities including Newcastle, the University of New England and the University of Western Sydney. Following an academic career in Criminology, Andrew joined the University of Newcastle in a research development capacity. He is also on the board of NUsport, and the Tom Farrell Institute for the Environment.

### Allen Kearns

Allen Kearns is an environmental scientist with research interests in the ecological consequences of urban and industrial development. He is Deputy Chief of CSIRO Sustainable Ecosystems, based in Canberra, and the Research Leader of CSIRO's Sustainable Cities theme. Prior to joining CSIRO, Allen worked for 13 years in environmental chemistry and applied ecology with the international consulting company, Dames & Moore. He ran consulting practices for the company in Australia, California and France working on a wide range of natural resource management and infrastructure development projects for the mining, energy, chemical, manufacturing and urban sectors.

# GOVERNANCE AND MANAGEMENT

### John Oliver

John Oliver is a Senior Consultant with Rider Levett Bucknall formerly Rider Hunt. He has held an executive role in a professional cost consultancy practice since 1975 and has experience in every major facet of the profession working on small projects through to those with multi-million dollar budgets. John has a hands-on approach, and uses his experience in contractual and cost planning matters to provide risk-averse strategies. John is also Chair of the Research Committee for the CRC for *Construction Innovation*.

### Arun Sharma

Arun Sharma is the Deputy Vice-Chancellor (Research and Commercialisation) at QUT. He was co-founder of National ICT Australia Limited (NICTA) and of the Cooperative Research Centre for Smart Internet Technology. Arun sits on the ICT Sector Advisory Committee of CSIRO, is a member of the Queensland Premier's Smart State Council and the President of the Australia/India Business Council (Queensland Chapter).

### Max Smith

Max Smith is the Deputy Director-General of the Queensland Department of Public Works, accountable for the successful delivery of a Works Program with an annual budget of $3 billion. 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.

### Dennis Wogan

Dennis Wogan is an Executive Director in the Queensland Department of Main Roads with extensive experience in the planning, design, construction and management of Queensland's main road network. In his current role, Dennis is responsible for undertaking special projects in the area of road infrastructure delivery and performance. He is also involved in knowledge transfer and mentoring roles across the Department.

## 3.2 Research Committee members

**Arup**

Richard Hough

**Building Commission**

Peter Nassau

**Australian Building Codes Board**

Brian Ashe (pictured)
Matthew McDonald
Phillip Lord (alternate)

**CSIRO**

Peter Newton (pictured)
(to December 2006)
Greg Foliente
Stephen McFallan (alternate)

**Brisbane City Council**

Dean Morse (pictured)
Mary Shortland
Phillip Lord (alternate)

**Curtin University of Technology**

Peter Davis

John Holland Group

Gerry Shutt

Queensland Department of Public Works

Dale Gilbert

QUT

Robin Drogemuller
(from February 2007
– formerly CSIRO)

The University of Newcastle

Kerry London (pictured)
Tony Williams (alternate)

Queensland Building Services Authority

Jason Smith

Queensland Department of Public Works

Tom Fussell

Rider Levett Bucknall

John Oliver (Chair)

The University of Sydney

Mary Lou Maher (pictured)
Andy Dong (alternate)

Queensland Department of Main Roads

John Spathonis

QUT

Neal Ryan (pictured)
Kerry Brown (alternate)

RMIT

Ron Wakefield

Western Australia Department of Housing and Works

Peter Tilley (pictured)
Greg Fraser

# GOVERNANCE AND MANAGEMENT

*Board member David Golightly talks with Queensland Department of Public Works' Lee Wade at* Construction Innovation's *2006 seasonal cocktail function.*

*At the launch of* Construction Innovation *in Western Australia: (L-R) John McCarthy, Chair,* Construction Innovation*; Hon Michelle Roberts, Minister for Housing and Works; Keith Hampson, CEO,* Construction Innovation.

## 3.3 CEO and headquarters staff

### Senior Management Team

*Construction Innovation* staff coordinate and manage the five program areas: Research, Education and Training, Communication, Commercialisation and Administration.

### Keith Hampson

**Chief Executive Officer**

Keith's career has spanned industry, government, education and research, and he has gained a reputation as an energetic leader with a strong blend of technical and management skills. Reporting directly to the Board, Keith has overall leadership and management responsibility for *Construction Innovation*.

### Carole Green

**Chief Operating Officer, Business; Secretary, *Construction Innovation* Governing Board; Company Secretary, Icon.Net Pty Ltd; and Member, Research Committee**

Carole has an extensive background in commercially-focused industry and university collaborative research. Carole has over 12 years experience in the negotiation of research activities and management of the contractual and financial matters relating to the operation of research programs. Reporting to the CEO, Carole has leadership and managerial responsibilities for overall financial, contractual, reporting, promotional and human resource management for *Construction Innovation*.

### Peter Scuderi

**Chief Operating Officer, Research and Commercialisation, and Secretary, Research Committee**

Peter's career has spanned 30 years in design, program management and industry development in Australia and overseas across the construction and ICT industries. Reporting to the CEO, Peter has leadership and managerial responsibilities for the research, commercialisation and education outcomes for *Construction Innovation*.

Construction Innovation *Senior Management Team: (L–R) Carole Green, Peter Scuderi, Keith Hampson.*

## Headquarters staff

### Colleen Foelz
**Publications and Communication Officer**
Supports *Construction Innovation* activities as a publishing, web content manager and communication specialist.

### Lauren Gubbin
**Administration Officer – Research**
Supports the Chief Operating Officer, Research and Commercialisation in administration of the research programs.

### Shally Ho
**Finance Officer**
Supports the Chief Operating Officer, Business as an accountant and financial reporting specialist.

### Rosie Meaton
**Administration Officer**
Supports *Construction Innovation* activities with communication support, specifically in relation to web management, publishing and general administration duties.

### Lyn Pearson
**Education and Training Officer**
Supports the Chief Operating Officer, Research and Commercialisation as an education and training specialist.

### Margaret Puls
**Media and Communication Officer**
Supports *Construction Innovation* activities as a media and communication specialist.

### Carolyn Ribone
**Administration Officer**
Supports the office by undertaking reception and administration duties.

### Vivienne Sharp
**Administration Officer**
Personal assistant to the CEO and general administrative support.

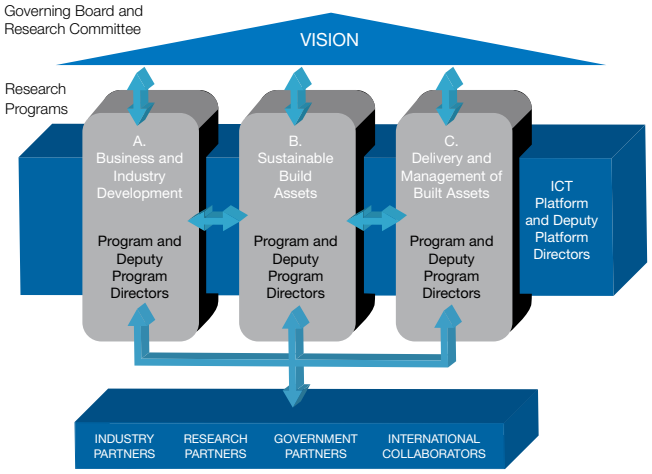
### Brad Warner – Projects
**Administration Officer**
Supports the Chief Operating Officer, Business and the Chief Operating Officer, Research and Commercialisation with research administration duties.

*(L–R – seated) Colleen Foelz, Lyn Pearson, Vivienne Sharp, Margaret Puls (L–R – back) Lauren Gubbin, Carolyn Ribone, Rosie Meaton, Shally Ho, Brad Warner.*

# 4. RESEARCH PROGRAMS

OVER THE PAST 12 MONTHS, *CONSTRUCTION INNOVATION* HAS DELIVERED INTERNATIONALLY RECOGNISED OUTCOMES FOR ITS 21 PARTICIPANTS AND FOR AUSTRALIAN INDUSTRY, HIGHLIGHTING THE VALUABLE ROLE RESEARCH AND DEVELOPMENT PLAYS WITHIN ONE OF AUSTRALIA'S MOST IMPORTANT INDUSTRIES.

*Construction Innovation's* research structure is outlined in the diagram below. The research program has three core programs of research, supported by an advanced Information and Communication Technology (ICT) platform.




This structure incorporates the research goals of its participants – shaped through a process of regular consultation at multiple levels.

Research and industry are represented on the Research Committee, the Board and in project workshops with leadership from industry participants. Each research project requires a minimum of two research and two research-user organisations. Publications and presentations arising from *Construction Innovation* projects often have joint authorship by researchers and research-users.

Our staff and project teams aim to develop and deliver a high quality, industry-led research program. The program remains our core activity.

## 4.1 Research activities and achievements

Four new projects were developed in 2006–07 and 25 projects were active during the reporting period.

Delivering outcomes of our research to industry by means of training programs, eLearning, workshops, seminars and the dissemination of high quality publications remained a key focus of activity.

Our staff and project teams presented their work at a number of conferences in Australia and overseas, in addition to publication of outcomes in leading industry and academic publications.

As detailed in Appendix 1, *Construction Innovation* staff and researchers delivered:

- 33 book and journal articles
- 24 refereed conference papers/presentations
- 16 industry and academic presentations
- 3 submissions to government inquiries.

Under the leadership of *Construction Innovation*, Australia is leading the world in the development of internationally recognised Building Information Models (BIM) and FM techniques.

A two-year exemplar project developed from Australian Government's Facilities Management Action Agenda to deliver an integrated solution for Australia's FM sector was completed and the findings comprehensively disseminated to industry nationally and internationally. The Sydney Opera House FM Exemplar Project demonstrated an integrated FM solution promoting best practice and the case for FM as a business enabler. Importantly, this exemplar project was underpinned by the use of advanced digital modelling technology that provides a single, consistent and up-to-date view of all aspects of a building. We believe that these capabilities will increasingly be mandated by major clients internationally.

This research achieved widespread industry recognition and won the 2007 Facility Management Association of Australia – Rider Hunt Terotech Industry Achievement Award for advancing facility management strategy and practice. The BIM component of the project also featured in two recent international awards – the Jury's Choice category of the American Institute of Architects Technology in Architectural Practice 2007 awards, and the Bentley Awards for Excellence 2007 award for BIM in multiple disciplines.

*Construction Innovation* collaborates closely with the Australian Construction Industry Forum (ACIF) and its member organisations, and is an active member of the Australian Sustainable Built Environment Council (ASBEC), the Housing Industry Association (HIA) and the Urban Development Institute of Australia (UDIA).

Strong international collaborations were further developed with CIB – a global network for international exchange and cooperation in research and innovation in building and construction – and buildingSMART International Alliance for Interoperability (IAI), the organisation which established the IFC international open standard for object technology in construction and facilities management.

Another initiative undertaken to strengthen our industry engagement and broaden our reach, has been the establishment of Industry

Taskforces to provide strategic input into key research projects from organisations both within and external to our participant base (see further details in Section 4.2). This approach has proved highly effective with the Safer Construction and Your Building projects and has been expanded into our extension program, where an Industry Taskforce provides guidance and input into the newly established Dispute Avoidance and Resolution project. This approach also increases pathways for adoption of research outcomes for industry.

Our researchers and staff actively contributed to policy development through submissions to government inquiries on business regulation, sustainability and infrastructure development. We welcomed further collaboration with key government agencies, such as the Office of the Federal Safety Commissioner (OFSC) who have participated in several worksite safety projects and provided additional funding for the Construction Safety Competency Framework Implementation project and the Australian Greenhouse Office (AGO) through the Your Building sustainable commercial building web portal project. The Your Building project was undertaken through the provision of a $750,000 grant from the Department of the Environment and Water Resources to develop a business and technical web portal for sustainable commercial buildings.

Our industry-focused collaborative research has been recognised by winning four prominent industry association awards, as noted in the Executive Summary.

*Dean Cipolla (right), John Holland Group Safety Manager with Don Dingsdag of the University of Western Sydney – receiving the Victorian Chapter of the Australian Institute of Building's (AIB) Professional Excellence in Building for the Construction Site Safety Culture project in June 2007.*

## 4.2 Research collaborations

### Development of two-year extension program

*Construction Innovation's* two-year extension program, which commenced on 1 July 2007, was developed following extensive stakeholder engagement by consultation with CEOs and senior management of industry, government and research organisations and through a series of workshops held in Sydney, Melbourne, Brisbane and Perth.


*Federal Safety Commissioner Tom Fisher at the launch of the* Construction Safety Competency Framework *in September 2006. The OFSC has partnered with* Construction Innovation *in a number of safety initiatives.*

Input from these discussions was considered in the context of current and previous industry needs-analyses, including the Building and Construction Industries Action Agenda (1999); the Facility Management Action Agenda (2004); and current work forming part of the Built Environment Design Professions Action Agenda (due to be published in 2008).

The extension program enables *Construction Innovation* to strengthen its engagement with its broader participant network and develop and deliver outcomes in the areas of digital modelling, safety and dispute resolution.

### Industry Taskforces

Industry Taskforces have been established to provide senior strategic input into key research projects from organisations both within, and external to, our participant base. This approach has proved highly effective with the Safer Construction project, chaired by Engineers Australia Taskforce for Construction Safety Chair and Leighton Holdings Chief Operating Officer, Bill Wild. The project delivered an industry-wide *Guide to best practice for safer construction*.
The Taskforce consists of key representatives from:

- Engineers Australia (EA)
- Australian Constructors Association (ACA)
- Property Council of Australia (PCA)
- Royal Australian Institute of Architects (RAIA)
- Association of Consulting Engineers Australia (ACEA)
- Australian Procurement and Construction Council (APCC)
- Master Builders Australia
- Office of the Federal Safety Commissioner (OFSC)
- National Committee for Construction Engineering
- John Holland Group
- *Construction Innovation.*

Delivered in collaboration with Engineers Australia, Safer Construction brings together the peak national associations for clients, designers and constructors in the development and dissemination of this ground-breaking guide. In doing so, the project reinforces the unique position *Construction Innovation* occupies in its ability to provide national, independent industry R&D leadership.

# RESEARCH PROGRAMS

The success of industry-wide collaboration in the Safer Construction project has resulted in the Australian Institute of Building reviewing and endorsing outcomes from the project.

A similar approach was adopted for the Your Building project, which involved development of an industry-wide web portal for sustainable commercial buildings. This was undertaken in collaboration with the AGO and ASBEC representatives. The Your Building Industry Taskforce comprised representatives from *Construction Innovation*, AGO, ASBEC, RAIA, ACEA, PCA, Szencorp and Building Products Innovation Council.

Our new Dispute Avoidance and Resolution project also operates with a senior-level strategic Industry Taskforce consisting of the former Royal Commissioner into the Building and Construction Industry and representatives from the Civil Contractors Federation, Queensland Department of Main Roads, Built Environment Design Professionals, Australian Constructors Association, and the Australian Procurement and Construction Council.


*The development of the Your Building portal content and web platform was informed by intensive industry consultation, and guided by an Industry Taskforce. The content was reviewed by specialist researchers and industry practitioners.*

## Sponsorship received

Your Building is a collaborative project of *Construction Innovation*, the Department of the Environment and Water Resources and ASBEC. The Your Building web portal is Australia's key online resource about sustainable commercial buildings. It provides information for all those involved across the building life cycle – from investors, owners and occupiers, to developers, builders, designers and facility managers. Industry sponsorship for the Your Building website was received from Connell Wagner, Bluescope Steel, Fletcher Insulation, Leighton Contractors, Building Commission (Victoria), Arup, Stockland, Architectus, Szencorp and Boral. These sponsors have strengthened *Construction Innovation's* industry partnerships and facilitated a pathway to adoption of key project outcomes.

## Submissions to government inquiries

- Performance Benchmarking of Australian Business Regulation (Productivity Commission)
  *Construction Innovation's* Construction Industry Business Environment (CIBE) project prepared a submission to the Productivity Commission, in their study on the performance benchmarking of Australian Business Regulation. On the basis of this submission, *Construction Innovation* was invited to attend a closed round table discussion on benchmarking the regulatory environment. *Construction Innovation* was the only research organisation invited to attend. The work of the CIBE project and *Construction Innovation* has been noted in the final published report *(Performance Benchmarking of Australian Business Regulation Productivity Commission Research Report, 19 February 2007).*

- Submission to the Draft Brisbane Economic Development Plan (Brisbane City Council)
  Elements of *Construction Innovation's* submission have been incorporated into the final Brisbane Economic Development Plan — particularly in relation to infrastructure development. Most of these inclusions are verbatim. These inclusions focused on construction industry skills development, and the likely impact of continued population growth on transport infrastructure in Brisbane and surrounding loal government areas.

- Inquiry into a Sustainability Charter (House of Representatives Standing Committee on Environment and Heritage)
  Based on this submission, *Construction Innovation* was subsequently invited to address the Standing Committee as part of a select round table discussion in October 2006 on the Sustainability Charter. *Construction Innovation* nominated leaders from ASBEC – an organisation which *Construction Innovation* worked to establish. ASBEC has subsequently met with the Minister for the Environment and Water Resources in relation to the submission.

## Research symposiums

Two research symposiums were held in Perth and Sydney in 2006–07. The research symposiums *Construction Innovation* continue to provide a conduit for disseminating research outcomes to industry and developing engagement with Small to Medium Enterprises (SME).

The Perth symposium, held at Engineers Australia in February 2007, focused on seven research projects and featured industry and academic presenters.

The Sydney research symposium held in June 2007 featured an overview of current worksite safety research and the benefits of innovation. The research symposiums were very well received, with over 150 people attending. Further research symposiums are planned for other cities.

## International collaborations

Our international industry and research collaboration has achieved significant recognition. *Construction Innovation's* Chair, Mr John McCarthy, sits on the Board of CIB, a global network for international exchange and cooperation in research and innovation in building and construction.

Mr McCarthy was appointed Chair of the CIB Marketing and Communication Committee at the Triennial CIB World Building Congress held in Capetown in May 2006.

CEO Keith Hampson leads the international *CIB Innovation in Construction* Task Group.

*Construction Innovation* staff and researchers presented the following refereed papers at the CIB Congress:

- *Effective Financial Incentive Mechanisms: An Australian Case Study;* Rose, T., Manley, K.
- *An Integrated Approach to the Relife of Office Buildings;* Yang, J., Lim, S.
- *Role of Cultural Capital towards the Development of a Sustainable Business Model for Design Firm Internationalisation;* London, K., Chen, J.
- *Uptake of OHS Code of Practice by Australian Construction Firms;* Charles, M.B Furneaux, C., Pillay, J., Thorpe, D., Castillo, CP., Brown, K.
- *Mapping the Australian Regulatory Environment: Implications for Construction Firms;* Furneaux, C., Brown, K., Hampson, K.
- *Managing Building Projects through Enhanced Communication: An ICT Based Strategy for Small and Medium Enterprises*, Yang, J., Ahuja, V., Shankar, R. and;
- *Strategies for Minimising the Whole of Life Cycle Cost of Reinforced Concrete Bridge Exposed to Aggressive Environments;* Humphreys, M., Setunge, S., Fenwick, J., Alwi, S.

*At the launch of the* Guide to Best Practice for Safer Construction *– a research project outcome guided by a high level industry steering committee – were (L–R) John McCarthy, Chair,* Construction Innovation*; the Hon Joe Hockey, Federal Employment and Workplace Relations Minister, Keith Hampson, CEO,* Construction Innovation*; Bill Wild, CEO, Leighton Holdings (and Chair of the Engineers Australia Taskforce for Construction Safety).*

CEO Keith Hampson was invited to participate in an International Review Panel of PSIBouw (Process and System Innovation in Building and Construction) in The Netherlands, which promotes the CRC model of industry-research collaboration to deliver industry and national benefit.

*Construction Innovation* also strengthened its collaboration with buildingSMART International Alliance (IAI) for Interoperability, the organisation which established the international open standard IFC for object-based software in construction and facilities management.

*Construction Innovation's* Chief Operating Officer, Research and Commercialisation, Peter Scuderi, is a member of the IAI International Council and attended IAI International Council meetings in London, where he showcased the significant research outcomes of *Construction Innovation's* Sydney Opera House FM Project.

*Project Leader John Tsoukas (right) and Daniyal Mian of Arup with the 2006 Professional Excellence award for Research and Development for* Construction Innovation's *Project Diagnostics at the AIB National Awards in September 2006.*

# PROGRAM A: BUSINESS AND INDUSTRY DEVELOPMENT

## 4.3 Research projects

**PURPOSE:** TO IMPROVE THE LONG-TERM EFFECTIVENESS, COMPETITIVENESS AND DYNAMICS OF A VIABLE PROPERTY, DESIGN, CONSTRUCTION AND FM INDUSTRY IN AUSTRALIAN AND INTERNATIONAL CONTEXTS THROUGH:

- GREATER INNOVATION IN BUSINESS PRACTICE
- MORE EFFECTIVE INTERACTIONS BETWEEN INDUSTRY AND CLIENTS
- STRENGTHENED HUMAN RELATIONS AND ETHICAL PRACTICES.

### Building Research Innovation Technology and Environment (BRITE)

Research project 2004-021-A

Project duration: 1 January 2006–31 December 2007
Project leader: Karen Manley, QUT
Project members: **Arup:** Richard Hough
**CSIRO:** Stephen McFallan
**Queensland Department of Main Roads:** Michael Swainston, Sam Fernando
**Queensland Department of Public Works:** Dale Gilbert, Wendy May-Taylor, Julia Willis
**QUT:** Mary Hardie, Stephen Kajewski, Linden Spindler

*Karen Manley*

The BRITE project has improved industry awareness of innovation and the capability of firms to innovate, particularly small firms, which generate two-thirds of value added and three-quarters of employment. An external review of BRITE's impact conducted in 2006 showed that 65% of respondents felt that *Construction Innovation's* BRITE case studies have had a positive impact on overall industry attitudes to innovation, while 90% of respondents felt innovation adoption rates would increase over time because of the BRITE demonstration series. In 2006–07, Phase Two of the BRITE project developed a national database of innovative contractors with the purpose of identifying best practice innovation strategies and share these with smaller contractors. An industry report, *Being the Best*, was also produced investigating the way highly innovative contractors sustain their market leadership. Available free of charge online, 1024 copies of *Being the Best* have been distributed, with the assistance of state government departments, to pre-qualified contractors in the building and infrastructure industries throughout Australia. Another 200 copies have been distributed through BRITE project participants and to policy and contracting participants in the Queensland Department of Public Works and Queensland Department of Main Roads.

### Supply Chain Sustainability

Research project 2004-016-A

Project duration: 1 July 2005–30 June 2007
Project leader: Kerry London, The University of Newcastle
Project members: **Brisbane City Council:** Harry Copeland
**Queensland Department of Main Roads:** John Spathonis, Alan Carse
**Queensland Department of Public Works:** Don Allan, Wendy May-Taylor
**QUT:** Steve Rowlinson
**Rider Levett Bucknall:** Stuart Rayner
**The University of Newcastle:** John Burgess, Amir Mahmood

*Kerry London*

Construction sector policy makers have the opportunity to create improvements and develop economic, social and environmental sustainability through supply chain economics. This project examines supply chain economic policy implementation by two government agencies – Queensland Department of Main Roads and Queensland Department of Public Works. The project also seeks to address Brisbane City Council's strategic objective of increased recycled materials content from expansion of the construction and demolition waste sector. The project informs strategic policy development and offers long term benefits of stabilisation of employment levels, reduction in high staff turnover and flow on improvements in skill levels and OHS. Other benefits will include improved product quality and reduction in remedial work and wasted government resources to monitor a poor performing sector.

## Construction Industry Business Environment (CIBE)

Research project 2004-032-A

Project duration: 1 July 2005–31 December 2007
Project leader: Kerry Brown, QUT
Project members: **Brisbane City Council:** Neil Abel, Paul Champtaloup, Mike Hortz
**CSIRO:** Stephen McFallan
**John Holland Group:** Gerry Shutt
**Queensland Building Services Authority:** Jason Smith, Cameron Murphy
**Queensland Department of Main Roads:** Michael Swainston
**Queensland Department of Public Works:** Sheena McConville, Dayv Carter
**QUT:** Craig Furneaux, Norm Katter, Paula McDonald, Ishara Ratnayaka, Nik Vassilev, Sandra Janssen, Nina Yousefpour
**The University of Newcastle:** John Burgess, Kerry London, Guillherme Pires

*Kerry Brown*

The CIBE project undertakes a comparative analysis of the context and content of regulations and policies affecting the construction industry in Australia. This includes themed case studies in the areas of eBusiness, OHS, BIM, procurement, sustainability and contractual disputes. These case studies are used to explore the regulatory relationships between jurisdictions and identify barriers and enablers for coherent policy-making and productivity gains.

CIBE researchers have made successful submissions to the Productivity Commission and to the House of Representatives Standing Committee on Environment and Heritage (Standing Committee) inquiry into sustainable cities.

## Modelling Construction Business Performance

Research project 2005-017-A

Project duration: 10 February 2006–31 December 2007
Project leader: Natalie Gallery, QUT
Project members: **Building Commission (Victoria):** Roger Frith, Marcelle West
**Curtin University of Technology:** Peter Davis, Peter Galvin
**Queensland Building Services Authority:** Bob Johnson, Shelley Lockton, Cameron Murphy, Dale Rylko, Jason Smith
**Queensland Department of Public Works:** Dayv Carter, Steve Fredericks
**QUT:** Michael Falta, Neal Ryan, Steve Su, Roger Willett, Andrew Colin, Terena Burrows
**The University of Sydney:** Robert Czernkowski, Stewart Jones
**Western Australian Department of Housing and Works:** Marleen Voortman

*Natalie Gallery*

This project seeks to develop a software prototype that will provide early warning signals which can be used to predict the financial performance of construction firms. By using existing financial and non-financial data, this software will develop a series of measures to promote business health in the construction industry. At present, such software does not exist. A system that highlights early indicators of potential business distress will enable government authorities charged with the responsibility of monitoring business activity in the construction industry to interact with these firms to ensure satisfactory industry outcomes. These outcomes will have a flow-on effect in terms of safeguarding the business health of construction firms and minimising unanticipated delays and expenses.

# PROGRAM A: BUSINESS AND INDUSTRY DEVELOPMENT

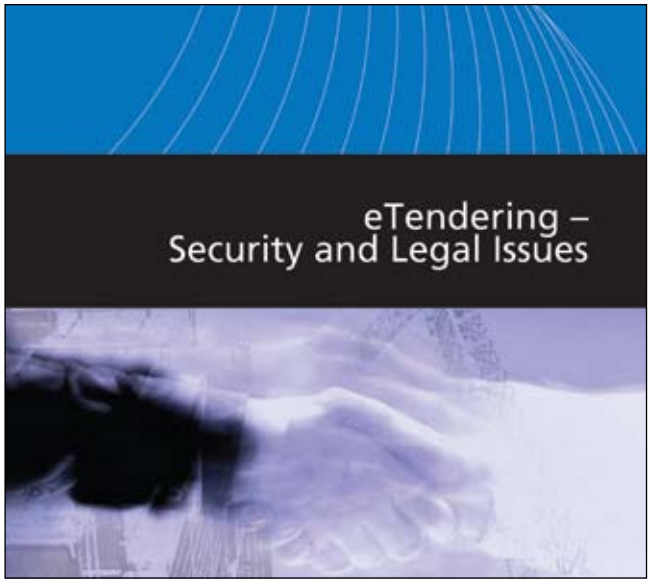
## Electronic Contract Administration – Legal and Security Issues

Research project 2005-025-A

Project duration: 1 December 2005–31 May 2007
Project leader: Sharon Christensen, QUT
Project members: **Brisbane City Council:** Neil Abel
**John Holland Group:** Geoff Gannon, Gerry Shutt
**Queensland Department of Main Roads:** Ross Guppy
**Queensland Department of Public Works:** Dayv Carter, Michael Austin, Pat O'Brien
**QUT:** Martin Betts, Edward Dawson, Bill Duncan, Ernest Foo, Praveen Gauravaram, Audun Josang, Debbie Smit
**The University of Newcastle:** Kerry London

*Sharon Christensen*

The project identifies security and legal risks that result from the adoption of ICT in the building and infrastructure industry for eContracting purposes, and makes recommendations to avoid or minimise the risks. The project builds upon outcomes of *Construction Innovation's* eBusiness – Security and Legal Issues project which identified a range of legal and security issues that may be encountered in electronic tendering in the building and infrastructure industry. A proposed eContracting architecture that addresses the identified security risks has been developed in this project, which incorporates security and functional features to minimise the impact of security risks resulting from the formation, administration and recording of construction contracts in an electronic environment.




Construction Innovation's eTendering – Security and Legal Issues *publication.*

## Construction Site Safety Culture

Research project 2003-050-A

Project duration: 31 March 2005–30 September 2006
Project leader: Dean Cipolla, John Holland Group
Project members: **Bovis Lend Lease:** Tom McFadyen, Linda Sokolich, Danny Potocki
**QUT:** Herbert Biggs
**University of Western Sydney:** Don Dingsdag, Vaughn Sheahan

External participant:
**Office of the Federal Safety Commissioner:** Wayne Artuso, Valerie O'Keefe

*Dean Cipolla*

This project has achieved significant industry recognition for providing a framework for improving safety on Australian construction sites. The framework aims to bring about a long-term cultural and behavioural change in the building and construction industry to improve occupational health and safety (OHS) practices. Designed for use by safety managers, senior managers and executives, this project has delivered a guide to create a positive safety culture by ensuring key staff such as project managers, supervisors, OHS advisors and engineers are aware of and can effectively execute tasks needed to better manage OHS. The framework was launched in September 2006 by the Hon Kevin Andrews, the Minister for Workplace Relations. National workshops to disseminate the project findings to industry attracted hundreds of industry attendees. This project won the Victorian Chapter of the Australian Institute of Building's Professional Excellence in Building Award in June 2007.


*At the launch of the Construction Site Safety Culture project. (L-R): Keith Hampson, CEO,* Construction Innovation*; Lindsay Fraser, Assistant National Security, CFMEU; and Bill Wild, Chief Operating Officer, Leighton Holdings Ltd.*

## Safer Construction

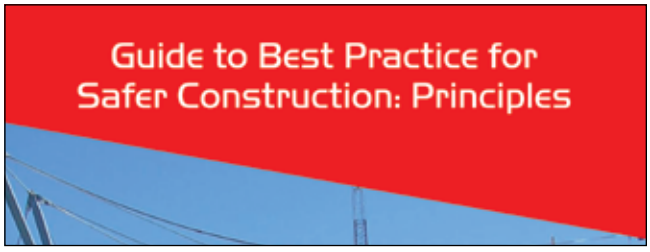
Research project 2005-027-A

Project duration: 1 February 2006–12 September 2007
Project leader: Tim Fleming, John Holland Group
Project members: John Holland Group: Bradd Hamersley
Bovis Lend Lease: Tom McFadyen
Curtin University of Technology: Anne Francis, Verena Marshall, Kerry Pedigo, David Baccarini
QUT: Kerry Brown, Michael Charles, Janet Pillay, Neal Ryan, Paul Barnes, Juanita Grillmeier, Lynette Sperling, Clinton Reid, Cinthya Paredes Castillo
RMIT: Nick Blismas, Helen Lingard, Ron Wakefield, Tracy Cooke, Richard Bird, Stawomir Marcinski, Timothy French
Western Australian Department of Housing and Works: Greg Fraser

Engineers Australia Taskforce for Construction Safety:
Leighton Holdings: Bill Wild – Chair
Association of Consulting Engineers Australia: Paul Dougas
Australian Procurement and Construction Council: Jane Montgomery-Hribar
Bovis Lend Lease: Murray Coleman
John Holland Group: Tim Fleming, Stephen Sasse
Engineers Australia: Peter Godfrey
Master Builders Association: Richard Calver
Property Council of Australia: Peter Verwer
Royal Australian Institute of Architects: Bill Barlow

*Tim Fleming*

The Safer Construction project soughts to reduce construction workplace deaths and injuries by creating a *Guide to Best Practice for Safer Construction* to integrate OHS. Safer Construction is a collaboration between Engineers Australia and *Construction Innovation*. The project examined OHS practices at the design, procurement, construction and commissioning stages of built assets. The project brings together stakeholders across the supply chain of the project — ensuring a whole-of-industry solution – and has undergone an extensive industry consultation process. The guide has developed safety principles and practices for key stakeholders that influence safety in the Australian construction industry, complemented by a series of best-practice case studies.




## Multi-Outcome Construction Policies

Research project 2006-036-A

Project duration: 1 October 2006–31 December 2007
Project leader: Siobhan Austen, Curtin University of Technology
Project members: Curtin University of Technology: Richard Seymour
Rider Levett Bucknall: John Oliver, David Stewart, Robert Lopez
Queensland Department of Public Works: Dan Wallace, Keith Eaton
QUT: Kerry Brown, Gerry Gallery, Craig Furneaux, Angela McCabe
Western Australian Department of Housing and Works: Greg Fraser, Peter Tilley

*Siobhan Austen*

This project aims to evaluate the impact of the current policy of leveraging social outcomes from the procurement of public works. Specifically, this research project will seek to answer the following research questions: what are the current socio-economic policies 'leveraged' within procurement policies; what is the policy intent embedded in 'leveraging' contracts to achieve these social policies; and what are the costs and benefits associated with this 'leveraging' (financial and non-financial), and who is paying and who is benefiting. The project aims to develop a mechanism for assessing future proposals for the inclusion of social policies in construction projects. The project will also establish a framework for understanding the role, significance and potential costs and benefits of leveraged social outcomes in construction projects. The results of the Western Australian-based quantitative investigation have already provided useful insights into the Western Australian Department of Housing and Work's tendering environment and will inform the Western Australian Government's Department of Treasury and Finance as they develop future procurement strategies.

*Swan Bell Tower, Perth. © Peter Brandon.*

# PROGRAM A: BUSINESS AND INDUSTRY DEVELOPMENT

## Managing Knowledge in an Outsourcing Environment

Research project 2006-039-A

Project duration: 1 January 2007–31 December 2007
Project leader: Peter Galvin, Curtin University of Technology
Project members: **Curtin University of Technology:** Peter Davis, David Baccarini, Janet Sutherland
**QUT:** Stephane Tywoniak
**Queensland Department of Main Roads:** John Spathonis
**Western Australian Department of Housing and Works:** Greg Fraser, Peter Tilley, Karyn Ash
**Western Australian Department of Main Roads:** John Taya, Serena Buckley, John Robertson

*Peter Galvin*

The dual pressures of experienced staff (often baby-boomers) leaving organisations and a trend for government agencies to contract out numerous activities has created a need to better understand the way in which organisations manage knowledge effectively when contracting-out services that rely upon knowledge not held internally. This project seeks to develop a checklist system that will enable managers to identify possible knowledge management issues from external contracts. It will provide a better understanding of how to manage external contracts in a more effective manner, especially when these contracts build upon knowledge that does not reside locally within the organisation. By mapping the knowledge boundaries of government agencies, along with the knowledge requirements for different contracts and studying the way in which they interface with the agency, it will be possible to develop a series of criteria that highlight the different knowledge management requirements and systems for a range of contracts. This will provide government agencies with a useful tool that allows them to ensure appropriate knowledge management systems, structures and processes are in place for the effective management of external contracts.

*Image © 2007 Shutterstock.*

Table 2: Program A research outputs and/or milestones

| Output/milestone number | Description | Contracted achievement date | Achieved (Yes or No) | Reasons why not achieved (if applicable) | Strategies to achieve unmet milestones |
|---|---|---|---|---|---|
| Outcome 4 | Innovation | December 2006 | Yes | | |
| Outcome 5 | Organisational capability | December 2006 | Yes | | |

# PROGRAM B: SUSTAINABLE BUILT ASSETS

**PURPOSE:** TO DRIVE HEALTHY AND SUSTAINABLE CONSTRUCTED ASSETS AND OPTIMISE THE ENVIRONMENTAL IMPACT OF BUILT FACILITIES THROUGH:

- A SOUND CONCEPTUAL BASIS FOR ECONOMIC, SOCIAL AND ENVIRONMENTAL ACCOUNTING OF THE BUILT ENVIRONMENT
- VIRTUAL BUILDING TECHNOLOGY TO EXAMINE DESIGN PERFORMANCE PRIOR TO DOCUMENTATION, CONSTRUCTION AND USE
- ASSESSMENT OF HUMAN HEALTH AND PRODUCTIVITY BENEFITS OF SMART INDOOR ENVIRONMENTS.

## Sustainable Subdivisions — Ventilation

Research project 2002-077-B

Project duration: 1 October 2005–30 September 2007
Project leader: Anne Miller/Angelo Delsante, CSIRO
Project members: **Bovis Lend Lease:** Daniel Grunbaum, Guy Gibson
**Brisbane City Council:** Medha Gokhale, Nelson Ross
**CSIRO:** Michael Ambrose, Fanny Boulaire, Angelo Delsante, Robin Drogemuller, David Paterson, Loretta Kivlighon
**Queensland Department of Public Works:** Michael Ball, Ron Apelt
**QUT:** Nur Demirbilek, Rosie Kennedy, Robin Drogemuller, Danny O'Hare, Glenn Thomas

*Anne Miller*

This research sought to determine the relationship between data recorded by Bureau of Meteorology monitoring stations and a variety of dwelling types through monitoring of wind conditions in south-east Queensland. The research will verify and quantify the role natural ventilation has in cooling residences in sub-tropical climates, inform the development of a lot-rating methodology for South-East Queensland and may also make a recommendation that the existing lot-rating methodology in use in other parts of Australia, be modified to allow for the impact of natural ventilation. The research is also expected to highlight the fundamental importance of good subdivision and dwelling design and will also inform the ongoing development of rating tools. Urban designers and greenfield land developers will be able to use the recommendations to design more environmentally sustainable subdivisions.

## Learning System for Life Prediction of Infrastructure

Research project 2005-003-B

Project duration: 1 October 2005–31 August 2007
Project leader: Penny Corrigan, CSIRO
Project members: **CSIRO:** Angela Bradbury, Ivan Cole, Robin Drogemuller, Stephen Egan, Wayne Ganther, Tim Muster, David Paterson, Gerardo Trinidad, Wan Yee Chan, Natalie Sherman, Ronald Brown, Andrew Martin
**Queensland Building Services Authority:** Peter Hope
**Queensland Department of Main Roads:** Wayne Muller
**Queensland Department of Public Works:** Michael Ball
**QUT:** Richi Nyak, Yue Xu, Yuefeng Li, Robin Drogemuller

*Penny Corrigan*

This project further develops software tools created in previous prediction of metallic components projects to widen their applicability and usefulness. The project has illustrated the potential of linking maintenance data to other sources of life prediction for use in design and maintenance in the Queensland Government Departments of Public Works and Main Roads. It is estimated that the Queensland Government spent $5 million in replacing corroding metal components in 2004–05. A fully implemented life prediction program would assist in reducing these costs. The Queensland Department of Public Works application will be extended to include up to ten metal façade components. The maintenance costs will be used as a guideline to evaluate life-cycle costs. The bridge application will be extended to include additional bridge structures, as well as incorporating the effects of height above water level and natural wash-off on the salt deposition levels.

# PROGRAM B: SUSTAINABLE BUILT ASSETS

## Your Building

Research project 2005-015-B

Project duration: 1 July 2005–31 August 2007
Project leader: Tony Stapledon, CSIRO
Project members: **CSIRO:** Peter Boxhall, Robin Drogemuller, Greg Foliente, Murray Hall, Melissa James, Peter Newton, Michael Syme, Emily Yip
Industry Taskforce
*Construction Innovation* (CSIRO): Peter Newton – Chair
*Construction Innovation*: Tony Stapledon – Project Leader
**Association of Consulting Engineers Australia:** John Ridgway
**Australian Greenhouse Office:** Tony Marker, Stephen Berry
**Building Products Innovation Council:** Tony McDonald
**Australian Sustainable Built Environment Council and Royal Australian Institute of Architects:** Caroline Pidcock
**Property Council of Australia:** Peter Verwer, Paul Waterhouse
**Szencorp:** Peter Szental, Mark Lister

*Tony Stapledon*

In Australia, commercial buildings produce 10% of national greenhouse emissions and therefore have a major part to play in meeting greenhouse targets. Commercial buildings also influence social and business outcomes. They are an investment and a cost, can express an organisation's identity and image, contribute to reputation and profitability, affect occupant health, and shape – and be shaped by – behaviour. The key outcome from this project is the Your Building web portal – a central online Australian resource about sustainable commercial buildings. Your Building provides information for all those involved across the building life cycle – from investors, owners, and occupiers to developers, designers, builders and facility managers.

*50 Lonsdale St Melbourne features solar panels for tempered hot water for showers. © Erica Lauthier, courtesy DEWR.*

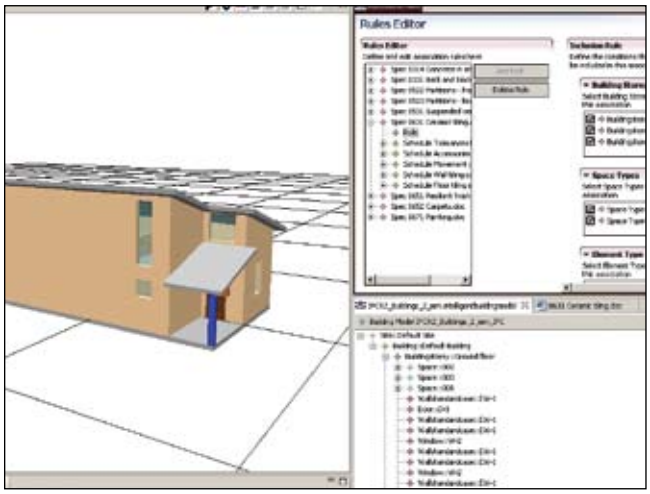
## SpecNotes and Viewer Extension

Research project 2004-014-B

Project duration: 1 July 2005–28 February 2007
Project leader: Stephen Egan, CSIRO
Project members: **Brisbane City Council:** Joyce Law
**CSIRO:** Robin Drogemuller, Kevin McDonald, Cheryl McNamara, Nigel Goodman
**Queensland Department of Public Works:** Thomas Fussell, Lee Wade
**Rider Levett Bucknall:** Jeanette Clough, John Oliver
**Woods Bagot:** David Marchant

*Stephen Egan*

This project developed two software prototypes – DesignView and DesignSpec. DesignView was developed as a "next generation" viewer which will act as the core of future versions of the *Construction Innovation* software deliverables, including LCADesign and Automatic Estimator. DesignView provides the ability to view interoperable IFC files. DesignSpec is a "plug-in" for DesignView that integrates specifications with the building model to provide data linkages. The DesignSpec software reads a specification document and identifies missing pieces of information within the specification document. DesignSpec also allows the user to add information in the project specification and allows the user to add links between specification clauses and building scope definitions. For example, a user can state that a particular type of floor tiling referenced from a specific clause be used on wet areas on certain floors of a building. DesignSpec adds the geometrical representations of finishes to the building model so that the results of the specification can be visualised.




*DesignSpec "association" perspective defines relationships between a specifications document and building model.*

## Microclimatic Impacts on the Built Environment

Research project 2004-003-B

Project duration: 1 February 2005–31 October 2006
Project leader: Judy Kraatz, Brisbane City Council
Project members: **Brisbane City Council:** Heidi Astin, Medha Gokhale, Nelson Ross
**CSIRO:** Fanny Boulaire, Angelo Delsante, Robin Drogemuller, Melissa James, Anne Miller, Steven Moller, David Paterson, Gerardo Trinidad
**Queensland Department of Public Works:** Ron Apelt, Dale Gilbert
**QUT:** Ian Cowling, Steve Coyne, Adrian Cupitt, Nur Demirbilek, John Hayes, Ross Hayward, Rosie Kennedy, Anthony Nguyen, Zinmar Thein, Jinglan Zhang

*Judy Kraatz*

This project developed a proof of concept showing it is possible to quantify and model the potential microclimatic influences and impacts of a building, within a precinct of buildings, through interrogation of a 3D CAD model linked to locally-collected climate data. This enables planners/developers/designers to model this interaction at a conceptual level — and in the future could provide Local Authorities Australia-wide with a tool to rapidly quantify impacts of building designs within a precinct or region of buildings. Presently, there are individual tools available for the assessment of shading, thermal, radiation and wind flow characteristics of a proposed design which require assessment by expert users.

*Image © 2007 Aaron Puls.*

## Regenerating Construction to Enhance Sustainability

Research project 2003-028-B

Project duration: 1 January 2005–15 December 2007
Project leader: Peter Newton (until December 2006) and Phillip Paevere, CSIRO
Project members: **Arup:** Ken Stickland, Karen Hovenga, PC Thomas
**Brisbane City Council:** Ken Moschner
**CSIRO:** Michael Ambrose, Steven Brown, Robin Drogemuller, Melissa James, John Mahoney, Phillip Paevere, Selwyn Tucker
**Queensland Department of Public Works:** Dale Gilbert, Del Jones
**QUT:** Philip Crowther, Robin Drogemuller
**University of Western Sydney:** Mary Hardie, Shahed Khan, Graham Miller

*Peter Newton*

This project assists in the delivery of demonstrably superior green buildings in respect of eco-efficient re-design: achieving a smaller ecological footprint, enhanced indoor environment quality and performance, reflected in improved health, wellbeing and productivity of building occupants and waste minimisation (through re-design for dis-assembly). Much of the work in this project has been provided as content for the Your Building sustainable commercial buildings web portal and is available to industry online. The project is currently undertaking post-occupancy surveys and productivity improvement surveys to gauge the impact of indoor air quality on productivity. Two indoor environment assessments have been undertaken in Council House 1 and Council House 2 in Melbourne in summer and winter, and a study of occupant health wellbeing and productivity is underway.

*Queensland Gallery of Modern Art (GoMA). The new Gallery comprises an urban pavilion that responds through its form, materials and disposition to its location, climate, site and use. © Queensland Government.*

# PROGRAM B: SUSTAINABLE BUILT ASSETS

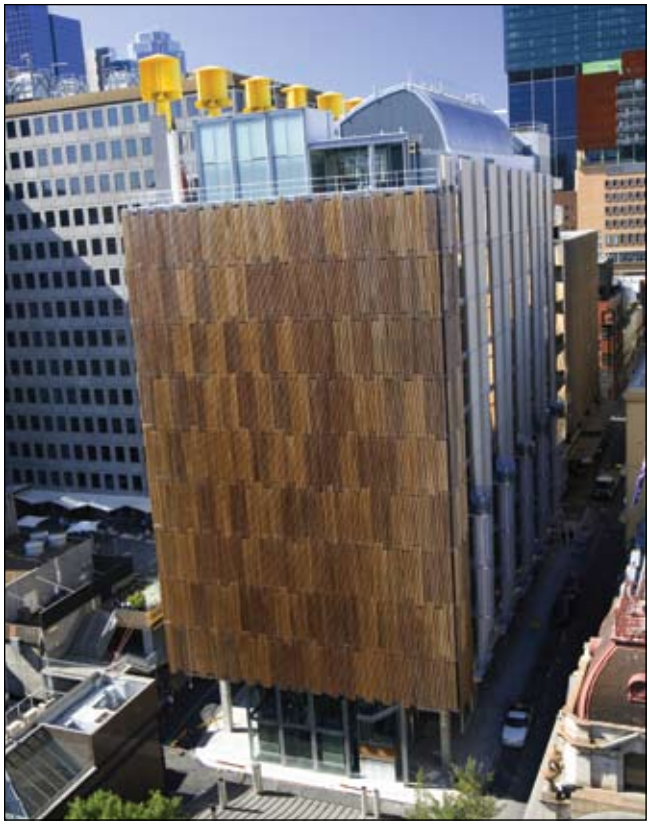
**Indoor Air Quality Estimator**

Research project 2004-033-B

Project duration: 1 February 2006–31 May 2007
Project leader: Selwyn Tucker, CSIRO
Project members: **Brisbane City Council:** Medha Gokhale, Dean Morse
**CSIRO:** Steven Brown, David Johnson, Antony Mikulic, Stephen Egan, Angela Williams
**Queensland Department of Public Works:** Dale Gilbert, Alan Sharp
**QUT:** Lidia Morawska, Hai Guo
**Woods Bagot:** David Marchant, Trudy-Ann King, John Flynn

*Selwyn Tucker*

This project has developed a prototype software tool for estimating indoor air quality in commercial buildings by combining existing indoor air quality measurement, product emission and ventilation/filtration knowledge into a practical model for estimating the indoor air quality of indoor spaces over time. The potential implementations of the model include both a stand alone tool or as a commercial extension module attached to a 3D CAD evaluation package such as LCADesign. This approach will integrate three aspects of buildings affecting indoor quality: emissions from fixed large surface products, including furniture; operational activities such as equipment including computers and printers; and air intakes from outside a building.



*The City of Melbourne's Council House 2 (CH2) project is the first purpose — built office building in Australia to achieve the six Green Star certified rating. CH2 features sustainable such as a water-mining plant in the basement, phase-change materials for cooling, automatic night-purge windows, wavy concrete ceilings, a façade of louvres (powered by photovoltaic cells) that track the sun. © City of Melbourne.*

Table 3: Program B research outputs and/or milestones

| Output/milestone number | Description | Contracted achievement date | Achieved (Yes or No) | Reasons why not achieved (if applicable) | Strategies to achieve unmet milestones |
|---|---|---|---|---|---|
| Outcome 1 | Informing policy – sustainability principles operating in BCA | December 2006 | Yes | | |
| Outcome 3 | Improved human and environmental health – legionella eliminated as a public health risk | June 2007 | No | Research Committee reviewed the milestone in light of issues such as liability and lack of critical equipment. | Air quality surveys are being undertaken as part of project 2003-028-B and a prototype indoor air quality estimator tool has been developed. |

# PROGRAM C: DELIVERY AND MANAGEMENT OF BUILT ASSETS

**PURPOSE:** TO DELIVER WHOLE-OF-LIFE PROJECT VALUE FOR STAKEHOLDERS FROM BUSINESS NEED, DESIGN AND CONSTRUCTION, THROUGH TO OWNERSHIP, ASSET MANAGEMENT AND REUSE THROUGH:

- IMPROVED COMMUNICATION AND USE OF INFRASTRUCTURE
- INCREASED PRODUCTIVITY AND VALUE
- EFFECTIVE DELIVERY AND MANAGEMENT OF BUILT ASSETS.

## Automated Estimating for Civil Concrete Structures

Research project 2005-008-C

Project duration: 1 November 2005–1 December 2006
Project leader: Robin Drogemuller/Kwok-Keung Yum, CSIRO
Project members: Brisbane City Council: Darren Leeson
John Holland Group: Gerry Shutt
Queensland Department of Main Roads: John Spathonis
RMIT: Guillermo Aranda-Mena

*Robin Drogemuller*

This project assessed whether it is feasible to extend the benefits of automatic estimating from buildings to civil concrete structures (mainly concrete bridges). Currently there is no automatic estimator for bridges. Design drawings are carried out in 2D (plan and cross sections). The industry typically uses traditional processes in which design and construction are separated. During tendering, cost estimating is on a critical path between design and construction. An automatic estimator for bridges requires a 3D model for each bridge design. However, designers are resistant to changing current 2D practices to produce 3D models, unless there are clear drivers from the design and construction value chain. The project examined the existing design and construction practice, assessed the capability of existing software systems used in design and estimating, and developed recommendations on how bridge designers, estimators and contractors can move from their current practice to 3D integrated modelling and estimating. Queensland Department of Main Roads will reference this research in future-decision making regarding automation of design and estimation interfaces in civil construction.

## Team Collaboration through Wireless Computing

Research project 2002-057-C

Project duration: 28 September 2004–1 March 2007
Project leader: Stephen Kajewski, QUT
Project members: John Holland Group: Justin Lee
QUT: Sugiharto Alwi
The University of Sydney: Andy Dong, Brian Lee, Mary Lou Maher
Woods Bagot: David Marchant

*Stephen Kajewski*

This project had two streams that considered the use of pervasive computing technologies. The first context is the construction site deployment of mobile computing devices. The second context is the use and development of intelligent rooms based on sensed environments and new human-computer interfaces (HCI) for collaboration in the design office. Together, these two streams presented a model of team collaboration that relied on continuous communication to people and information to reduce information leakage. The project involved an examination of recent developments in mobile ICT with a view to adopting a limited range of industry-specific software applications. Such ICT allows the contractor and consultant real-time interaction with the collaborative Internet-based project portal and the information contained therein. The associated software applications allows many of the more repetitive project administration and communication activities to be more easily captured in an electronic format, thus eliminating the requirement for extensive manual data re-entry, processing, and communication. Based on feedback from industry participants, John Holland Group and Woods Bagot, two versions of the mobile computing application for defect management were developed, each customised to the defect management process in practice with the respective industry participants.

# PROGRAM C: DELIVERY AND MANAGEMENT OF BUILT ASSETS

## Wayfinding in the Built Environment (Phase 2 and 3)

Research project 2004-028-C

Project duration: 1 December 2004–30 September 2006
Project leader: Dennis Hogan, Building Commission (Victoria)
Project members: Australian Building Codes Board: Matthew McDonald
CSIRO: Robin Drogemuller, Loretta Kivlighon, John Crawford
Queensland Department of Public Works: Ron Apelt, Dale Gilbert, Stuart Grierson
QUT: Debbie Smit, Paul Smith

*Dennis Hogan*

Wayfinding systems involve more than just signage. They encompass architecture, landscape architecture, interior design, lighting and cognitive landmarks. This project has identified wayfinding systems, technologies and devices appropriate for people with a sensory impairment, particularly people with vision impairment. It has also identified systems, technologies and devices making access to properties easier and safer for all people. Wayfinding design guidelines were developed to foster a reasonable, practical and comprehensive design approach to assist designers, developers, property owners and managers in identifying ways of improving access to new or existing property, particularly buildings and large complex facilities. The guidelines are intended to be flexible within the context of a built environment and can be used by designers from a number of perspectives including systems for pedestrians, cyclists, drivers of vehicles, building occupants, and visitors. The project won the Queensland Government's 2007 Disability Action Week Award in the Building and Accessible Environments Category. The Building Commission (Victoria) is using the research to promote industry consideration of wayfinding systems in the design of buildings through information dissemination via web, newsletters and eBulletins.

## Off-Site Manufacture in Australia

Research project 2005-004-C

Project duration: 1 May 2006–16 March 2007
Project leader: Tom Fussell, Queensland Department of Public Works
Project members Building Commission (Victoria): Peter Nassau
Curtin University of Technology: Peter Bullen
John Holland Group: John Reddie
Queensland Building Services Authority: Jason Smith, Peter Hope
RMIT: Richard Bird, Nick Blismas, Carolyn Hayles, Ron Wakefield, Mark Vines
The University of Newcastle: Willy Sher
Western Australia Department of Housing and Works: Peter Tilley, Karyn Ash

*Tom Fussell*

Off-site Manufacture (OSM) has long been recognised, both in Australia and internationally, as offering numerous benefits to all parties in the construction process. More importantly, it is recognised as a key vehicle for driving improvement within the construction industry. However, the uptake of OSM in Australia is limited, despite its well-documented benefits. OSM can reduce construction time, deliver higher quality and better control, provide higher levels of consistency, reduce costs when resources are scarce; reduce costs where work is in remote areas, reduce on-site risks, reduce waste on and off site, and achieve better energy performance. Opportunities to exploit OSM in Australia include high-density multi-residential complexes as well as the public sector (including hospitals, schools, prisons). Technical areas for research and development into OSM have been identified for walling systems, modularised housing and lightweight concrete wall panels. The research has identified risk and mitigation strategies for OSM and developed an action plan for encouraging more OSM through the Australian industry.


*Wayfinding signage © Queensland Department of Public Works.*

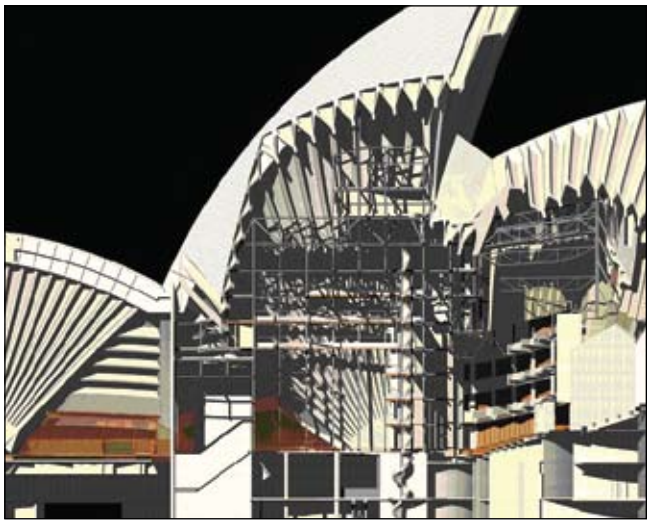
## Business Drivers for BIM

Research project 2005-033-C

Project duration: 1 May 2006–30 August 2007
Project leader: Ron Wakefield, RMIT
Project members: **Building Commission (Victoria):** Paul Crapper
**Queensland Department of Main Roads:** John Spathonis
**Queensland Department of Public Works:** Tom Fussell
**QUT:** Robin Drogemuller, John Frazer, Stephan Gard, Davina Jackson, David Nielsen
**RMIT:** Guillermo Aranda-Mena, Agustin Chevez, John Crawford, Thomas Froese

*Ron Wakefield*

This project aimed to develop an understanding of the business drivers and barriers to Building Information Models (BIM) software adoption in the property, design, construction and FM industry. The project investigated the nature of economic, process and industry constraints to BIM adoption and identified business strategies, cost and benefit models. These strategies are based on case studies from property, design, construction and FM as well as other industries, and interviews with business leaders and users of advanced applications of CAD in the industry. General speculation on the reasons for slow adoption of innovative technology has been attributed to factors such as real and/or perceived market barriers, industry organisation, market incentive, pressures and rewards and uncertainty regarding economic benefits. This research will evaluate the impediments to adoption of BIM technology and provide framework for the future development of an effective industry adoption model.



*© Sydney Opera House. Courtesy of Utzon Architects/Johnson Pilton Walker (Architects in collaboration) – Arup.*

## Sydney Opera House — FM Exemplar Project

Research project 2005-001-C

Project duration: 28 February 2005–24 November 2006
Project leader: **Stephen Ballesty, Rider Levett Bucknall**
Project members:**Brisbane City Council:** Sunil Madan
**CSIRO:** Lan Ding, Robin Drogemuller, Hans Schevers, Marcello Tonelli
**Queensland Department of Public Works:** Selwyn Clark, Frank Seed
**QUT:** Andrew Frowd
**Rider Levett Bucknall:** Ankit Shah
**The University of Sydney:** Janet Henriksen, David Leifer, Katharine Martindale, Alan Tracey
**Woods Bagot:** Peter Hoskins, David Marchant

External participants:
**Facility Management Association of Australia (FMA):** Karen Hill
**Sydney Opera House:** Paul Akhurst, Chris Linning, Gary Singh, Anthony Williams
**Transfield Services:** Alex Dontas, George Spink

*Stephen Ballesty*

Sydney Opera House – Australia's most famous landmark and one of the busiest performing arts centres in the world – has taken centre stage in producing world class research for the FM industry. The Opera House was showcased as a template for innovative FM practices in a major Department of Industry, Tourism and Resources and *Construction Innovation* research project – the Sydney Opera House FM Exemplar Project. Australia's FM industry employs more than 170,000 people and generates approximately $12 billion of Australia's gross domestic product. The Sydney Opera House FM Exemplar Project delivered against recommendations of the Australian Government's Facilities Management Action Agenda, as part of a strategic framework for managing the built environment. The Sydney Opera House FM Exemplar Project has received industry accolades, including the 2007 Facility Management Association of Australia – Rider Hunt Terotech Industry Achievement Award for FM strategy and practice. The BIM component of the research also featured in two international awards – the Jury's Choice category of the American Institute of Architects Technology in Architectural Practice 2007 awards, and the Bentley Awards for Excellence 2007 award for BIM in multiple disciplines. The outcomes of this project continue to be extensively disseminated to industry through workshops, conferences and publications.

# PROGRAM C: DELIVERY AND MANAGEMENT OF BUILT ASSETS

## Delivering a Re-Life Construction Project

Research project 2003-026-C

Project duration: 1 August 2004–30 September 2006
Project leader: Jay Yang, QUT
Project members: **John Holland Group:** Bruce Carlyle
**Queensland Department of Public Works:** Selwyn Clark, Stuart Grierson
**QUT:** Soon Kam Lim
**Rider Levett Bucknall:** Michael Gilligan, John Oliver
**RMIT:** Arun Kumar, Tom Molyneaux, Chintha Perera, Sujeeva Setunge, Srikanth Venkatesan
**University of Western Sydney:** Mary Hardie, Graham Miller

*Jay Yang*

Thousands of buildings in Australian cities have reached an age when decisions must be made about their future. Products of the 1970s building boom, these buildings no longer meet tenants' requirements or energy efficiency standards, and a decision must be taken to demolish and build new, or "re-life" through refurbishment. To assist in this process, this re-life project has developed a set of guidelines to test the commercial, technical and environmental viability of re-lifing projects. With the growing commitment to sustainability, improving existing building stock is an attractive option and it is estimated up to 50 per cent of annual capital budgets will go to re-lifing by the year 2020. The research team studied the re-lifing of three 30-to 40-year-old government buildings in Brisbane, Melbourne and Sydney to investigate the characteristics of re-life projects including the identification and mitigation of risks, issues of decanting and existing tenants, identification of existing structure and services, work scheduling, occupational health and safety issues for construction personnel and tenants, demolition, waste and recycling, issues of quality and workmanship, cost planning and cost modelling methodologies. Outcomes of the research are available to industry online through the Your Building sustainable commercial buildings web portal.

*Jay Yang. Image © Erika Fish, QUT.*

## Sustainable Infrastructure in Aggressive Environments

Research project 2004-018-C

Project duration: 1 July 2005–31 December 2006
Project leader: Sujeeva Setunge, RMIT
Project members: **Queensland Department of Main Roads:** John Fenwick, Peter Rotolone, Lex Vanderstaay
**QUT:** Matthew Humphreys
**RMIT:** Rebecca Gravina, Tom Molyneaux, Srikanth Venkatesan

*Sujeeva Setunge*

This project developed a diagnostic tool that assists in the interpretation of distress symptoms in bridges exposed to aggressive environments. Distress mechanisms pertinent to Queensland bridge stock have been investigated and the methodology of diagnosing from visual symptoms has been developed. Based on further analysis of about 30 bridges, a database of parameters and issues to be considered in relating the symptoms of distress to their mechanisms has been developed using a mind-map analysis technique. This has led to the systematic documentation of a rule based matrix that includes three levels of confidence (High, Medium and Low). Based on this documentation, a software tool (BridgeDIST) has been developed with a "knowledge base" and an inference engine. Imprecise information has been evaluated using a fuzzy-logic approach. The developed software is simple in application with an open-ended architecture; this helps experts to create their own new rule-bases, as and when sufficient expertise has now been gained. Furthermore, the software can potentially be linked to the bridge management systems and future deterioration of bridge stock could be predicted. A hardcopy costing module has been developed to accompany the software tool which evaluates the cost of repairs for a given scenario. The outcomes of this project will inform Queensland Department of Main Roads approaches to rehabilitating concrete structures in marine environments.

*Image © Peter Brandon.*

### Procurement Method Toolkit

Research project 2006-034-C

Project duration: 22 August 2006–4 January 2008
Project leader: Peter Davis, Curtin University of Technology
Project members: **Curtin University of Technology:** David Baccarini
**Western Australian Department of Housing and Works:** Wayne Carter, Michael Pearson
**Rider Levett Bucknall:** Alistair McMichael
**RMIT:** Tony Mills, Ron Wakefield

*Peter Davis*

This project undertakes a study into best practice project delivery in terms of identifying appropriate procurement methods. This project utilises research outcomes from an earlier project which developed a procurement toolkit designed specifically for the Queensland context. The original toolkit was prescriptive and required additional qualitative data, which has been addressed in this new project. A procurement decision support toolkit will be created to help guide owners and project teams towards the best procurement strategy for specific projects. These resources will be focused on promoting the principles that underlie best practice procurement rather than simply identifying a particular delivery method. Accordingly, it is envisaged that users will gain a better understanding of procurement principles, including design excellence and market conditions. These resources will include information on case studies and lessons learnt to allow participating organisations to access actual examples of construction projects that illustrate best practice procurement selection principles. The outcomes of this research will inform policy for construction procurement.

*Image © 2007 Shutterstock.*

Table 4: Program C research outputs and/or milestones

| Output/milestone number | Description | Contracted achievement date | Achieved (Yes or No) | Reasons why not achieved (if applicable) | Strategies to achieve unmet milestones |
|---|---|---|---|---|---|
| Outcome 1 | Productivity increase of 10% over business as usual | December 2006 | Yes | | |

# 5. COMMERCIALISATION AND UTILISATION

*CONSTRUCTION INNOVATION* ENGAGES IN COLLABORATIVE RESEARCH AND IMPLEMENTATION FOR THE PROPERTY, DESIGN, CONSTRUCTION AND FACILITIES MANAGEMENT (FM) INDUSTRY. IT WORKS WITH INDUSTRY, GOVERNMENT AND RESEARCHERS TO IMPROVE PRODUCTIVITY AND SUSTAINABILITY.

## 5.1 Commercialisation and utilisation strategies and activities

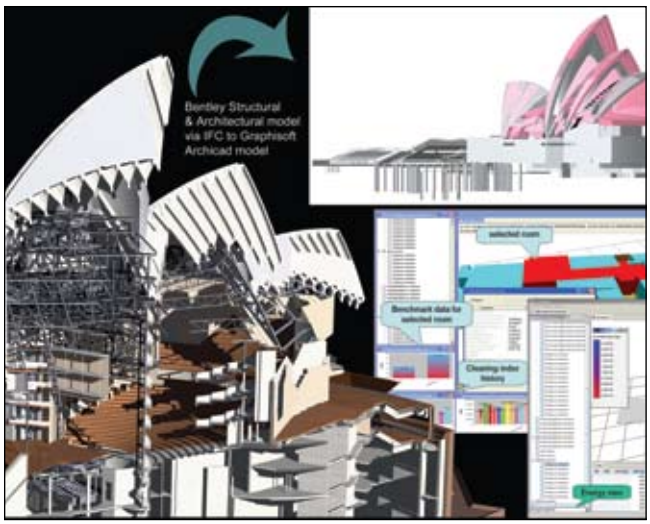
*Construction Innovation's* Commercialisation/Technology Transfer Program is designed to enhance the transfer of research outputs into commercial or industry outcomes of economic, environmental or social benefit to Australia.The three guiding principles in achieving this are:

- to ensure Intellectual Property (IP) management and strategies for commercialisation are targeted to potential commercial opportunities
- to transfer public good research outcomes to *Construction Innovation* participants, the construction industry and the broader Australian community
- to ensure that smart and streamlined systems are utilised to effectively manage research activities in a focused and targeted manner, allowing easy identification and exploitation of commercialisation opportunities.

*Construction Innovation's* project agreements address a process for commercialisation and/or utilisation of the outputs at the commencement of a project. Each six-monthly project review considers the commercialisation opportunities with, where appropriate, a more focused strategy being developed six to nine months from the completion of the research. Legal and technology development professionals are engaged, as required, to develop appropriate licence agreements. Market analysis and economic impact reports are sourced externally.

To facilitate the management of Intellectual Property and strategies for commercialisation, *Construction Innovation* also educates and trains key personnel. A workshop was held for students and researchers in April 2007 on knowledge IP management and commercialisation processes.

Trials of project outputs allow participants to become familiar with tools or processes developed at a project level. Often, the learnings from projects influence processes within participant organisations. For example, two of our government agency participants are reviewing the requirements of their electronic tender and contract administration procedures to allow appropriate electronic signatures to be used, electronic contract formations, electronic contract administration, issues of IP, evidentiary and archive issues. The BRITE project also encouraged innovation in government agencies and allowed suppliers and contractors to share risk and develop procurement contracts which give suppliers and contractors more scope for innovation in their delivery approach.




*Digital technology provides the technology for a virtual information model to be handed from the design team to the owners. © Sydney Opera House. Courtesy of Utzon Architects/Johnson Pilton Walker (Architects in collaboration) – Arup.*

Our first preference for commercialisation partners are our *Construction Innovation* participants. In all projects it is a requirement that there are at least two research-users. Therefore, potential initial adopters of the technology are likely to be the industry participants involved early in the specific project.

The Sydney Opera House has been able to employ knowledge, processes and tools developed to demonstrate to its stakeholders that there is the option to increase the effectiveness of their FM services portfolio. *Construction Innovation* research has provided prototypes and guidelines that will also contribute to the development of the new 25 year strategic asset management plan, provided a new model for the ongoing procurement of design works to the current refurbishment program and insights into the strategic decision making on digital modelling and the FM tools and systems.

Another example of this approach has been the adoption by John Holland Group of outputs from our Construction Site Safety Culture project into their safety leadership development activities. John Holland Group was an active contributor to this project – Dean Cipolla, John Holland's Group Safety Manager, led the project.

Additionally, engagement with industry associations in the project development and delivery strengthens industry pathway to adoption. In the case of the Sydney Opera House FM Exemplar Project, our collaboration with the Facilities Management Association of Australia (FMAA) ensured the FM industry received key project outcomes by

Table 5: Commercialisation and utilisation outputs and/or milestones

| Output/milestone number | Description | Contracted achievement date | Achieved (Yes or No) |
|---|---|---|---|
| Commercialisation | IP register and IP valuation | 30 June 2007 | Yes |
| Commercialisation | Commercialisation strategies – review and development | 28 February 2007 | Yes |
| Commercialisation | Partner/student development on commercialisation | 30 June 2007 | Yes |
| Utilisation | Industry workshops | 30 June 2007 | Yes |

dissemination of the industry publication, newsletter and FM magazine updates and promotion of a national series of industry workshops.

In 2006–07 the following trade marks have been registered:

Trade Mark No.1095003
CRC for *Construction Innovation* logo – registered for a period of 10 years commencing on 19 January 2006.

DesignCheck – 1095007
DesignCheck logo – registered for a period of ten years commencing 19 January 2006.

No spin off companies have been formed.

## 5.2 Intellectual property management

Intellectual Property is managed according to the terms and conditions of the Centre Agreement and in the specific agreements at the project level. These processes are reviewed annually to ensure continued adherence to the *National Principles of IP Management.*

A number of software evaluation licence agreements have been put in place to allow the trial of software by organisations external to our participant group. These agreements are typically of only three months duration and require a report to be provided outlining software errors, suggestions for enhancements and details of 3D CAD building information models used. The aim is to protect the IP while at the same time sourcing valuable user feedback on its suitability.

## 5.3 Communication strategy

*Construction Innovation* is highly focused on disseminating key outcomes of our research activities. *Construction Innovation's* communication strategy seeks to advise and inform our participants and private and public industry stakeholders and the community of the beneficial outcomes deriving from our applied research.

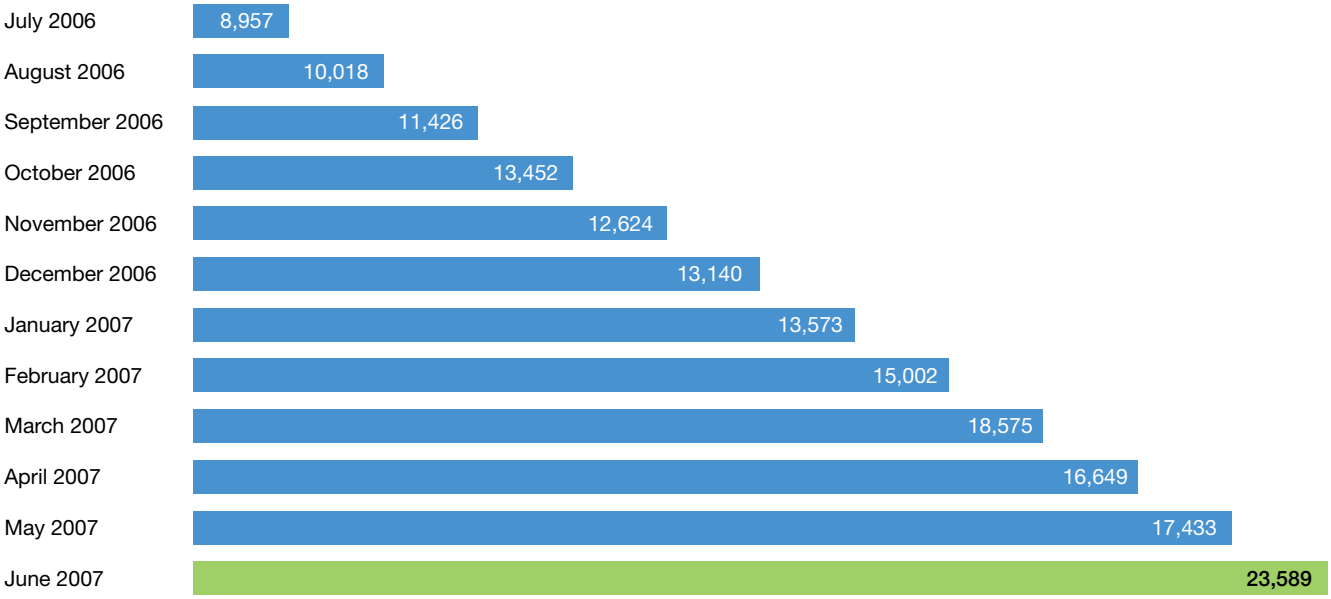
We undertake a range of communication activities which include both internal and external communication and include our intranet site, corporate and project websites, industry-directed publications and brochures, monthly eNewsletter, media and publicity, launches, workshops, and international conference and event sponsorships. A major communication highlight in the 2006–07 period has been the strategy developed to engage industry associations in the Safer Construction project. The project, which developed a guide for best practice for safer construction, was supported by a *Construction Innovation* communication plan developed to inform industry and provide a mechanism for industry associations to input into the project.

*Construction Innovation* also undertakes other communication activities, such as meetings, reports and events to build communication of research outcomes in our partner organisations. Our intranet site is the primary tool supporting internal communication. Through this site, project team members are able to quickly and easily access and share essential documents. Key to external communication is *Construction Innovation's* website (www.construction-innovation.info) which includes background information on the CRC, project briefs, event details, a comprehensive media file, a Research Library providing a map of our research

*(L–R) Siobhan Austen, Associate Professor, Curtin University of Technology and Wayne Carter, Principal Policy Officer, Western Australia Department of Housing at a* Construction Innovation *dinner for Perth-based participants, May 2007.*

# COMMERCIALISATION AND UTILISATION

Number of unique website hits per month 2006–07:




activities and downloads of the project reports. Through 2006–07 *Construction Innovation* has committed increased resources to maintaining and updating the website.

Website traffic has substantially increased over the 2006–07 period, more than doubling from the month of July 2006 (8,957 unique website hits) to the month of June 2007 (23,589 unique website hits). The majority of these hits have been from Australian industry.

The Update newsletter is uploaded to the website regularly and distributed by email to approximately 3000 key national and international stakeholders. In 2006–07 nine editions were produced.

## Industry publications

The 2006–07 period has seen a number of projects produce research reports suited to further development into industry publications, as listed below. These publications present the key learnings and benefits emerging from the research in a format aimed at facilitating industry acceptance and uptake. Publications are an important tool for communicating with industry and SMEs.


Update
newsletter – July 2007
RC Construction Innovation
UILDING OUR FUTURE
www.construction-innovation.in
New international role for John McCarthy
Building networks and disseminating technology in the developing nations of China and India will be a key focus of *Construction Innovation's* Chair John McCarthy's new role as Chair of the CIB Marketing and Communication Committee. More details
Safety culture research is a winner
*Construction Innovation's* safety culture research won the Victorian Chapter of the Australian Institute of Building's (AIB) Professional Excellence in Building, announced on 22 June. More details
Safety & Innovation Research Symposium—more details
Global reach for Australia's *Construction Innovation* team
Australian construction research has featured
From the CEO's desk
*Construction Innovation* has been successful in being granted a one year extension by the CRC Programme – to extend our Centre to 30 June 2009. Our industry-driven Extension Program will engage our new and existing partner network and position us for a

*Update Newsletter.*

Publications and industry brochures have been widely disseminated through their availability on our website, at selected conferences, *Construction Innovation* research symposia and industry workshops and with the assistance of our participants and industry associations.

- *Being the best* (1300 copies distributed)
- *Innovate now!* (610 copies distributed)
- *adopting eBusiness in building and construction* (1120 copies distributed)
- *eTendering — Security and Legal Issues* (180 copies distributed)
- *Predicted lifetimes of metallic building components* (120 copies distributed)
- *PICTURING SUCCESS* series – includes hard copy introductory overview to online resources (140 copies distributed)
- *Construction safety competency framework: Improving OH&S performance by creating and maintaining a safety framework* and its executive summary (919 copies distributed)
- *FM as a business enabler* and its executive summary (344 copies distributed)
- *Adopting BIM for facilities management* (885 copies distributed)
- *HVAC system size: Getting it right* (120 copies distributed)

After their initial distribution at launches and related industry workshops, our industry publications continue to be offered for sale and can be ordered for purchase or downloaded for free online. At least seven additional publications will be available by December 2007.

## Online industry collaboration

To support and promote the Your Building sustainable commercial buildings portal, an introductory website was developed in mid 2006. It provided background and updates on the project and served as a means to attract and provide documentation to sponsors as well as content authors and reviewers. It also enabled us to notify those who registered their email on the site when the main site went live.

## Project brochures

A number of industry-brochures were produced, summarising key research outcomes:

- *Guidelines for successful eTendering implementation*
- *Digital Modelling and BIM*
- *2007 Research Highlights*

## Industry Communication

Executive Report Cards are produced annually and customised to the interests and needs of each of our participants. The report cards provide a snapshot of the value to the participant of their investment in *Construction Innovation*. This is an annual process, following the data collection for the Annual Report. Participant feedback during the subsequent face-to-face consultations continues to reinforce the value of the Executive Report Card process.

Media releases are regularly issued by *Construction Innovation* and through our participant organisations, resulting in significant coverage across print, electronic and broadcast media. Eleven media releases were issued by *Construction Innovation* or through participant organisations in 2006–07. Media releases issued in the 2006–07 period include:

*David Marchant, Woods Bagot* – Construction Innovation *research participant.*

- Opera House facilities management research takes centre stage (May 2007)
- Innovators wanted for industry showcase (May 2007)
- Construction industry takes on safety (May 2007)
- Adopt the new: Construction innovations that boost productivity (April 2007)
- Road building costs underestimated up to a third (April 2007)
- QUT eases Australia's CBDs through mid-life crises (March 2007)
- Digital Opera House leads the way for facility managers (Febuary 2007)
- Opera House backstage secrets revealed (November 2006)
- Project support tool wins national award (October 2006)
- Clients and crises major drivers of property and construction innovation (September 2006)
- New framework for safety in construction (September 2006)

Industry media articles are another key tool for communicating with industry and SMEs. *Construction Innovation* has achieved strong industry media dissemination in 2007, more than doubling the number of major articles in industry media in the period January to August 2007 (76 articles) to the number of articles published in 2006


*Addressing* Construction Innovation's *2006 seasonal cocktails in Brisbane: the Hon Rob Schwarten, Minister for Public Works, Housing and ICT in Queensland. © Erika Fish, QUT.*

(35 articles). To date in 2007, *Construction Innovation* has achieved more industry media coverage than any other year of its operation, with additional extensive media coverage in mainstream and industry media expected following the launches of the Safer Construction and Your Building projects in September 2007.

Relationship building with communication and marketing staff of partner organisations and other CRCs continues, to foster stronger collaborative relationships, and with editors, journalists and broadcasters. In 2006–07, our participant organisations were sent a summary of the year's research outcomes for projects in which they were involved.

## 5.4 End-user involvement and CRC impact on end-users

*Construction Innovation's* research program is undertaken by large and small industry companies, government agencies and research organisations. SMEs form a major component of the building and infrastructure industry.

*Construction Innovation* engages SMEs through industry and professional associations, delivers industry information sessions


Construction Innovation *industry publication.*

The Adopting BIM for facilities management *publication was launched at RAIA National conference in April 2007. (L–R) David Marchant, Stuart Bull, Paul Akhurst, John Mitchell and Keith Hampson.*

around Australia on topics such as innovation, digital modelling, FM and safety. *Construction Innovation* also regularly supplied information on research outcomes to industry media. For example, *Construction Innovation's* BRITE project has generated articles in 49 different industry publications, including the publications of our participant organisations.

The impact of these activities was undertaken in an external review conducted by the STEM Group, with their 2006 report showed that 65% of respondents to their survey felt that *Construction Innovation* case studies undertaken by the BRITE project had a positive impact on overall industry attitudes to innovation, while 90% of respondents felt innovation and adoption rates would rise over time.

A 2006–07 external survey of industry and government *Construction Innovation* participants reported that these organisations saw value in their involvement with *Construction Innovation*. The organisations sought to play a leadership role in industry and their involvement with *Construction Innovation* was regarded as an important component in this leadership strategy. The survey participants believed that *Construction Innovation* delivers outcomes that will improve competitiveness and performance of the construction industry.

### Industry sponsorship and collaboration

In the 2006–07 period, *Construction Innovation* provided sponsorship to:

- The Australian Institute of Building National Conference, 28–29 September 2006
- 3rd International Conference on Project Management, 27–29 September 2006
- Australian Procurement and Construction Council International Procurement Conference, 29–31 October 2006
- International Alliance for Interoperability – buildingSMART, for activities in 2006.
- 22nd ARRB Transport Research Conference, 29 October–11 November 2006
- 2007 Royal Australian Institute of Architects National Architecture Conference, 19–21 April 2007

Table 6: End-user involvement in *Construction Innovation* activities

| End-user name | Relationship with CRC (e.g. industry, participant, international) | Type of activity and end-user location | Nature/scale of benefits to end-user (e.g. exports increase, productivity, employment) | Actual or expected benefit to end-user ($ terms) |
|---|---|---|---|---|
| Sydney Opera House (SOH) and FMA Australia | Project partner | Utilisation of research nationally and internationally | Use of project outcomes/ findings to increase productivity | Improvements to FM practices and increased access to data will generate potential savings for SOH's $19 million FM budget, with flow on benefits to the broader FM industry. |
| Queensland Department of Main Roads Queensland Department of Public Works John Holland Group | Government and industry participants | Utilisation of research through training activities in Queensland and nationally | Change in culture leading to improved productivity | Reduced costs due to less disputes. |
| John Holland Group | Industry participant | Utilisation nationally | Improved safety culture on construction sites | Reduced time lost from injuries. |

## International conference

Planning continued for *Construction Innovation's* Third International Conference to be held on the Gold Coast, 12–14 March 2008. *Clients Driving Innovation: Benefiting from Innovation* focuses on demonstrating the social, environmental and economic benefits of applied research and innovation in the property, design, construction and FM industry.

The conference is expected to attract 250 national and international research and industry attendees.

## Industry workshops

A series of national industry-focused workshops on FM and safety research outcomes were presented across Australia, attracting 500 industry attendees.

The workshops provided participants with publications summarising key research outputs and enabled interaction with industry, government and research from the project teams.


*Postcard image of 2008* Construction Innovation *conference.*

# 6. EDUCATION AND TRAINING

## *CONSTRUCTION INNOVATION'S* EDUCATION AND TRAINING PROGRAM IS RECOGNISED AS A SIGNIFICANT CONTRIBUTOR TO ENHANCING THE COLLABORATIVE CULTURE OF CONSTRUCTION.

### Education program

*Construction Innovation's* education and training program is recognised as a significant contributor to enhancing the collaborative culture of construction.

By partnering with industry, government and researchers to develop educational and professional development courses and by encouraging industry participants to co-supervise students, *Construction Innovation's* scholars' program successfully attracts a high calibre of students.

Many of those who have completed their scholarships have gone on to practically apply their studies in the property, design, construction and FM industry.

An integral part of *Construction Innovation's* education and training program is to hold workshops, forums and other events to help build the skills and knowledge of its scholars and research teams and build personal and professional networks amongst these key individuals.

In 2006–07, *Construction Innovation* conducted the following events:

### Scholars' workshops

Two scholars' workshops were held. The first, in September 2006 was a two day workshop with focus on media skills, negotiation skills and career directions.

The second workshop held over two days in April 2007, focused on knowledge transfer and research commercialisation.

Feedback from each of these workshops indicated they were well received by attendees and provided an opportunity to develop highly relevant skills, build networks and gain an appreciation of what other scholars are achieving.

### Research symposiums

*Construction Innovation* hosted two research symposiums in Western Australia and New South Wales. The symposiums continue to disseminate research benefits to industry.

Perth Research Symposium held at Engineers Australia, West Perth on 20 February 2007 was attended by 50 industry practitioners. This event included both public and industry focused sessions covering seven research projects with both industry and academic presenters. Feedback summary:

- 90% of respondents indicated that the presentations were relevant to their needs
- 95% of respondents indicated that they were likely to use the learnings in their workplace.


*John Dwyer, a registered building practitioner with over 20 years experience, spoke at* Construction Innovation's *Brisbane Research Symposium on the topic of Innovation in Workplace Safety. John's safety innovations feature in* Construction Innovation's *BRITE Innovation Gallery 2007.*

The Sydney Research Symposium held at Portside Conference Centre, Sydney on 4 June 2007 attended by 100 industry practitioners. This event provided a safety focus, with industry and academic presenters providing a snapshot of where and how workplace safety issues are being addressed through their projects, with additional presentations on innovation and Building Information Models. Feedback summary:

- 95% of respondents believed that all presentations and presenters were relevant to their needs
- 80% of respondents had attended to hear updates on safety research.

## 6.1 Industry training

Following on from the Value in Project Delivery Systems: Facilitating a Change in Culture research project, a two-day workshop was developed. Entitled "Relationship Management in Project Delivery", this workshop has been embraced by our participants and industry.

Throughout 2006–07, the following Relationship Management workshops have been delivered. Each workshop is designed for a maximum of 20 people and is customised for each organisation's need.

Piloted in **Queensland Department of Main Roads** in October 2006 – 27 attendees. Feedback summary:

- 89% respondents believed the workshop was relevant to their needs
- 95% respondents would recommend workshop to others.

Piloted in **John Holland Group** in March 2007 – for subsequent wider rollout 17 attendees. Feedback summary:

- 84% respondents believed the workshop was relevant to their needs
- 92% respondents would recommend workshop to others.

Implemented in **Queensland Department of Public Works** in April 2007 – 13 attendees. Feedback summary:

- 86% respondents believed the workshop was relevant to their needs
- 100% respondents would recommend workshop to others.

Piloted in **Laing O'Rourke** in June 2007 – for subsequent wider rollout 12 attendees. Feedback summary:

- 86% respondents believed the workshop was relevant to their needs
- 100% respondents would recommend workshop to others.

### Contribution to professional skill development in industry

Following the completion of the research projects, several eLearning initiatives have been developed in conjunction with professional associations and/or academic researchers. These include:

- in conjunction with QUT's Built Environment and Engineering a module covering online document management

- in conjunction with The University of Newcastle, two modules for continuing professional development and initially targeted toward architects, entitled Social Capital and Virtual Teams

- in conjunction with The Royal Australian Institute of Architects (RAIA), two modules for continuing professional development of their members, entitled *Integrated Water Services* and *Introduction to Building Information Models*.

## 6.2 Courses with *Construction Innovation* project content

Industry, government and research participants are involved in the conduct of research, the outputs from which form the basis for university curriculum content and delivery. The following courses were added to curriculum in 2006–07:

Sustainable Infrastructure for Aggressive Environments

- RMIT – CIVE 1173 Infrastructure Management – final year discipline elective in Bachelor of Civil and Infrastructure Engineering with 48 students completing the subject in first semester 2007.

Sustainable Subdivisions – Ventilation

- QUT – DAB 435 Architectural Technology 1 in Bachelor of Design (Architectural Studies) for 112 second year students.

Sustainable Subdivisions – Energy and Water Efficiency Design

- QUT – BEB100 Introducing Professional Learning for 1500 first year Construction Management students.

Construction Site Safety Culture

- RMIT – Project leader lecture for third year students studying property, construction and project management.
- UWS

  EH313A – Undergraduate Occupational Health and Safety for 170 students.

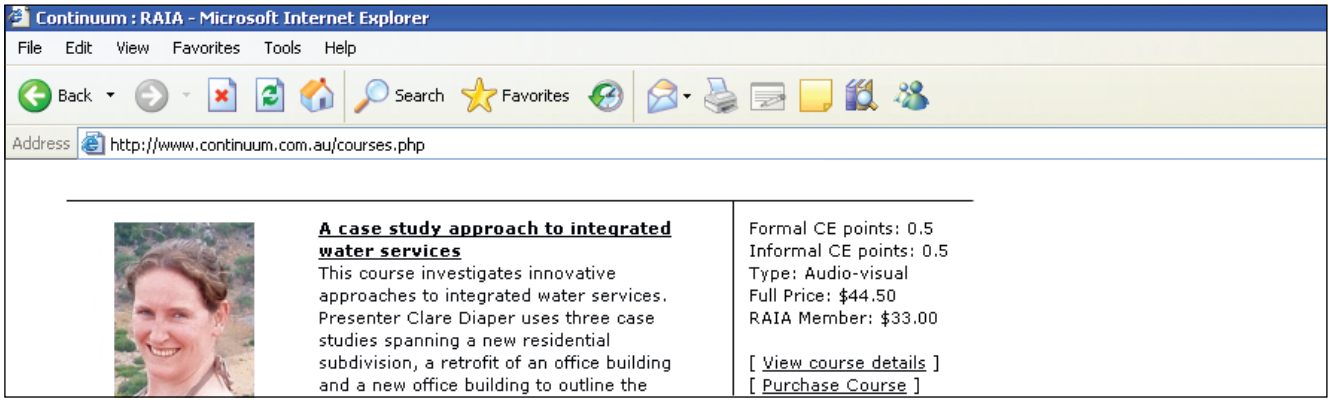
  Safety Management Unit – Grad Dip and Masters of Occupational Health and Safety and Environmental Management for 40 students.

Safer Construction

- RMIT – Lecture – Human Relations and Occupational Health and Safety – 155 students.

IT Enabled Business Strategies

- QUT – CNB309 Online Documentation for 110 third year Construction Management students.




*In conjunction with RAIA, two modules for Continuing Professional Development, including* Integrated Water Services *and* Introduction to Building Information Models *were developed.*

# EDUCATION AND TRAINING

## 6.3 Scholarship program

New *Construction Innovation* scholars 2006–07

| Name | Degree | Project title | University participant | Principal academic supervisor | Industry supervisor | Date awarded |
|---|---|---|---|---|---|---|
| 1. Soon Kam Lim | PhD | Decision-making processes for sustainable construction | QUT | Associate Professor Jay Yang | Derek Skinner Queensland Department of Main Roads | 1 October 2006 |
| Soon Kam's research will develop an integrated decision-making tool for industry clients, consultants and contractors to improve collaboration, consultation and communication between decision-makers of infrastructure project delivery to achieve improved sustainability outcomes. The intended benefits to industry include improved understanding among stakeholders and better sustainability reporting mechanisms. | | | | | | |
| 2. Agustin Chevez Bernaldo de Quiros | PhD | Evolution of workplace architecture as a consequence of technology development | RMIT | Dr Guillermo Aranda-Mena | James Calder Woods Bagot | 18 September 2006 |
| Agustin's research will identify changes in the way workplaces are used to design new office environments and redevelop existing ones with a holistic approach to maintain a balance amongst people, space and technology in the Australian context. The intended outcomes for industry from this research will also assist Facility Managers to strategically plan their workspace changes due to alternative ways of working. | | | | | | |
| 3. Abdulkader Sharabah | PhD | A reliability based predictive model for building asset management | RMIT | Associate Professor Sujeeva Setunge | Axl Driml Queensland Department of Public Works | 18 September 2006 |
| Abdul's research will develop a deterioration model for building asset management capable of predicting the distributions of future conditioned states of building elements for asset management systems through data collection, data inspection, performance modelling and forecasting. The intended benefits to industry include tools to support decisions on maintenance priority in relation to all building elements. | | | | | | |
| 4. Robert Lopez | PhD | The impact of poor quality design documentation on construction buildability/ project management | Curtin | Professor Peter Love | Peter Tilley Western Australian Department of Housing and Works | 7 May 2007 |
| Robert's research will identify design errors as a 'project pathogen' and quantify their financial impact on projects, and underlie a taxonomy of design errors and strategies to reduce or mitigate them. It is anticipated that the research outcomes will highlight how fewer design errors will result in less waste, less rework and improved project performance in terms of schedule and cost. | | | | | | |

*1. Soon Kam Lim*

*2. Agustin Chevez Bernaldo de Quiros*

*3. Abdulkader Sharabah*

*4. Robert Lopez*

## *Construction Innovation* postgraduate degrees awarded 2006–07

| Name | Degree | Project title | University participant | Principal academic supervisor | Industry supervisor | Graduation date |
|---|---|---|---|---|---|---|
| 1. Tim Rose | PhD | Optimising the impact of financial incentive mechanisms in Australian commercial building projects | QUT | Dr Karen Manley and Professor Keith Hampson | Don Allan QDPW | 29 December 2006 |
| Tim successfully completed his PhD and now works full time as a Senior Policy Officer for Queensland Department of Public Works. | | | | | | |
| 2. Ji Soo Yoon | PhD | Wayfinding in dynamic virtual worlds using Swarm Intelligence | University of Sydney | Professor Mary Lou Maher and Dr Andy Dong | David Marchant Woods Bagot | 1 October 2006 |
| After completing his PhD, Ji Soo took up a role with Accenture in Sydney. | | | | | | |
| 3. Wei Peng | PhD | An adaptive design tool that learns | University of Sydney | John Gero and Rabee Reffat | David Marchant Woods Bagot | 1 August 2006 |
| Since completing his PhD, Wei has accepted a position as Research Scientist with the CSIRO's ICT Centre in Hobart. Wei is working on a research project related to energy management simulation tools. | | | | | | |

*1. Tim Rose*

*2. Ji Soo Yoon*

*3. Wei Peng*

*Scholars got to know each other over dinner and other social events during the scholars' workshop.*

*Adrian Cupitt (right) is interviewed about his research for Channel 10's* Scope *TV program.*

# EDUCATION AND TRAINING

## *Construction Innovation* continuing scholars 2006–07

| Name | Degree | Project title | University participant | Principal academic supervisor | Industry supervisor | Expected graduation date |
|---|---|---|---|---|---|---|
| 1. Joanne Jakovich | PhD | Research title: A model of Adaptive Soundspace Installation. | University of Sydney | Dr Kirsty Beilharz | David Marchant Woods Bagot | 11 January 2008 |
| Joanne's research will develop a model for the application of sensor-based audio environments in architectural design and construction. Software development will deliver a set of soundspace modules to support the integration of sensor and audio hardware into the built environment. The intended benefits to industry include the potential for interaction beyond traditional computer interfaces with the next generation of "smart" buildings and environments. | | | | | | |
| 2. Brett Mayze | PhD | Multilevel approach to safety culture in construction industry | QUT | Associate Professor Lisa Bradley | Dean Cipolla John Holland Group | 23 October 2008 |
| Brett's research identified a multilevel model to measure safetly culture that facilities benchmarking across the construction industry and identifies the key drives and characteristtics of an effective safely culture. The research will also measure and compare construction 'safely culture' over time and across sites. The intended benefits to industry will be identifing the impact safety leadership training can have for a large construction. | | | | | | |
| 3. Judy Kraatz | PhD | Critical success factors associated with major construction projects | QUT | Dr Karen Manley | Scott Stewart Brisbane City Council | 22 May 2009 |
| Judy's research will establish a value-mapping framework applicable to Australian public sector agencies via a decision-making methodology to assist project teams to highlight and track key decision points and options. The intended benefits to industry include improved ability to better identify and align project outcomes and impacts with stated corporate objectives as well as assist in managing risks and minimise possible ecological and social harm. | | | | | | |
| 4. Craig Furneaux | PhD | Policy networks: Demonstrating their presence, structure and network | QUT | Professor Kerry Brown and Dr Amanda Gudmundsson | | 30 May 2008 |
| Craig's research will demonstrate the existence, structure and influence of networks of construction industry organisations on public policy. Research approaches will enable the triangulation of results and elicitation of the interaction and influence of inter-organisational networks of actors on policy processes. The intended benefits to industry include an improved understanding of inter-organisational relationships in the construction industry, and how these relationships in turn are able to influence government policy. | | | | | | |

*1. Joanne Jakovich*

*2. Brett Mayze*

*3. Judy Kraatz*

*4. Craig Furneaux*

## *Construction Innovation* continuing scholars 2006–07 continued

| Name | Degree | Project title | University participant | Principal academic supervisor | Industry supervisor | Expected graduation date |
|---|---|---|---|---|---|---|
| 5. Adrian Cupitt | Masters by Research | Microclimatic impacts on the built environment – extension of day lighting theory to produce algorithms for light technical parameters for any location | QUT | Mr Stephen Coyne | Ron Apelt Queensland Department of Public Works | 30 June 2007 |
| Adrian's research will develop a tool for predicting daylight levels and the average reflection coefficient in a precinct if a building is to be constructed or changed. The tool will also determine the relationship between building position, dimensions and luminance. The intended benefits for industry include assisting architects, city planners and developers to design buildings to incorporate comfortable light levels and reduced glare and pollution due to less use of lights, heaters and air conditioners. | | | | | | |
| 6. Marcello Tonelli | PhD | Exploring corporate real estate decision-making in the Italian consulting industry | QUT | Stephane Tywoniak and Boris Kabanoff | Teng Hee Tan Queensland Health | 28 February 2007 |
| Marcello's research seeks to identify the effects of real estate decisions on business performance by linking the characteristics of the property to some of the key variables of the business. The intended benefits to industry is to guide future development of optimal corporate real estate strategies, improve understanding of interrelationships between real estate and business performance and contribute to knowledge of performance drivers within the service industry. | | | | | | |
| 7. Colleen Yuile | PhD | Attention to CSR by Australian corporations: trends over time and the relationship with financial performance | QUT | Professor Boris Kabanoff and Dr Amanda Gudmundsson | N/A | 2 February 2009 |
| Colleen's research aims to identify the level of attention Australian organisations give to corporate social responsibility (CSR) and establish whether there is a relationship between the levels of attention given to CSR and the effects on a company's financial performance. The intended benefits to industry include improved information for those implementing CSR strategies and identifying CSR dimensions in relation to financial performance. | | | | | | |

*5. Adrian Cupitt*

*6. Marcello Tonelli*

*7. Colleen Yuile*

# EDUCATION AND TRAINING

Construction Innovation *scholars (L–R) Soon Kam Lim, Abdul Sharabah and Joanne Jakovich with James Shelvin, First Assistant Secretary of the Policy Coordination Division, Department of Water Resources and the Environment, at the launch of the Your Building sustainable commercial buildings web portal.*

Construction Innovation *scholar Joanne Jakovich at the Your Building launch.*

Table 7: Education and Training outputs and/or milestones

| Type of milestone and/or output | Description of all 2006–07 milestones and/or outputs including past milestones which have not been met (and date) | Achieved (yes/no) | If achieved, progress during 06/07 and planned activities in 07/08 | Reasons why milestones and/or outputs have not been achieved | Strategies to achieve milestones which have not been met |
|---|---|---|---|---|---|
| Review Education and Training Strategy | Strategy reviewed as part of revised Strategic Plan 2005–08 | Yes | The Education and Training Strategy will be reviewed six monthly. | | |
| PhD students – recruit, orientation, commercialisation training | Two x 2 day Scholars workshops conducted during 06/07 year in September 2006 and March 2007.<br><br>Themes included Knowledge Transfer & Research Commercialisation, Media & Negotiation Skills, Career Directions. Three additional scholars have been recruited and inducted into the CRC scholars program. | Yes | • Attendance at Scholars Workshps Brisbane October 2007 & Gold Coast March 2008<br>• Attendance at industry and university forums | | |
| Student involvement in conferences | Students submit and either co-present or present papers at national and international conferences. Eg:<br>* ICOMS Asset Mgmt Conf Melbourne May 2007<br>* CIB March 2007 Sth Africa<br>* Intl Research Symposium on Public Management XI Germany April 2007 | Yes | • Scholars have submitted papers to<br>• 3rd Int *Construction Innovation* conf Gold Coast March 2008<br>• PRoBE conf Edinburgh November 2007<br>• CIB Hong Kong December 2007<br>• 4th Intl Conf 2007 Assoc of Architecture Schools of Australasia Sydney September 2007 | | |
| *Construction Innovation* dissemination strategies | • Research Symposiums conducted in Perth, Sydney and Brisbane<br>• 4 eLearning modules developed and implemented<br>• 2 day Relationship Management workshop conducted in QDMR, QDPW, JHG and LOR. | Yes | • Development of seminars, workshops & eLearning modules from research outcomes<br>• Further research symposiums | | |
| Industry workshops | Industry workshops conducted in Brisbane, Sydney, Melbourne and Perth as rollouts from research projects | Yes | Continued industry workshops in at least four states | | |

# 7. PERFORMANCE MEASURES

## THE PERFORMANCE INDICATORS ADDRESSED IN THIS ANNUAL REPORT ARE THOSE AGREED TO IN THE JANUARY 2004 COMMONWEALTH VARIATION.

### Quality research

**1. Satisfaction of partners and users with research quality and value to industry**

2006–07

The quality and value to industry of *Construction Innovation* research was recognised by a number of industry awards:

- *Construction Innovation's* Sydney Opera House FM Exemplar Project won the Facility Management Association of Australia — Rider Hunt Terotech Industry Achievement Award for facility management strategy and practice in May 2007. The BIM component of the research also featured in two international awards – the Jury's Choice category of the American Institute of Architects Technology in Architectural Practice 2007 awards, and the Bentley Awards for Excellence 2007 award for BIM in multiple disciplines.
- *Construction Innovation's* safety culture research won the Victorian Chapter of the Australian Institute of Building's (AIB) Professional Excellence in Building Award in June 2007.
- *Construction Innovation's* DesignCheck project won the Research and Development category at the AIB 2006 New South Wales Professional Excellence in Building Awards. The project also won a High Commendation in the 2006 Professional Excellence Award for Research and Development at the AIB National Awards in September 2006.
- *Construction Innovation's* Project Diagnostics won the 2006 Professional Excellence Award for Research and Development at the AIB National Awards in September 2006.

*Construction Innovation* retained the support of the majority of its current participants and achieved increased industry support for the development of its two-year extension program.

In May 2007, a variation of the Commonwealth Agreement was commenced to extend *Construction Innovation* until 30 June 2009, engage six new industry participants – Leighton Contractors Pty Ltd, Mirvac Ltd, Nexus Point Solutions Pty Ltd, Thiess Pty Ltd, Transfield Services (Australia) Pty Ltd, and Sydney Opera House – and to undertake three new research programs with a duration of two years commencing 1 July 2007 to 30 June 2009. A 2007 external review of two industry and government participants in *Construction Innovation* found the main benefits and other impacts from *Construction Innovation* research was the Centre's unique capacity to bring various industry partners to collaborate on projects nationally – a capacity that participants identified individual parties are not able to do. The review noted participants regarded *Construction Innovation* research as validating approaches being developed by industry participants and supporting a culture of change to adopt new technologies and innovation in the industry.

2005–06

The CRC for *Construction Innovation's* activities have been significantly broadened in 2005–06 with a strongly emerging education and technology transfer and commercialisation focus in addition to ongoing research management. Concurrently the external communication requirements have enlarged the industry and participant reach of the Centre.

**2. Increase volume of research contribution to CRC**

2006–07

- The cash contribution in 2006–07 exceeded the agreed amount by $283K or 12%.
- Funding of $60,000 for the Construction Site Safety Culture Framework Implementation Kits project was committed by the Australian Government's Office of the Federal Safety Commissioner (OFSC), bringing the total additional support from the OFSC for *Construction Innovation's* safety research to over $100K.
- Additional research programs, developed through the extension program with funding from participants, commenced on 1 July 2007. The total additional cash and in-kind support received from existing participants and new participants for the extension program for the 2007-09 period is $4.6 million.

2005–06

Industry and research sectors are exceeding their in-kind commitments to this CRC with a total excess of 9.5% overall throughout 2005–06. Since the beginning of our CRC the cumulative in-kind contributions to the end of June 2006 exceeds the agreed amount by 3.5%. Close relationships with our research users in the development, management and diffusion of our research outcomes continue to ensure this high level of research contribution.

### 3. Adoption of research results/Benefits of result by partners

2006–07

- BIM and procurement processes identified in the Sydney Opera House FM Exemplar Project have been implemented by the Sydney Opera House.
- Safety programs at John Holland Group and Bovis Lend Lease have adopted outcomes from *Construction Innovation's* Construction Site Safety Culture project, diffused through the supply chain.
- Queensland Department of Public Works is using outcomes from the Off-Site Manufacturing project to inform policy development.
- Queensland Government and Brisbane City Council are using recommendations arising from *Construction Innovation's* eTendering project to inform the development of wider adoption of eTendering in procurement.
- A two-day industry workshop developed from the Value in Project Delivery Systems: Facilitating a Change in Culture project has been embraced by our partners and industry. In the 2006–07 year, workshops were run Queensland Department of Main Roads, John Holland Group, Queensland Department of Public Works and Laing O'Rourke.
- A licence agreement for LCADesign and LCI Database software with an Australian company is in the final stages of development.
- The outcomes of the Sustainable Infrastructure in Aggressive Environments project will inform the Queensland Department of Main Roads' approaches to rehabilitating concrete structures in marine environments.

2005–06

Research project outcomes throughout this year have been trialled extensively by CRC participants and other select partners; or been the subject of industry diffusion through publications, industry breakfast or workshops. In particular the ICT suite of products *(Automated Estimator, Automated Scheduler, DesignCheck and LCADesign)* has been trialled either as a complete suite or as a stand-alone package by eight partners. The results of these trials have been generally positive – with a formal process of feedback to the CRC for package upgrades to advance the project prototypes to a higher level.

The *Construction Site Safety Culture Project* will recommend national uniformity of construction safety supervisor roles to allow more appropriate site safety practices wherever construction sites may be located. This project launch is scheduled to be launched in September 2006. The value to industry can be assessed by understanding the magnitude of the poor safety performance of this industry where workplace deaths and injuries cost the nation $3.6 billion each year.

### 4. Increase national and international collaborations

2006–07

Our project *Value in Project Delivery Systems: facilitating a change in culture* has been developed into a series of learning modules to be delivered to industry and government groups.

In 2006–07, *Construction Innovation* undertook collaborations with 27 industry, government and research participants to develop a two-year research extension program, which commenced on 1 July 2007.

*Construction Innovation's* third International Conference to be held 12-14 March 2008 – *Clients Driving Innovation: Benefiting from Innovation* – focuses on demonstrating the social, environmental and economic benefits of applied research and innovation in the property, design, construction and FM industry. Prominent industry and research speakers from the USA, UK and Hong Kong have confirmed their presentations at the conference.

*Construction Innovation's* Chair, John McCarthy, was appointed Chair of the CIB Marketing and Communication Committee. CIB is a global network for international exchange and cooperation in research and innovation in building and construction, in support of an improved building process and of improved performance of the built environment. *Construction Innovation's* CEO Keith Hampson led the CIB TG58 *Innovation in Construction* Task Group meeting Committee at the Triennial CIB World Building Congress, held in Cape Town in May 2007 and a number of *Construction Innovation* researchers presented papers at the Congress.

*Construction Innovation's* CEO Keith Hampson was invited to participate in an International Review Panel of PSIBouw (Process and System Innovation in Building and Construction) in The Netherlands, which champions the CRC model of industry-research collaboration to deliver industry and national benefit.

In 2006–07 *Construction Innovation* also strengthened its collaboration with buildingSMART International Alliance for Interoperability (IAI), the organisation which established the international open standard IFC for object technology in construction and facilities management. *Construction Innovation's* Chief Operating Officer, Research and Commercialisation, Peter Scuderi, is a member of IAI Board and holds the position of International Education Coordinator – Australasia. Mr Scuderi attended IAI International Council meetings in London and presented research outcomes of the Sydney Opera House FM project.

*Construction Innovation* has also undertaken increased collaboration with organisations progressing digital modelling in the UK, The Netherlands, USA and Germany. These collaborations have led to benefits for our research and commercialisation activities in LCADesign, DesignView and development of the BIM National Guidelines and Case Studies project regarding BIM implementation.

# PERFORMANCE MEASURES

2005–06

This CRC been provided with significant benefits thanks to the foundation laid throughout it's history in linking closely with industry associations. *Construction Innovation* has continued to provide industry diffusion activities through ACIF partners and others. Throughout this year this CRC's reports to industry have been co-branded and/or launched in conjunction with significant national industry associations. In particular, the relationships with the AIB, PCA, AIPM, UDIA, FMAA and RAIA have been enhanced. International collaborations and repute by international industry development groups has also increased. *Construction Innovation's* Board Chair serves on the international board of the CIB – the International Council for Research and Innovation in Building and Construction.

Our CRC is recognised internationally as a leader in servicing the challenging fragmented construction sector. International researchers from our ICALL partners have added value to our private and public participants through collaborations and personal visits in sustainability, ICT and industry development. This international network provides CRC participants and the Australian industry with direct access to the world's construction research leaders. Additionally, our Development Manager's leadership of the IAI's international group's education and training strategy coupled with our ICT products has provided Australian research with an unparalleled access to global leaders. For example, our CRC was invited to present at the annual Bentley Technical Advisory Committee held in Munich in April 2006.

The international collaborations have led to commercial application of CRC products in The Netherlands and ongoing trails in Norway, Finland and USA.

**5. Increase in industry innovations and shifts in the knowledge base**

2006–07

An initiative undertaken to strengthen our industry engagement and ensure pathways to research utilisation has been the establishment of Industry Taskforces to provide senior strategic input into key research projects from organisations both within, and external to, our participant base. This approach has proved highly effective with the Safer Construction project, chaired by Engineers Australia Taskforce for Construction Safety Chair and Leighton Holdings Chief Operating Officer, Bill Wild.

The Taskforce consists of key representatives from:

- *Construction Innovation*
- Engineers Australia (EA)
- Australian Constructors Association (ACA)
- Property Council of Australia (PCA)
- Royal Australian Institute of Architects (RAIA)
- Association of Consulting Engineers Australia (ACEA)
- Australian Procurement and Construction Council (APCC)
- Master Builders Australia
- Office of the Federal Safety Commissioner (OFSC).

Delivered in collaboration with Engineers Australia, Safer Construction brings together the peak national associations for clients, designers and constructors in the development and dissemination of this ground-breaking industry guide to safer construction. In doing so, the project addresses current importance placed on safety by the industry.

A similar approach was adopted for the Your Building project, which involved development of an industry-wide web portal for sustainable commercial buildings for Australian industry. This was undertaken in collaboration with AGO and ASBEC representatives. The Your Building Industry Taskforce comprised representatives from AGO, ASBEC, RAIA, ACEA, PCA and Building Products Innovation Council (BPIC). Increasingly, businesses are placing a value on sustainable commerical buildings.

The Sydney Opera House FM Exemplar Project achieved innovations in the adoption of BIM for the FM industry, an industry which has lagged in the uptake of ICT solutions.

Industry-accredited *Water Services Technology* and *Introduction to BIM* eLearning modules were developed in collaboration with the RAIA. *Construction Innovation's* BRITE project showcased innovative management practices in its *Being the Best* publication and innovation gallery. These have been distributed, with the assistance of state government departments, to a total of 1024 pre-qualified contractors in the road and building industries throughout Australia. Another 200 copies have been distributed through BRITE project participants and to policy and contracting sections of the Queensland Department of Public Works and Queensland Department of Main Roads.

2005–06

*Construction Innovation* has unquestionably developed a high profile in our industry. The BRITE project has continued to *lead the way* with industry publications showcasing industry innovations. From a national survey, this project has also estimated the proportion of industry innovators who are aware of our CRC's activities as 30%. This group of innovators may also contribute to the increasing number of hits on Construction Innovation's website – downloading case studies and reports at a rate that is now almost ten times the monthly hit rate one year ago. Again, industry feedback has confirmed the BRITE project as most valuable for engaging with the SME's that dominate our industry.

*Construction Innovation's* partnership with the FMA in delivering the Sydney Opera House industry seminars (contributing to the Facilities Management Action Agenda) provide another practical example of this CRC's contribution to enhancing the knowledge base. Already, the digital modelling component of this project has contributed to the ongoing development of the Sydney Opera House's 3D modelling architecture and created significant industry interest in a broader application of this technology – particularly lending value to the integrated design/construction/FM whole-of-life digital model.

## 6. Increased recognition of the CRC's contribution to improved standards of design and construction

2006–07

The Building Commission is using the research outcomes (guidelines and a checklist) from the Wayfinding in the Built Environment project to promote consideration of wayfinding systems in the design of buildings through information dissemination via web, newsletters and eBulletins. The wayfinding project collaborated with Standards Australia to ensure alignment and the project outcomes reinforce the Australian standard in this area, specifically for commercial buildings. The project won the Queensland Government's 2007 Disability Action Week Award in the Building and Accessible Environments Category.

*Construction Innovation's* DesignCheck project won the research and development category at the AIB 2006 New South Wales Professional Excellence in Building Awards. The project also won a High Commendation in the 2006 Professional Excellence Award for Research and Development at the AIB National Awards in September 2006.

Industry provided funding for the development of two new research projects which focus on the development of national guidelines for sharing data between disciplines based on case-studies of projects using BIM and the development of a collaborative ICT platform where such data can be shared.

In 2006–07 *Construction Innovation* also strengthened its collaboration with IAI, the organisation which established the international open standard IFC for object technology in construction and facilities management.

2005–06

Standards Australia has recognised the CRC project *Decision Support Tools for the Rehabilitation of Concrete Infrastructure* as providing a necessary set of industry guidelines for practitioners' use. A technical manual is being produced by Standards Australia based on this project outcome to be co-badged, and with sales income to be shared by both organisations.

*Construction Innovation's* extensive industry collaborations in developing improved functionality and robustness of digital modelling have provided a foundation for enhanced industry uptake of this tool. Studies in the United States have indicated that digital modelling will allow improved design, team collaboration, construction bidding, planning and execution and real owner value at all stages of the life cycle. The comprehensive US report (NIST, 2003) has provided an Australian valuation of the benefit of improved productivity through digital communication and sharing at $1.2 billion.

## 7. Contribution by CRC participants in developing public policy initiatives

2006–07

- Performance Benchmarking of Australian Business Regulation (Productivity Commission)
  *Construction Innovation's* CIBE project prepared a submission to the Productivity Commission, in their study on the performance benchmarking of Australian business regulation. On the basis of this submission, the CRC was invited to attend a closed round table discussion on benchmarking the regulatory environment. The work of CIBE project, and the CRC has been noted in the final published report.

- Submission to the Draft Brisbane Economic Development Plan (Brisbane City Council)
  Elements of *Construction Innovation's* submission have been incorporated into the final Brisbane Economic Development Plan — particularly in relation to infrastructure. These inclusions focused on construction industry skills development, and the likely impact of continued population growth on transport infrastructure in Brisbane, and surrounding local government areas.

- Inquiry into a Sustainability Charter (House of Representatives Standing Committee on Environment and Heritage)
  *Construction Innovation* was invited to address the Standing Committee as part of a select Round Table discussion in October 2006 on the Sustainability Charter. *Construction Innovation* nominated ASBEC to participate. ASBEC has subsequently met with the Minister for Environment and Water Resources in relation to the submission.

- Queensland Department of Public Works is using outcomes from the Off-Site Manufacturing project to inform policy development.

- Queensland Government and Brisbane City Council are using recommendations arising from *Construction Innovation's* eTendering project to inform the development of wider adoption of eTendering in procurement.

2005–06

*Construction Innovation* continues to make a recognisable contribution in developing public policy initiative – through its participant policy makers in QDPW, QDMR, QDSDTI, ABCB, Building Commission (Victoria) and BCC. Our CRC has made public policy comment to a draft Brisbane Economic Development Plan and the House of Representatives Standing Committee on Environment and Heritage Inquiry into a Sustainability Charter. Additionally the ABCB is moving to more complete adoption of sustainability provisions in the new Building Code of Australia. The study recommended to the ABCB the need to include sustainability requirements in the BCA. It demonstrated the need to control and regulate sustainability along with the methods available to control and regulate it.

# PERFORMANCE MEASURES

The industry-led Construction Site Safety Culture Project is delivering a national industry safety management system developed in collaboration with employers and employees and leading firms across the industry. This project has the public support of the Australian Safety and Compensation Council and the Federal Safety Commissioner, and is being launched by the Minister for Employment and Workplace Relations, The Hon Kevin Andrews in September 2006.

### 8. Strength of collaboration achieved in research development between researchers and industry

2006–07

The use of Industry Taskforces to strengthen R&D collaboration with industry has proved extremely successful with the Safer Construction project, where senior strategic input across the property, design, construction and FM industry led to ground-breaking collaboration in the development of an industry-wide *Guide to Best Practice for Safer Construction Implementation Kit*. The primary focus of this approach is to engage with the industry associations at a senior level.

This approach has also been adopted for the development of an industry-wide information portal for sustainable commercial buildings – Your Building. Your Building is a collaborative project of *Construction Innovation*, the AGO and ASBEC.

Our new Dispute Avoidance and Resolution project also operates with a senior-level strategic Industry Taskforce.

*Construction Innovation's* BRITE project disseminated findings from interviews with 20 contractors across Australia, of various sizes, to discover and share the management practices of Australia's most highly innovative construction contractors. An innovation database was launched in November 2006. The database was developed in response to calls from the construction industry for a "yellow pages" of innovative contractors. Only qualifying contractors are listed on the database. To qualify, businesses completed a form asking them questions about their innovation activity. The answers are scored and businesses must pass a hurdle score to qualify for listing on the database.

As of January 2007, 107 Australian contractors have applied for registration to the database, with 80 successfully qualifying.

2005–06

The previous mention of in-kind support clearly indicates strength of collaboration between researchers and industry exceeding that initially projected. The industry leadership of *Construction Innovation's* Research Committee and Board has ensured the direct industry input to this CRC's activities. As in previous years, the bottom-down, top-up approach continues to encourage research engagement.

### 9. External recognition of CRC for *Construction Innovation* as a leader in collaborative and innovative research in Australia

2006–07

- *Construction Innovation* management were sought out for comment in mainstream and industry media, including the *Business Review Weekly, Australian Financial Review* and ABC radio.
- Australian Government Minister for Employment and Workplace Relations, the Hon Kevin Andrews, launched *Construction Innovation's* Construction Site Safety Culture project in September 2006.
- The Hon Bob Baldwin MP, Parliamentary Secretary to the Minister for Industry, Tourism and Resources, launched the Sydney Opera House FM Exemplar Project showcases in Melbourne in November 2006.
- *Construction Innovation* developed an extension program which has been broadly supported by the majority of our existing participants, in addition to support from six new industry participants, in recognition of the value of our collaborative research activities in the areas of safety, digital modelling and procurement and dispute resolution.
- *Construction Innovation* staff and project team members from industry and research participants were invited to speak at key national and international conferences and industry events.
- *Construction Innovation* research symposiums on safety and innovation were attended by 200 industry stakeholders.
- Industry demand for FM best practice R&D outcomes resulted in Australia-wide industry workshops to disseminate findings from the Sydney Opera House FM Exemplar Project.
- The Construction Site Safety Culture project workshops attracted 250 industry stakeholders. The recommendations for development of a safety framework have received wide industry recognition and elements of the research have been adopted by John Holland Group and Bovis Lend Lease in their leadership training activities.
- The OFSC provided an additional $100k cash and in-kind support for further development of *Construction Innovation's* safety research, in recognition of the unique role our Centre plays in facilitating collaboration across industry, government and research agencies.

2005–06

Industry feedback can be summarised by international conference keynote speaker Professor Peter Brandon, *"the content was some of the best I have heard anywhere. In many ways this was a*

*watershed event with 3D now firmly in the commercial domain and virtual prototyping now poised to take off. The quality of the presentations was tremendous and I heard nothing but excellent reports… To get that balanced representation (between academic and industry) was almost unique…".*

Our CRC's Board Chair's service on the CIB International Board provides a basis for global comparison of this CRC's leadership in collaborative and innovative research. *"The leadership demonstrated by the CRC for Construction Innovation has represented an exceptional milestone in the global focus of research and development in the built environment … (your) leadership provided in areas including industry development, sustainability and facilities management is without questions a leading contribution from across all CIB members" (Dr Rodney Milford, CIB President).*

Contrary to the trend of other CRC's participation at this mature stage of our life, *Construction Innovation* has been successful in securing additional, core participants. For example, in May 2006 our CRC was launched officially in Western Australia, embracing the Western Australian Government and Curtin University of Technology. The Western Australian Government views our CRC as servicing their Five Year Whole of Government Works Reform Agenda. This provides a practical example of our national industry's recognition of *Construction Innovation* as a national leader in innovation.

## Education and training

### 1. Uptake of *Construction Innovation* inputs to curriculum

2006–07

Industry, government and research participants are involved in the conduct of research, the outputs from which form the base for curriculum content and delivery. The following courses were added to curricula in 2006–07:

Sustainable Infrastructure for Aggressive Environments

- RMIT – CIVE 1173 Infrastructure Management – final year discipline elective in Bachelor of Civil and Infrastructure Engineering with 48 students completing the subject in first semester 2007.

Sustainable Subdivisions – Ventilation

- QUT – DAB 435 Architectural Technology 1 in Bachelor of Design (Architectural Studies) for 112 second year students.

Sustainable Subdivisions – Energy and Water Efficiency Design

- QUT – BEB100 Introducing Professional Learning for 1500 first year Construction Management students.

Construction Site Safety Culture

- RMIT – Project leader lecture for third year students studying property, construction and project management.
- UWS

  EH313A – Undergraduate Occupational Health and Safety for 170 students.

  Safety Management Unit – Grad Dip and Masters of Occupational Health and Safety and Environmental Management for 40 students.

Safer Construction

- RMIT – Lecture – Human Relations and Occupational Health and Safety – 155 students.

IT Enabled Business Strategies

- QUT – CNB309 Online Documentation for 110 third year Construction Management students.

2005–06

A significant number courses incorporating *Construction Innovation* research were added into university curricula in this reporting period. Specifically, research outcomes for the BRITE Project have been incorporated into courses at QUT, UWS, University of Newcastle, and RMIT. The applied *Construction Culture Project* is successfully being developed into local, regional and international education learning resources. One final example highlights the importance of promoting digital modelling in the university curriculum for future project managers and designers. The *eLearning Modules for Building Construction and IT Enabled Business Strategies* will provide current industry case studies for a major international education project with the IAI – as well as forming a component of our universities' undergraduate and graduate curricula.

### 2. Co-supervision of students by industry partners

2006–07

All *Construction Innovation* scholars undertake their studies with both an academic and relevant industry supervisor. Four new scholars joined *Construction Innovation's* industry-focused education program in 2006–07. Industry sponsors of these students, who are all undertaking PhD studies, include Queensland Department of Main Roads, Woods Bagot, Queensland Department of Public Works and the Western Australian Department of Housing and Works.

2005–06

*Construction Innovation* has advanced the number of research training scholarships available across our university network. In each case we seek a complimentary industry partner to act as Associate Supervisor for the student's program of study. In 2005–06 additional scholarships have been funded by Brisbane City Council and John Holland Group. To date ten of our 25 scholars have been sourced by industry participants.

# PERFORMANCE MEASURES

### 3. Uptake of *Construction Innovation* Research Scholarships by quality candidates

2006–07

In 2006–07 four new scholars were welcomed into the scholarship program (see details in Section 6). Each of these students meets ARC postgraduate training criteria, as specified in the Australian Postgraduate Award Industry (APAI) guidelines. This ensures a consistent high standard of scholars across our five university participants. Applications from students are also reviewed by a panel of academic and research-user organisations from our participant network to ensure research projects combine both academic rigour and industry relevance. As of 30 June 2007, the scholarship program included seven PhD students.

2005–06

The new scholars we welcomed into the scheme in 2005–06 were all industry experienced candidates with significant understanding of the 'real-world' needs our industry. In one case the industry partner (Brisbane City Council) has provided the research scholarship funds to support the PhD research of Judy Kraatz, an experienced and capable industry consultant.

### 4. Growth in numbers of industry users involved in research training

2006–07

Four new PhD scholarships were commenced in 2006–07. These scholars are actively supported by industry users of our research from Queensland Department of Main Roads, Woods Bagot, Queensland Department of Public Works and the Western Australian Department of Housing and Works. In addition, three scholars completed their studies in the period. Tim Rose now works fulltime as a senior policy officer for the Queensland Department of Public Works; Ji Soo Yoon has taken up a position with Accenture in Sydney and Wei Peng is working as a research scientist with the CSIRO ICT Centre in Hobart.

2005–06

*Construction Innovation* has advanced the number of research training scholarships available across our university network. In each case we seek a complimentary industry partner to act as Associate Supervisor for the student's program of study. In 2005–06, additional scholarships have been funded by Brisbane City Council *(Critical Success Factors Associated with Major Construction Projects*, Judy Kraatz, supervised by Stephen Kajewski, School of Urban Development, QUT and co-supervised by David Stewart, Executive Manager, Major Infrastructure Projects, BCC); and John Holland Group *(Multi-level approach to safety culture in the construction industry*, supervised by Lisa Bradley, School of Management, QUT and co-supervised by Dean Cipolla, National Safety Manager, John Holland Group).

To date ten of our 25 scholars have been sourced by industry participants. One additional scholarship will be made to Curtin University of Technology, with an appropriate industry co-supervisor this next period. A developing trend embraced by our industry participants is for the increasing use of embedded researchers – where the student is physically co-located with the industry participants for a substantial duration during their research. This practice encourages stronger linking between the partner and student and fosters long-lasting personal, organisational and industry benefits.

### 5. Number of alliances delivering *Construction Innovation* research outputs to industry

2006–07

The use of Industry Taskforces to strengthen R&D collaboration with industry has proved extremely successful with the Safer Construction project, where senior strategic input across the property, design, construction and FM industry led to ground-breaking collaboration in the development of an industry-wide *Guide to Best Practice for Safer Construction Implementation Kit*. The primary focus of this approach is to engage with the industry associations at a senior level.

This approach has also been adopted for the development of an industry-wide information portal for sustainable commercial buildings – Your Building. Your Building is a collaborative project of *Construction Innovation*, AGO and ASBEC. Sponsorship for the Your Building website was received from Connell Wagner, Bluescope Steel, Fletcher Insulation, Leighton, Building Commission, Arup, Stockland, Architectus, Szencorp and Boral.

Other alliances include collaborations with industry associations, such as the APCC, which makes *Construction Innovation* research outcomes available on its website for download by members.

2005–06

Industry alliances continue to be an important element of our strategy to deliver research outputs to industry. Throughout 2005–06, breakfasts, seminars, in-house training programs and public seminars in partnership with the leading industry associations have been successfully delivered.

### 6. Growth in value of research training sponsorship awarded by government and industry for research and/or study related to CRC projects

2006–07

Three *Construction Innovation* scholars received top-up funding from government and industry participants. Organisations contributing funding to our scholars are Brisbane City Council and John Holland Group.

2005–06
Four of our scholars now receive top-up funding from government and industry partners. In many cases this allows mature and experienced professionals to undertake advanced study within our partner universities that they may not previously have had the opportunity to do.

## External Communication

**1. Press releases raising profile of *Construction Innovation* and for research its partners in the promotion of collaboration and innovation**

2006–07

Eleven media releases were issued by *Construction Innovation* or through key partner organisations in 2006–07.

2005–06
Nine media releases were distributed to specialist and general media, and one television and one radio interview was conducted. Networking with our partner and industry association communication network has continued to provide significant media coverage in mainstream and specialist media.

**2. Growth in impact of publications recognised as key by industry and academic partners**

2006–07

Ten specialist industry publications were produced in 2006–07. These publications present the key learnings and benefits emerging from the research in a format aimed at facilitating industry acceptance and uptake. In 2006–07, 4,300 printed copies of industry publications were disseminated to industry, by means of targeted dissemination through industry associations, at selected conferences, research symposiums and industry workshops and with the assistance of our partners and industry associations. All publications are available for free download.

Our *Sustainable Subdivisions: Energy Efficiency* publication is used as a reference book for 1500 first year Construction Management students at QUT.

Outcomes from our HVAC publication were included in Australian Institute of Refrigeration Air Conditioning and Heating (AIRAH) industry publication.

The high level of recognition of our publications is evidenced by the involvement of senior politicians and leading industry representatives in their launch and dissemination. In September 2006, the Minister for Employment and Workplace Relations, the Hon Kevin Andrews, launched *Construction Innovation's* Construction Site Safety Culture project.

The Hon Bob Baldwin MP, Parliamentary Secretary to the Minister for Industry, Tourism and Resources, launched the Sydney Opera House FM Exemplar showcases and *FM as a business enabler* publication in Melbourne in November 2006.

2005–06
2005–06 has seen a significant growth in impact of our publications with over 20 booklets and/or research reports completed by *Construction Innovation.* Involvement by senior industry leaders at key industry events has been encouraged. For example, Bill Wild, former MD John Holland Group, launched our CRC's *Clients Driving Construction Innovation: Mapping the Terrain* book (Brown, Hampson and Brandon eds, 2005) at the Australian Institute of Project Management National Conference in Melbourne in October 2005. Additionally our CRC's Research Library readily provides industry with internet access to our completed industry relevant reports. The growth in web hits this past 12 months and the downloading of our industry report confirms the interest in our CRC's outputs. In this next period a number of ministerial launches at major industry events will be realised including the launch of the *Construction Safety Culture* research outcome booklet by Minister for Employment and Workplace Relations, Kevin Andrews.

**3. Numbers of paper presented to national and international conferences and promotional activities**

2006–07

13 refereed conference papers were delivered to international conferences and four international industry presentations were made in 2006–07. Ten papers were delivered to national conferences and 16 industry and academic presentations were delivered during the year (see Appendix 1).

2005–06
14 refereed papers and 5 conference papers were delivered to international conferences. 19 refereed papers and 21 conference papers were delivered to national conferences.

**4. Number of presentations to partners, industry and community groups**

2006–07

*Construction Innovation* conducted as series of 7 projects industry seminars, launches, 3 stakeholder workshops, 2 research symposiums and extensive participant meetings and events, in addition to a comprehensive industry consultation process to develop our new extension program, which runs from 1 July 2007 to 30 June 2009. Individual project teams present on a regular basis to industry groups.

# PERFORMANCE MEASURES

2005–06

An extensive national program of presentations to partners, industry and community groups have continued throughout 2005–06, with over 105 presentations conducted. *Construction Innovation* is invited at the major industry association events and contributes regularly to our partner's internal presentations and workshops. Additionally our CRC has contributed a number of formal submissions to government and community groups relating to sustainability, industry skilling and infrastructure development.

CRC is widely recognised throughout industry as being the central R&D service provider in our industry and is sought after by industry associations to deliver informative content to their members at national and international conferences.

## Commercialisation

**1. Diffusion activities undertaken by CRC audience indicated by number of project-initiated seminars and workshops**

2006–07

*Construction Innovation* hosted two research symposiums in Western Australia and New South Wales.

Perth Research Symposium held at Engineers Australia on 20 February 2007 was attended by 50 industry practitioners. Feedback summary:

- 90% of respondents indicated that the presentations were relevant to their needs
- 95% of respondents indicated that they were likely to use the learnings in their workplace.

Sydney Research Symposium held on 4 June 2007 was attended by 100 industry practitioners. Feedback summary:

- 95% of respondents believed that all presentations and presenters were relevant to their needs
- 80% of respondents had attended to hear updates on Safety research for industry.

In November 2006 four showcases presented the project research outcomes to over 300 leading practitioners from the FM and building and construction sector. Industry representation included 48% from the FM sector, and 14% from the Design and Construct and Property Services respectively. Smaller percentages from a wide range of other interest groups in the construction sector attending totalled 24%. Attendees with a managerial role were the most well attended at (54%) followed by those operating in an operational capacity (24%) and an executive capacity (22%).

*Construction Innovation* is widely regarded within industry for its dissemination activities and as an interface for research outcomes.

2005–06

41 project-initiated seminars/workshops throughout Australia were undertaken promoting the outcomes of 12 projects.

**2. Invitations as keynote speaker to industry conferences, seminars, etc**

2006–07

6 keynote presentations were delivered by *Construction Innovation* researcher users nationally and 4 keynote presentations were delivered internationally.

2005–06

2 keynote presentations were delivered by CRC for *Construction Innovation* researchers nationally and internationally.

**3. Increase in participation in industry, trade and academic conferences**

2006–07

*Construction Innovation* was represented in 16 international and 17 state or national conferences.

2005–06

*Construction Innovation* was represented in 15 international and 18 state or national conferences.

**4. Increase in publications for industry users**

2006–07

Ten specialist industry publications were produced in 2006–07. These publications present the key learnings and benefits emerging from the research in a format aimed at facilitating industry acceptance and uptake. In 2006–07, 4,300 printed copies of industry publications were disseminated to industry, by means of targeted dissemination through industry associations, at selected conferences, research symposiums and industry workshops and with the assistance of our partners and industry associations. All publications are available for free internet download.

2005–06

*Construction Innovation* has developed industry-focussed project brochures, including the next six in the BRITE Project innovation case studies series. These brochures are all available on the web and are also distributed via industry mail outs, our industry association

networks and through personal distribution at conferences and industry meetings.

**5. Increase in number of media clippings/ appearances**

2006–07

*Construction Innovation* has achieved strong industry media dissemination in 2007, more than doubling the number of major articles in industry media in the period January to August 2007 (76 articles) to the number of articles published in 2006 (35 articles). To date in 2007, *Construction Innovation* has achieved more industry media coverage than any other year of its operation with additional extensive media coverage in mainstream and industry media expected following the launches of the *Safer Construction* and *Your Building* projects in September, further reflecting the relevance of our research activities.

2005–06

Over 50 media hits in the form of magazine, newspaper articles and press releases, radio and television were recorded for 2005–06.

**6. Growth in income and industry uptake from commercialisation of IP**

2006–07

5 products are being trialled as prototypes by participants and external parties: LCADesign, Automatic Estimator, Automatic Scheduler, DesignCheck and Noise Management. Project Diagnostics is the subject of an existing licence agreement with an international commercial partner.

The Australian Building Codes Board is interested in further development of the DesignCheck software. DesignCheck is an automated design checking system that quickly assesses if a building design meets the requirements of Australia's new disability access code. There is real potential for the software to be applied to elements of the Building Code of Australia.

2005–06

In the last period this CRC has seen considerable growth and industry update from commercialisation of IP. In particular, the BRITE project, eBusiness Legal and Security, Construction Site Safety Culture, Road Asset Management and Analysis Tools for BIM, online collaborative tools and facilities management.

## Administration

**1. Satisfaction of Participant and Commonwealth with financial and research management systems**

2006–07

19 Executive Report Cards (ERCs) were circulated to industry, government and research participants of *Construction Innovation* detailing the impact of their engagement for each participant. The ERCs provide specific detail on participant staff involved in *Construction Innovation* research, a breakdown of the cash and in-kind investment from each participant organisation and detail of research impact from projects in which the participant has invested.

A 2007 external survey of two industry and government partners found a high level of satisfaction with *Construction Innovation* research management systems. Participants reported numerous benefits in their association with our national research Centre, including validation of their own industry programs, opportunity to interact with researchers and the credibility of the research. The survey found the main benefits for participants from their involvement in *Construction Innovation* research was the Centre's capacity to bring various industry partners together to collaborate on projects nationally – a capacity that participants felt individual parties are not able to do. The review noted participants regarded *Construction Innovation* research supported a culture of change to adopt new technologies and innovation in the industry.

Additionally, the vast majority of existing participants re-engaging for the extension project of our CRC to 2009, demonstrates the satisfaction and value of engagement with our participants.

The audit signoff achieved from the 2006–07 accounts verifies the rigour of *Construction Innovation's* financial and research management systems.

2005–06

The Executive Report Card process and ongoing informal feedback mechanisms continue to demonstrate satisfaction with the CRC's financial and research management systems. The Fifth Year Review was very positive, stating *"(This CRC) has achieved a considerable amount of success in the past four years and it is encouraging to see the level of support from partners and from the industry as a whole. There is a growing sensitivity to research and a recognition that a culture of self improvement through innovation is necessary for property and construction to remain competitive and further address the needs of the range of communities it serves … The CRC CI is well organised and now faces a challenge to manage and drive the research it has commissioned to further meet its objectives and the deliverables it has set."*

The audit signoff achieved from the 2005–06 accounts also verifies the rigour of Construction Innovation's financial and research management systems.

# PERFORMANCE MEASURES

### 2. Effective Centre operations across all Commonwealth programs

2006–07

*Construction Innovation* met all reporting and audit milestones as defined by the CRC Programme. The value of the Centre to R&D was recognised by the CRC Programme's one-year extension of *Construction Innovation's* research program. The Centre's Governing Board has again expressed confidence in the established systems contributing across all Commonwealth programmes. The CRC community acknowledges that *Construction Innovation* is well managed and successfully engaging with industry partners in an industry environment that has previously had limited interaction with the research fraternity.

The Australian Institute for Commercialisation has identified *Construction Innovation* as one of the top five preforming CRCs based in part on an analysis of the Management Data Questionnaire responses.

2005–06

The Governing Board has again expressed confidence in the established systems contributing across all Commonwealth programmes. The CRC community acknowledges that *Construction Innovation* is well managed and successfully engaging with industry partners in an industry environment that has previously had limited interaction with the research fraternity.

### 3. Collaborative transactions with industry or government partners, including research projects

2006–07

*Construction Innovation* collaborated with five industry conferences, providing sponsorship and conference presenters.

Your Building, a collaborative project of *Construction Innovation*, AGO and ASBEC, has developed Australia's key online resource about sustainable commercial buildings. Sponsorship for the Your Building website was received from Connell Wagner, Bluescope Steel, Fletcher Insulation, Leighton Contractors, Building Commission, Arup, Stockland, Architectus, Szencorp and Boral.

2005–06

Again, *Construction Innovation* has distinguished itself as being a highly collaborative CRC. Our interfaces with industry and government partners and industry associations (e.g. sourcing of students and scholarship funding, internal training programs, joint presentations at national and international conferences, jointly authored industry and academic journal publications, fresh project support, and the energetic response regarding our rejection of CRC funding in May 2006) stand testimony to *Construction Innovation's* extensive collaborative transactions with industry and government.

### 4. Growth in number of additional collaborations annually, particularly with industry

2006–07

In 2006–07, *Construction Innovation* undertook collaborations with 27 industry, government and research partners to develop a two-year research extension program, which commenced on 1 July 2007. The extension program features increased collaboration and research leadership from industry.

An initiative undertaken to strengthen our industry engagement and ensure pathways to research utilisation has been the establishment of Industry Taskforces to provide senior strategic input into key research projects from organisations both within, and external to, our participant base. This approach has proved highly effective with the Safer Construction project, chaired by Engineers Australia Safety Taskforce Chair and Leighton Holdings Chief Operating Officer, Bill Wild.

Delivered in collaboration with Engineers Australia, Safer Construction brings together the peak national associations for clients, designers and constructors in the development and dissemination of this ground-breaking industry guide to safer construction. In doing so, the project reinforces the unique position *Construction Innovation* occupies in its ability to provide national, independent industry R&D leadership. The success of industry-wide collaboration in the Safer Construction project has resulted in the Australian Institute of Building reviewing and endorsing outcomes from the project.

A similar approach was adopted for the Your Building project, which involved development of an industry-wide web portal for sustainable commercial buildings for Australian industry. The Your Building Industry Taskforce comprised representatives from AGO, ASBEC, RAIA, ACEA, PCA and BPIC.

Our new Dispute Avoidance and Resolution project also operates with a senior-level strategic Industry Taskforce.

2005–06

A number of our projects have produced software that complements existing CAD software. We have been actively seeking interest from the three international CAD developers and have strong interest from two Australian companies to take two of our tools to market. We are also actively engaged with a northern European group who are validating our technology for the purposes of a web-based business model:

- *DesignCheck* and *LCADesign* and the *Life Cycle Inventory* database continue to be of interest to two Australian companies, with discussions developing the terms for a Licence Agreement for *DesignCheck*. The interested companies are proposing to take these two products to the Australian market as a precursor to the international market place.

- *Automated Estimator* is also sparking commercial interest and although no formal commitment has been received by the CRC as yet, industry trials are underway.

- *Automated Scheduler* has been the focus of early discussions with two Australian software companies interested in a commercial arrangement.

- *DesignSpec*, the latest ICT tool is an auto generating specification tool that interfaces with a 3D CAD model. While *DesignSpec* is of interest to a number of specification companies it is too early to identify a particular commercial partner to work with.

**5. Growth in repeat collaborations with partners on projects and related activities**

2006–07

In 2006–07, *Construction Innovation* undertook collaborations with 27 industry, government and research partners to develop a two-year research extension program, which commenced on 1 July 2007. The extension program features increased collaboration from industry.

In 2006–07, the OFSC provided funding of $60,000 to further develop research outcomes from the Construction Site Safety Culture project. This brings the total additional funding received for our safety research from the OFSC to $100K. The funding will help develop implementation kits for industry dissemination of key findings from the project. The OFSC are also represented on the Industry Taskforce of the Safer Construction project.

Additionally, the vast majority of existing participants re-engaging for the extension project of our CRC to 2009, demonstrates the satisfaction and value of engagement with our participants.

2005–06

Again, the growth in repeat collaborations with partners and related activities is strong. Throughout 2005–06 the research user network increased by two core partners and our cash and in kind contributions to our CRC exceeded budget. By any measure our CRC has experienced significant success in its partner collaboration through research, education and training, and communication.

# APPENDIX 1 – PUBLICATIONS AND PRESENTATIONS

## Book and journal articles

Biggs, H.C., Sheahan, V.L., Dingsdag, D.P. and Cipolla, D., (2006) 'Safety culture, safety attitudes, and market force influences on construction site safety', in Brown, K., Hampson, K. and Brandon, P. (eds), *Clients Driving Construction Innovation: Moving Ideas into Practice*, Cooperative Research Centre for Construction Innovation, Brisbane, pp 201–213

Christensen, S., Mason, S. and O'Shea, K. (2006) 'The International Judicial Recognition of Electronic Signatures – Has Your Agreement Been Signed?' *Communications Law 150*, Vol 11, Issue 5

Christensen, S., McNamara, J. and O'Shea, K. (2007) 'Legal and Contracting Issues in Electronic Project Administration in the Construction Industry', *Structural Survey*, Vol 25, Issues 3 and 4

Dingsdag, D.P., Biggs, H.C. and Sheahan, V.L. (2006) 'Changing safety behaviour in the construction industry, using enforcement and education as the stick and the carrot to improve safety culture', in Brown, K., Hampson, K. and Brandon, P. (eds), *Clients Driving Construction Innovation: Moving Ideas into Practice*, Cooperative Research Centre for Construction Innovation, Brisbane, Icon.Net Pty Ltd., pp 214–219

Dingsdag, D.P., Biggs, H.C., Sheahan, V.L. and Cipolla, D.J. (2006) 'A Construction Safety Competency Framework: Improving OH&S performance by creating and maintaining a safety culture', Cooperative Research Centre for Construction Innovation, Brisbane, pp 1–66

Dingsdag, D. P., Biggs, H. C., and Sheahan, V, L. (In Press) 'Understanding and defining OH&S competency for construction site positions: Worker perceptions'

Drogemuller, R. (2007) 'Virtual Prototyping from Need to Pre-Construction', University of Salford

Drummond, M. (2007) 'Stephen Ballesty on FM as a Business Enabler', *FMA Australia's FMAonline newsletter* (ed 10 11 February)

Furneaux, C.W., Brown, K.A., Allen, D., Abel, N., McConville, S., McFallan, S., London, K., and Burgess, J. (2006) 'Client capabilities and capital works procurement policies: A comparative analysis of Australian jurisdictions', in Brown, K., Hampson, K. and Brandon, P., *Clients Driving Construction Innovation: Moving Ideas into Practice*, Cooperative Research Centre for Construction Innovation, Cooperative Research Centre for Construction Innovation, Brisbane, pp 62–71

Hampson, K. (2007) 'Building a Digital future', CRC-*Construction Innovation website from the CEO's desk*, referring to FM Exemplar Project, 26 February

Hampson, K. (2007) 'Sydney Opera House goes digital', *Australian National Construction – Major Project Review magazine*, industry comment, pp 12, April

Hardie, M., Khan, S. and Miller, G. (2006) 'Waste minimisation in office refurbishment projects: an Australian perspective', submitted to *Construction Management and Economics*

Hardie, M., Khan, S., O'Donnell, A. and Miller, G. (2006) 'The efficacy of waste management plans in Australian commercial construction refurbishment projects', submitted to the *Australian Journal of Construction Economics and Building*

Keast, and Hampson, KD, "Building Constructive Innovation Networks: The Role of Relationship Managment", *Journal of Construction, Engineering and Management, American Society of Civil Engineering*, Vol 133, No 5, pp364–373, May 2007.

London, K. and Chen, J. (Forthcoming), 'Inter-Agency Cooperative Relationships for Infrastructure Life-Cycle Supply Chain Economy Policy Implementation' in Smyth, H. and Pryke, S. (eds), *Collaborative Relationships in Construction*, Blackwell Publishing

Manley, K. (2006) 'The innovation competence of repeat public sector clients in the Australian construction industry', *Journal of Construction Management and Economics*, Vol 24, No 12, pp 1295–1304

Manley, K. and McFallan, S. (2006) 'Exploring the drivers of firm-level innovation in the construction industry', *Journal of Construction Management and Economics*, Vol 24, No 9, pp 911–920

Schevers, H., Mitchell, J., Akhurst, P., Marchant, D., Bull, S., McDonald, K., Drogemuller, R. and Linning, C. (2007) 'Towards Digital Facility modelling for Sydney Opera House using IFC and Semantic Web Technology', *ITcon* Vol 12, pp 347–362

December 2006, 'Opera House Backstage Secrets Revealed', FM Exemplar Showcase profiled in interview with Hon. Bob Baldwin, MP, *Australian Institute of Quantity Surveyors (AIQS)'s The Building Economist*, Briefings, pp 3

February 2007, 'Modelling the Sydney Opera House', *Master Builders Magazine*

5 February 2007, 'FM Report Published', *CRC-Construction Innovation online media: extra news* – via www.constructioninnovation.info

8 February 2007, 'Digital Modelling', 'Services Procurement' and 'Performance Benchmarking' research reports, CRC-Construction Innovation and FMA Australia website release of FM Exemplar Project: Sydney Opera House, available via www.constructioninnovation.info and www.fma.com.au culminating in the publication of *'FM as a business enabler'*

March 2007, 'A model Opera House' profiling the FM Exemplar Project, *Australian Government, Department of Education, Science & Training (DEST)'s CRCs Success through Innovation quarterly*

7 March 2007, 'Towards Integrated Practice', *Royal Australian Institute of Architects' website* – via www.architecture.com.au

12 April 2007, 'Adopting BIM for facilities management' profiling the FM Exemplar Project', *CRC-Construction Innovation newsletter update*

20 April 2007, 'Adopting BIM for facilities management', CRC-Construction Innovation release of FM Exemplar Project: Sydney Opera House, available for download or for sale

3 May 2007, 'Two FM reports published from FM Exemplar Project', *CRC-Construction Innovation's newsletter update*

12 June 2007, 'FM Excellence in the Spotlight' profiling the annual FM Excellence Awards including the FM Exemplar Project: Sydney Opera House winning the *FMA Australia and Rider Hunt Terotech FM Industry Achievement Award and Stephen Ballesty winning the FMA Australia 2007 Member of the Year Award, FMA Australia's FMAonline newsletter* (ed 14)

25 June 2007, 'Facilities Management takes centre stage' profiling the award winning FM Exemplar Project and quoting the Hon. Bob Baldwin MP, *National Building News*, Vol 7, No 5, pp 45

December 2006 (Submitted) The Client's Role in Promoting OHS in the Australian Construction Industry, *Construction Management and Economics*

January 2007 (Submitted) OHS in the Australian Construction Industry: The Role of Key Stakeholders, Construction

February 2007 (Submitted) Construction Designers' Role in the Management of Construction Site Safety: Current Practice in Australia, *Safety Science*

February 2007 (Submitted) The Development of an Evidence-based Code of Practice for OHS in the Australian Construction Industry, *Journal of Occupational Health and Safety* – Australia and New Zealand

## Refereed conference papers/conference papers

Akhurst , P., 'FM Exemplar Project', AusFM 2007 Conference, Sydney, 19 February 2007

Akhurst, P., Bull, S., Marchant, D. and Schevers, H., 'FM Exemplar Project: Sydney Opera House', RAIA's Departure Lounge National Architecture Conference, Melbourne, 20 April 2007

Ballesty, S., 'ICON: heart of the city – creation and maintenance with Sydney Opera House case study', Marcus Evans' City Development Asia 2007, Singapore, 23 January 2007

Ballesty, S., 'Managing the Built Environment and FM as a business enabler, the Australian experience', IFMA Foundation Board, Georgia, USA, 19 May 2007

Brown, K.A., Hampson, K. and Furneaux, C.W., 'Mapping the regulatory environment: Implications for construction firms', CIB 2007 World Building Conference, Cape Town, South Africa, Proceedings CIB World Building Congress, Cape Town, South Africa, pp 1827–1839, May 2007

Brown, K.A., London, K. and Furneaux, C.W., 'Harmonising construction regulation in Australia: Potentials and problems', Public Policy Network Conference, Adelaide, 1–2 February 2007

Charles, M.B., Furneaux, C.W., Pillay, J., Thorpe, D., Paredes-Castillo, C.H. and Brown, K.A., 'Uptake of an OHS code of practice by Australian construction firms', CIB2007 World Building Congress, Cape Town, South Africa, pp 1238–1252, May 2007

Cheung, Y.K.F., 'Supply chain sustainability – the role of trust and relationships', Joint International Conference on Construction Culture, Innovation and Management', Dubai, 26–29 November 2006

Drogemuller, R., 'Testing Collaboration using IFC based software', ECPPM 2006 Conference, Valencia, Spain, September 2006

Furneaux, C.W. and Brown, K.A., 'Capabilities, institutions and markets: A cross jurisdictional analysis of embedded public values in public works procurement in Australia, International Research Symposium on Public Management XI, Potsdam University, Germany, 2–4 April 2007

Ge, E., Nayak, R., Li, Y. and Xu, Y, 'Data Mining for Lifetime Prediction of Metallic Components, 'The Australasian Data Mining Conference: AusDM 2006, Sydney, November 2006, pp 75–83

Hampson, KD, *Procurement Strategies for New Forms of Cooperation, Partnering and Alliancing*, 2nd International Conference "Quality Chain Management", Stockholm, Sweden, 30–31 May, 2007

London, K. and Chen, J., 'Construction supply chain economic policy implementation for sectoral change: moving beyond the rhetoric', The Construction Research Conference of the RICS, London, 7–8 September 2006

London, K. and Chen, J., 'The difficulties of the simplistic traditional risk versus expenditure mapping tool for construction supply chain policymakers', CIBW92, Salford, United Kingdom, 29 November–1 December 2006

London, K., Purcell, S. and Bellamy, T., 'Harmonised procurement policy environment – Identifying key themes towards the development of a conceptual model', CIB W92 Procurement Systems, Salford, United Kingdom, 29 November–1 December 2006

Manley, K., 'Identifying the determinants of construction innovation', Joint International Conference on Construction Culture, Innovation and Management, Dubai, 26–29 November 2006

O'Hare, D., Miller, A. and Ambrose, M., 'Towards a lot rating methodology for subtropical climates', Sub tropical Cities Conference, Brisbane, 27–29 September 2006

# APPENDIX 1 – PUBLICATIONS AND PRESENTATIONS

Perera, C., Setunge. S., and Molyneaux, T., 'Optimizing floor space during retrofitting of high-rise office buildings', in the Proceedings of the WCEAM – Inaugural World Congress on Engineering Asset Management, Gold Coast, 11–14 July 2006

Rose, T. and Manley, K., 'Effective Financial Incentive Mechanisms: An Australian Study', CIB World Building Congress, Cape Town, South Africa, 14–18 May 2007

Seo, S., Tucker, S.N. and Newton, P.W., 'Automated material selection and assessment in the context of 3D building modelling', Proceedings of Joint AASMIC/Materials Australia Sustainable Materials Conference on Sustainable Materials in the Built Environment 2007, Melbourne, 18–20 February 2007, pp 11

Seo, S., Tucker, S.N. and Newton, P.W., 'Sustainable decision support tool for building materials', Proceedings of Fifth Australian Conference on Life Cycle Assessment, Melbourne, 22–24 November 2007, pp 7

Venkatesan, S., Setunge, S., Molyneaux, T.C.K., and Gravina, R.J., 'Towards a Rule-based matrix for evaluating distress mechanisms in bridges', ACMSM, November 2006

Yang, J. and Lim, S, 'An integrated approach to the "relife" of office buildings', abstracts accepted by the CIB 2007 International Congress, South Africa

'Occupational Health and Safety Reform in the Construction Sector', Public Policy Network, Glenelg, South Australia, 1–2 February 2007

## Industry and academic presentations

2003-050-A, Cipolla

- 22 September 2006, Launch of A Construction Safety Competency Framework, Melbourne
- 27 November 2006, Launch of A Construction Safety Competency Framework, Perth
- 6 December 2006, Launch of A Construction Safety Competency Framework, Brisbane
- 4 June 2007, Safety, Innovation & Integrated Digital Modelling Research Symposium, Sydney

2004-021-A, Manley

- 28–30 September 2006, Karen Manley 'Innovate Now!', Australian Institute of Building, Construct 2006 Conference, Gold Coast
- August 2007, Queensland Department of Main Roads Technology Forum, Brisbane

2004-032-A, Brown

- February 2007, CRC Symposiums, – OH&S regulation in Australia, Perth
- June 2007, CRC Symposiums, – OH&S regulation in Australia, Sydney

2005-025-A, Christensen

- 20 February 2007, industry presentation detailing the basic legal and security concepts in e-contracting, CRCI Perth Research Symposium, Perth

2002-077-B, Delsante

- March 2007, CRC for Construction Innovation Research Symposium, Perth

2005-015-B, Stapledon

- September 2006, FMA Queensland

2005-001-C, Ballesty

- 15 May 2007, Rider Hunt Levett & Bailey staff briefing on FM Action Agenda and FM Exemplar Project, Las Vegas, Nevada, USA
- 18 May 2007, IFMA Atlanta Chapter leaders meeting briefing on the FM Action Agenda and FM Exemplar Project at the Interface showroom in Atlanta, Georgia, USA
- 19 May 2007, IFMA Foundation Board presentation – 'Managing the Built Environment and FM as a Business Enabler, the Australian experience', Georgia, USA
- 22 May 2007, Bucknall Austin partners briefing on the FM Action Agenda and FM Exemplar Project, London, UK
- 20 June 2007, the Hon. Bob Baldwin, MP and Stephen Ballesty, FM Exemplar Project: Sydney Opera House Showcase #4 seminar series, Canberra

## Other presentations

2004-016-A, London

- September 2006, Professor Mustafa Mulhawi, University of Salford, UK
- September 2006, Professor Peter Brandon, University of Salford, UK
- September 2006, Professor Stuart Green, University of Reading, UK
- September 2006, Professor Kagliogou, Salford Centre for Innovation, UK
- September 2006, Jean Carrassus, CSTB, France
- September 2006, Professor Dave Langford, University of Strathclyde, UK

2004-032-A, Brown

- September 2006, Craig Furneaux, 'Policy Networks: Demonstrating their presence, structure and influence', Faculty of Business Student Research Colloquium, Brisbane

2004-003-B, Warner

- June 2007, TV show – Scope: City Science

## Working papers

2005-017-A, Gallery

- Falta, M., Business Performance Indicators with Direct Cause-and-Effect Relationships: An Analysis of Construction Industry Companies

- Falta, M., Business Performance Analysis and Prediction Through Hybrid Optimisation Techniques Using Heterogeneous Data

- Falta, M. and Gallery, N., Impact of Financial Reporting Requirements on Data Quality and Failure Frequency of Construction Companies

# APPENDIX 2 – ACRONYM LIST AND DEFINITIONS

| | |
|---|---|
| American Society of Civil Engineers | ASCE |
| Architecture Engineering and Construction | AEC |
| Association of Consulting Engineers Australia | ACEA |
| Association of Researchers in Construction Management | ARCOM |
| Australian Building Codes Board | ABCB |
| Australian Construction Industry Forum | ACIF |
| Australian Constructors Association | ACA |
| Australian Council for Infrastructure Development | AusCID |
| Australian Greenhouse Office | AGO |
| Australian Institute of Building | AIB |
| Australian Institute of Management | AIM |
| Australian Institute of Project Management | AIPM |
| Australian Performance Based Building Initiative | AusPeBBu |
| Australian Procurement and Construction Council | APCC |
| Australian Sustainable Built Environment Council | ASBEC |
| Australian Universities Building Educators Association | AUBEA |
| Bill of Quantities | BoQ |
| Bovis Lend Lease | BLL |
| Brisbane City Council | BCC |
| Brisbane Water Enviro Alliance | BWEA |
| Building Code of Australia | BCA |
| Building Commission (Victoria) | BC |
| Building Industry Redundancy Trust (Queensland) | BIRT |
| Building Information Modelling | BIM |
| Building Products Innovation Council | BPIC |
| Building Research Innovation Technology and Environment | BRITE |
| Building Services Research and Information Association | BSRIA |
| carbon fibre-reinforced polymer | CFRP |
| case-based logic | CBL |
| Centre for Integrated Engineering Asset Management | CIEAM |
| Civil Contractors Federation | CCF |
| Commonwealth Scientific and Industrial Research Organisation | CSIRO |
| Computer-Assisted Design | CAD |
| Contract Planning Workbench | CPW |
| Cooperative Research Centre | CRC |
| Cooperative Research Centre Association | CRCA |
| Construction and Property Services Industry Skills Council | CPSISC |
| Continuing Professional Development | CPD |
| Corporate Real Estate | CRE |
| Corporate Social Responsibility | CSR |
| Critical Success Factors | CSF |
| Decision-support Systems | DSS |
| Engineering database management | EDM |
| Environmental Protection Agency | EPA |
| Environmentally sustainable development | ESD |
| Executive support systems | ESS |
| Facilities Management Association Australia | FMAA |
| Facility management | FM |
| Fibre-reinforced composite | FRC |
| fibre-reinforced polymer | FRP |
| Forest and Wood Products Research and Development Corporation | FWPRDC |
| Government Asset Management Arena | GAMA |
| Housing Industry Association | HIA |
| Heating, ventilation and air-conditioning | HVAC |
| Human–computer interfaces | HCI |
| Industry foundation classes | IFC |
| Information and communication technology | ICT |
| Institution of Engineers Australia | IEAust |
| Intellectual property | IP |
| International Alliance for Interoperability | IAI |
| International Construction Research Alliance | ICALL |
| International Council for Research and Innovation in Building and Construction | CIB |
| Key performance indicators | KPIs |
| Life cycle analysis | LCA |
| National Occupational Health and Safety Commission | NOHSC |
| Noise-induced hearing threshold shifts | NITS |
| Occupational Health and Safety | OHS |
| Office of the Australian Safety and Compensation Council | OASCC |
| Off-site manufacture | OSM |
| Outcomes performance indicators | OPI |
| Property Council of Australia | PCA |
| Public-Private Partnership | PPP |
| Queensland Department of Main Roads | QDMR |
| Queensland Department of Public Works | QDPW |
| Queensland Department of State Development and Innovation | QDSDI |
| Queensland University of Technology | QUT |
| Research and development | R&D |
| Royal Australian Institute of Architects | RAIA |
| Royal Melbourne Institute of Technology | RMIT |
| Small-to-medium size enterprise | SME |
| Small office – home office | SOHO |
| Smart and Sustainable Built Environment | SASBE |
| Soft systems methodology | SSM |
| Strategic asset maintenance | SAM |
| Technical and Further Education | TAFE |
| Vocational education and training | VET |
| University of New South Wales | UNSW |
| Urban Development Institute of Australia | UDIA |
| Year of the Built Environment | YBE |

# APPENDIX 3 – SPECIFIED PERSONNEL

The following table of Specified Personnel reflects the revised list included in the Commonwealth Agreement Contract Variation dated 9 January 2004.

| Title and name | Contributing organisation | % Working time in CRC | % Actual time for Yr 05/06 | Role in Centre |
|---|---|---|---|---|
| Keith Hampson | CRC for *Construction Innovation* | 100% | 100% | CEO |
| Carole Green | CRC for *Construction Innovation* | 100% | 100% | Business Manager |
| Peter Scuderi | CRC for *Construction Innovation* | 100% | 100% | Development Manager |
| Peter Newton[1] | CSIRO | 50% | 35% | Program Leader, Research Committee |
| Neal Ryan[2] | QUT | 50% | 10% | Program Director, Research Committee, Project Leader |
| Robin Drogemuller[3] | CSIRO\QUT | 50% | 45% | Platform Director, Research Committee, Project Leader |
| Don Allan[4] | Queensland Department of Public Works | 20% | 0% | Deputy Program Director, Research Committee |
| Gerry Shutt[5] | John Holland Group | 20% | 5% | Deputy Program Director, Research Committee |
| Mary Lou Maher | The University of Sydney | 50% | 16% | Research Committee, Project Leader |
| Jeanette Clough[6] | Rider Levett Bucknall | 20% | 0% | Deputy Platform Director, Research Committee |
| Ron Wakefield | RMIT | 50% | 19% | Research Committee, Project Leader |
| John Oliver | Rider Levett Bucknall | 22% | 21% | Rider Levett Bucknall Projects Coordinator, Chair, Research Committee |
| John Spathonis | Queensland Department of Main Roads | 50% | 6% | QDMR Projects Coordinator, Research Committee |
| Dale Gilbert | Queensland Department of Public Works | 10% | 5% | QDPW Projects Coordinator, Research Committee |

[1] Dr Peter Newton left CSIRO in December 2006
[2] Professor Neal Ryan left QUT in December 2006
[3] Robin Drogemuller moved to QUT in March 2007
[4] Don Allen was on extended leave during this period
[5] Gerry Shutt left John Holland Group December 2006
[6] Jeanette Clough left John Holland Group

# APPENDIX 4 – STAFF TABLES

**Staff Table 1 – CRC In Kind Staff**

**Arup**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Colin Henson | A | 0.1% | - | - | - | 0.1% | - | - | - | - |
| Richard Hough | R | 3.2% | 0.3% | 0.2% | - | 3.2% | - | - | - | - |
| Ken Stickland | R | 0.4% | - | 0.2% | - | 0.4% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 3.7% | 0.3% | 0.4% | 0.0% | 3.7% | 0.0% | 0.0% | 0.0% | 0.0% |

**Bovis Lend Lease**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Matthew Boot | R | 0.8% | - | - | - | 0.0% | - | - | 0.8% | - |
| Ross Daddo | R | 1.6% | - | - | - | 0.8% | - | - | 0.8% | - |
| Guy Gibson | R | 2.8% | - | 2.8% | - | 2.8% | - | - | - | - |
| Simon Hardy | R | 2.7% | 0.7% | - | - | 1.4% | - | - | - | 1.3% |
| Tom McFadyen | R | 8.5% | 8.5% | - | - | 8.5% | - | - | - | - |
| Danny Potocki | R | 0.5% | 0.5% | - | - | 0.5% | - | - | - | - |
| Linda Sokolich | R | 0.5% | 0.5% | - | - | 0.5% | - | - | - | - |
| BLL Representatives | R | 2.1% | 0.8% | 0.5% | - | 1.3% | - | - | 0.8% | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 19.2% | 10.9% | 3.3% | 0.0% | 15.7% | 0.0% | 0.0% | 2.3% | 1.3% |

**John Holland Group**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Bruce Carlyle | R | 0.6% | - | - | 0.6% | 0.6% | - | - | - | - |
| Dean Cipolla | R | 7.7% | 7.2% | - | - | 7.2% | - | - | - | 0.5% |
| Tim Fleming | R | 19.9% | 10.8% | - | - | 19.9% | - | - | - | - |
| Geoff Gannon | R | 0.3% | 0.3% | - | - | 0.3% | - | - | - | - |
| David Golightly | R | 2.8% | 0.3% | - | 0.3% | 0.6% | - | - | - | 2.2% |
| Bradd Hammersley | R | 1.3% | 1.3% | - | - | 1.3% | - | - | - | - |
| Justin Lee | R | 0.5% | - | - | 0.5% | 0.5% | - | - | - | - |
| John Reddie | R | 1.0% | - | - | 1.0% | 1.0% | - | - | - | - |
| Stephen Sasse | R | 0.3% | - | - | - | 0.0% | - | - | - | 0.3% |
| Gerry Shutt | R | 4.6% | 1.8% | - | 1.0% | 4.2% | - | - | - | 0.4% |
| Relationship Trial Group | R | 17.4% | - | - | - | 0.0% | - | - | 17.4% | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 56.2% | 21.5% | 0.0% | 3.4% | 35.4% | 0.0% | 0.0% | 17.4% | 3.4% |

**Rider Levett Bucknall**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Stephen Ballesty | R | 13.8% | - | - | 12.1% | 13.8% | - | - | - | - |
| Nick Ferrara | R | 0.3% | - | - | 0.3% | 0.3% | - | - | - | - |
| Michael Gilligan | R | 0.5% | - | - | 0.5% | 0.5% | - | - | - | - |
| Robert Lopez | R | 0.1% | 0.1% | - | - | 0.1% | - | - | - | - |
| Jason Moradi | R | 1.5% | 1.5% | - | - | 1.5% | - | - | - | - |
| Neil Newman | R | 1.1% | - | - | - | 0.0% | - | - | 1.1% | - |
| Greg Nowak | R | 0.2% | - | 0.2% | - | 0.2% | - | - | - | - |

# APPENDIX 4 – STAFF TABLES

**Rider Levett Bucknall continued**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| John Oliver | R | 21.0% | - | 1.0% | 0.5% | 12.8% | - | - | 8.2% | - |
| Ankit Shah | R | 5.2% | - | - | 5.2% | 5.2% | - | - | - | - |
| David Stewart | R | 0.7% | 0.7% | - | - | 0.7% | - | - | - | - |
| Reginald Streifler | R | 2.9% | - | - | 0.5% | 0.5% | - | - | 2.4% | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 47.4% | 2.3% | 1.2% | 19.2% | 35.6% | 0.0% | 0.0% | 11.8% | 0.0% |

**Woods Bagot**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| John Flynn | R | 1.3% | - | 1.3% | - | 1.3% | - | - | - | - |
| Scott Henderson | R | 1.5% | - | - | 0.8% | 0.8% | - | - | - | 0.7% |
| David Marchant | R | 4.1% | - | 0.2% | 1.8% | 3.3% | - | - | 0.3% | 0.5% |
| Ivan Ross | R | 0.9% | - | - | - | 0.5% | - | - | - | 0.4% |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 7.8% | 0.0% | 1.5% | 2.5% | 5.9% | 0.0% | 0.0% | 0.3% | 1.6% |

**Australian Building Codes Board**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Brian Ashe | R | 2.3% | - | - | 2.3% | 2.3% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 2.3% | 0.0% | 0.0% | 2.3% | 2.3% | 0.0% | 0.0% | 0.0% | 0.0% |

**Brisbane City Council**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Neil Abel | R | 2.1% | 2.1% | - | - | 2.1% | - | - | - | - |
| Heidi Astin | A | 0.4% | - | 0.1% | - | 0.1% | - | - | - | 0.3% |
| Harry Copeland | R | 12.7% | 6.4% | - | 6.3% | 12.7% | - | - | - | - |
| Noel Faulkner | R | 5.1% | - | - | - | 0.0% | - | - | - | 5.1% |
| Shelley Flowers | A | 0.2% | - | - | - | 0.0% | - | - | - | 0.2% |
| Medha Gokhale | R | 9.6% | - | 8.8% | - | 8.8% | - | - | 0.2% | 0.6% |
| Kirsten Holden | R | 1.0% | 0.7% | - | - | 1.0% | - | - | - | - |
| Russell Hoskins | R | 1.0% | - | - | 1.0% | 1.0% | - | - | - | - |
| Tim Juckes | R | 0.1% | - | 0.1% | - | 0.1% | - | - | - | - |
| Joyce Law | R | 2.7% | - | 2.7% | - | 2.7% | - | - | - | - |
| Karen Lear | A | 1.7% | - | - | - | 0.0% | - | - | - | 1.7% |
| Sunil Madan | A | 0.2% | - | - | 0.2% | 0.2% | - | - | - | - |
| Heidi Mahler | R | 0.5% | - | 0.2% | - | 0.2% | - | - | - | 0.3% |
| Dean Morse | R | 3.5% | - | 0.3% | - | 0.3% | 0.1% | - | 0.1% | 3.0% |
| Marita Parker | A | 0.2% | - | - | - | 0.0% | - | - | - | 0.2% |
| Viki Podlich | A | 0.2% | - | - | - | 0.0% | - | - | - | 0.2% |
| Nelson Ross | R | 1.7% | - | 1.6% | - | 1.7% | - | - | - | - |
| Karen Wernham | R | 0.2% | 0.2% | - | - | 0.2% | - | - | - | - |
| Geoff Woodberry | R | 1.3% | 0.2% | - | - | 1.3% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 44.2% | 9.5% | 13.7% | 7.5% | 32.3% | 0.1% | 0.0% | 0.3% | 11.6% |

**Building Commission**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Paul Crapper | R | 1.3% | - | - | - | 1.3% | - | - | - | - |
| Roger Frith | R | 0.6% | - | - | - | 0.6% | - | - | - | - |
| Dennis Hogan | R | 8.3% | - | - | - | 8.3% | - | - | - | - |
| Peter Nassau | R | 0.9% | - | - | - | 0.9% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 11.1% | 0.0% | 0.0% | 0.0% | 11.1% | 0.0% | 0.0% | 0.0% | 0.0% |

**Queensland Building Services Authority**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Chris Boyle | R | 0.6% | 0.6% | - | - | 0.6% | - | - | - | - |
| Peter Hope | R | 2.6% | - | 0.6% | 1.4% | 2.5% | - | - | - | 0.1% |
| Bob Johnson | R | 0.1% | 0.1% | - | - | 0.1% | - | - | - | - |
| Cheryl Livingstone | R | 0.2% | 0.2% | - | - | 0.2% | - | - | - | - |
| Shelley Lockton | R | 0.2% | 0.2% | - | - | 0.2% | - | - | - | - |
| Olivia McMahon | R | 0.1% | 0.1% | - | - | 0.1% | - | - | - | - |
| Cameron Murphy | R | 0.5% | 0.5% | - | - | 0.5% | - | - | - | - |
| Emma Parker | R | 0.7% | 0.7% | - | - | 0.7% | - | - | - | - |
| Diane Russell | A | 2.0% | - | - | - | 0.0% | - | - | - | 2.0% |
| Jason Smith | R | 3.0% | 1.2% | 0.1% | - | 1.7% | - | - | - | 1.3% |
| Debbie White | R | 0.1% | 0.1% | - | - | 0.1% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 10.0% | 3.6% | 0.6% | 1.4% | 6.6% | 0.0% | 0.0% | 0.0% | 3.4% |

**Queensland Department of Main Roads**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Damien Caporale | R | 0.6% | - | - | - | 0.6% | - | - | - | - |
| John Fenwick | R | 1.2% | 0.3% | - | - | 1.2% | - | - | - | - |
| Sam Fernando | R | 3.0% | 2.9% | - | - | 3.0% | - | - | - | - |
| Robert Grant | R | 1.2% | - | - | - | 1.2% | - | - | - | - |
| Don Hicks | R | 0.6% | - | - | 0.6% | 0.6% | - | - | - | - |
| Cedric Roberts | R | 6.9% | - | - | - | 0.0% | - | - | 6.9% | - |
| Wayne Roberts | R | 0.7% | 0.6% | - | 0.1% | 0.7% | - | - | - | - |
| Neil Robertson | A | 0.6% | - | - | 0.6% | 0.6% | - | - | - | - |
| Derek Skinner | R | 0.5% | - | - | - | 0.5% | - | - | - | - |
| John Spathonis | R | 6.3% | 0.6% | - | - | 4.0% | - | - | - | 2.3% |
| Mike Swainston | R | 2.0% | 2.0% | - | - | 2.0% | - | - | - | - |
| Allan Tesch | R | 0.2% | - | - | - | 0.2% | - | - | - | - |
| Lex Vanderstaay | R | 0.6% | 0.6% | - | - | 0.6% | - | - | - | - |
| Justin Weligamage | R | 1.8% | - | - | 1.8% | 1.8% | - | - | - | - |
| Dennis Wogan | R | 2.2% | - | - | - | 1.8% | - | - | - | 0.4% |
| Ian Yorke | R | 1.2% | - | - | - | 1.2% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 29.6% | 7.0% | 0.0% | 3.1% | 20.0% | 0.0% | 0.0% | 6.9% | 2.7% |

# APPENDIX 4 – STAFF TABLES

**Queensland Department of Public Works**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Don Allan | R | 0.2% | 0.1% | - | - | 0.1% | - | - | - | 0.1% |
| Ron Apelt | R | 32.7% | - | 11.9% | 20.8% | 32.7% | - | - | - | - |
| Michael Ball | R | 0.6% | - | 0.5% | - | 0.6% | - | - | - | - |
| Ashely Byrnes | R | 2.3% | - | - | - | 2.3% | - | - | - | - |
| Jeff Brown | R | 0.1% | - | - | - | 0.1% | - | - | - | - |
| Dayv Carter | R | 2.9% | 1.3% | - | - | 2.9% | - | - | - | - |
| Steve Fredericks | R | 0.4% | 0.4% | - | - | 0.4% | - | - | - | - |
| Thomas Fussell | R | 12.9% | - | - | 12.4% | 12.9% | - | - | - | - |
| Dale Gilbert | R | 4.7% | 0.2% | 1.0% | - | 4.2% | 0.1% | 0.1% | - | 0.3% |
| Kerry Gray | R | 0.1% | - | - | - | 0.1% | - | - | - | - |
| Stuart Grierson | R | 1.2% | - | - | 1.2% | 1.2% | - | - | - | - |
| Delwyn Jones | R | 58.2% | - | 27.0% | - | 27.2% | 2.9% | 2.7% | 25.4% | - |
| Lucinda Kelly | R | 0.3% | - | - | - | 0.3% | - | - | - | - |
| Kelly Lindsay | A | 0.4% | - | - | - | 0.0% | - | - | - | 0.4% |
| Wendy May-Taylor | R | 2.4% | 0.5% | - | - | 1.1% | - | - | - | 1.3% |
| Sheena McConville | R | 0.1% | 0.1% | - | - | 0.1% | - | - | - | - |
| Pat O'Brien | R | 0.2% | 0.2% | - | - | 0.2% | - | - | - | - |
| Lee Rapley | A | 1.9% | 0.1% | - | - | 0.1% | - | - | - | 1.8% |
| Alan Sharp | R | 0.9% | - | 0.9% | - | 0.9% | - | - | - | - |
| Dan Wallace | R | 0.1% | 0.1% | - | - | 0.1% | - | - | - | - |
| Julia Willis | A | 5.9% | 0.9% | - | - | 1.5% | - | - | - | 4.4% |
| Alan Wolski | R | 0.3% | - | - | - | 0.3% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 128.3% | 3.8% | 41.3% | 34.4% | 89.1% | 3.0% | 2.8% | 25.4% | 8.2% |

**Western Australia Department of Housing and Works**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Karyn Ash | A | 17.3% | 2.9% | - | 3.0% | 17.3% | - | - | - | - |
| Chris Bagley | R | 0.5% | 0.2% | - | 0.2% | 0.5% | - | - | - | - |
| Wayne Carter | R | 0.7% | 0.2% | - | - | 0.7% | - | - | - | - |
| Greg Fraser | R | 2.6% | 0.6% | - | 0.2% | 2.6% | - | - | - | - |
| Michael Pearson | R | 0.9% | - | - | - | 0.9% | - | - | - | - |
| Ashwin Raj | R | 1.5% | 0.6% | - | 0.3% | 1.5% | - | - | - | - |
| Peter Tilley | R | 13.2% | 2.7% | - | 1.8% | 13.2% | - | - | - | - |
| Marleen Voortman | R | 7.4% | 7.3% | - | - | 7.4% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 44.1% | 14.5% | 0.0% | 5.6% | 44.1% | 0.0% | 0.0% | 0.0% | 0.0% |

**CSIRO**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Michael Ambrose | R | 16.2% | - | 16.2% | - | 16.2% | - | - | - | - |
| Fanny Boulaire | R | 25.0% | - | 25.0% | - | 25.0% | - | - | - | - |
| Ronald Brown | R | 0.4% | - | 0.4% | - | 0.4% | - | - | - | - |
| Steven Brown | R | 3.7% | - | 3.7% | - | 3.7% | - | - | - | - |
| Wan Yee Chan | R | 19.6% | - | 19.6% | - | 19.6% | - | - | - | - |

**CSIRO continued**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ivan Cole | R | 7.7% | - | 7.7% | - | 7.7% | - | - | - | - |
| Peter Cutris | R | 0.1% | - | - | - | 0.0% | - | - | 0.1% | - |
| Angelo Delsante | R | 12.4% | - | 12.4% | - | 12.4% | - | - | - | - |
| Clare Diaper | R | 4.9% | - | 4.9% | - | 4.9% | - | - | - | - |
| Lan Ding | R | 14.3% | - | - | 11.5% | 11.5% | - | - | 2.8% | - |
| Robin Drogemuller | R | 32.5% | - | 14.0% | 11.1% | 25.2% | - | - | 7.3% | - |
| Stephen Egan | R | 20.8% | - | 11.5% | - | 11.5% | - | - | 9.3% | - |
| Greg Foliente | R | 7.5% | - | 7.5% | - | 7.5% | - | - | - | - |
| Wayne Ganther | R | 37.6% | - | 37.6% | - | 37.6% | - | - | - | - |
| Meltem Gozukara | R | 0.9% | - | 0.9% | - | 0.9% | - | - | - | - |
| Murray Hall | R | 1.3% | - | - | - | 0.0% | - | - | 1.3% | - |
| Melissa James | R | 1.3% | - | 1.3% | - | 1.3% | - | - | - | - |
| Steven Kenway | R | 2.8% | - | 2.8% | - | 2.8% | - | - | - | - |
| Loretta Kivlighon | R | 26.3% | - | 21.4% | 4.9% | 26.3% | - | - | - | - |
| Kevin McDonald | R | 4.6% | - | 4.6% | - | 4.6% | - | - | - | - |
| Stephen McFallen | R | 10.5% | 10.3% | 0.2% | - | 10.5% | - | - | - | - |
| Cheryl McNamara | R | 4.2% | - | 4.2% | - | 4.2% | - | - | - | - |
| Anne Miller | R | 45.9% | - | 45.9% | - | 45.9% | - | - | - | - |
| Phillip Paevere | R | 22.7% | - | 22.7% | - | 22.7% | - | - | - | - |
| David Paterson | R | 5.4% | - | 5.4% | - | 5.4% | - | - | - | - |
| Hans Schevers | R | 3.2% | - | - | 3.2% | 3.2% | - | - | - | - |
| Seongwon Seo | R | 10.6% | - | 10.6% | - | 10.6% | - | - | - | - |
| Natalie Sherman | R | 16.8% | - | 16.8% | - | 16.8% | - | - | - | - |
| Michael Syme | R | 2.5% | - | 2.5% | - | 2.5% | - | - | - | - |
| Grace Tjandraatmadja | R | 2.1% | - | 2.1% | - | 2.1% | - | - | - | - |
| Gerry Trinidad | R | 23.8% | - | 10.0% | - | 10.0% | - | - | 13.8% | - |
| Selwyn Tucker | R | 12.5% | - | 12.5% | - | 12.5% | - | - | - | - |
| Angela Williams | R | 8.4% | - | 5.0% | - | 5.0% | - | - | 3.4% | - |
| Kwok-Keung Yum | R | 17.7% | - | 5.4% | 12.2% | 17.7% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 426.1% | 10.3% | 334.9% | 43.0% | 388.2% | 0.0% | 0.0% | 37.9% | 0.0% |

**Curtin University of Technology**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Siobhan Austen | R | 10.0% | 10.0% | - | - | 10.0% | - | - | - | - |
| David Baccarini | R | 8.3% | 2.5% | - | 5.8% | 8.3% | - | - | - | - |
| Poonam Bajaj | R | 0.5% | 0.3% | - | - | 0.5% | - | - | - | - |
| Peter Bullen | R | 2.5% | - | - | 2.5% | 2.5% | - | - | - | - |
| Rebecca Crosbie | R | 1.0% | 1.0% | - | - | 1.0% | - | - | - | - |
| Peter Davis | R | 42.8% | 15.0% | - | 27.8% | 42.8% | - | - | - | - |
| Peter Galvin | R | 13.8% | 13.8% | - | - | 13.8% | - | - | - | - |
| Adriana Griffin | A | 3.6% | - | - | - | 3.6% | - | - | - | - |
| Peter Love | R | 2.5% | 2.5% | - | - | 2.5% | - | - | - | - |
| Verena Marshall | R | 10.0% | 10.0% | - | - | 10.0% | - | - | - | - |
| Kerry Pedigo | R | 7.5% | 7.5% | - | - | 7.5% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 102.4% | 62.5% | 0.0% | 36.1% | 102.4% | 0.0% | 0.0% | 0.0% | 0.0% |

# APPENDIX 4 – STAFF TABLES

**The University of Newcastle**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| John Burgess | R | 12.5% | 12.5% | - | - | 12.5% | - | - | - | - |
| Kerry London | R | 26.8% | 24.8% | - | - | 24.8% | - | - | 2.0% | - |
| Amir Mahmood | R | 3.8% | 3.8% | - | - | 3.8% | - | - | - | - |
| Michael Ostwald | R | 10.8% | 10.8% | - | - | 10.8% | - | - | - | - |
| Guilherme Piers | R | 3.8% | 3.8% | - | - | 3.8% | - | - | - | - |
| Willy Sher | R | 2.3% | - | - | 2.3% | 2.3% | - | - | - | - |
| Tony Williams | R | 0.6% | - | - | - | 0.0% | - | - | - | 0.6% |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 60.4% | 55.5% | 0.0% | 2.3% | 57.8% | 0.0% | 0.0% | 2.0% | 0.6% |

**QUT**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Martin Betts | R | 10.3% | 3.8% | - | 2.3% | 6.0% | 4.3% | - | - | - |
| Bert Biggs | R | 10.0% | 10.0% | - | - | 10.0% | - | - | - | - |
| Kerry Brown | R | 33.8% | 33.8% | - | - | 33.8% | - | - | - | - |
| Michael Charles | A | 22.5% | 10.0% | - | - | 22.5% | - | - | - | - |
| Sharon Christensen | R | 18.8% | 18.8% | - | - | 18.8% | - | - | - | - |
| Andrew Colin | R | 5.6% | 5.6% | - | - | 5.6% | - | - | - | - |
| Ed Dawson | R | 5.0% | 5.0% | - | - | 5.0% | - | - | - | - |
| Nur Demirbilek | R | 7.5% | - | 7.5% | - | 7.5% | - | - | - | - |
| Robin Drogemuller | R | 12.0% | - | - | 12.0% | 12.0% | - | - | - | - |
| Bill Duncan | R | 8.1% | 8.1% | - | - | 8.1% | - | - | - | - |
| Ernest Foo | R | 17.2% | 17.2% | - | - | 17.2% | - | - | - | - |
| John Frazer | R | 2.5% | - | - | 2.5% | 2.5% | - | - | - | - |
| Andrew Frowd | R | 0.8% | - | - | 0.8% | 0.8% | - | - | - | - |
| Craig Furneaux | R | 10.8% | 10.8% | - | - | 10.8% | - | - | - | - |
| Natalie Gallery | R | 17.5% | 17.5% | - | - | 17.5% | - | - | - | - |
| Stef Gard | R | 18.0% | - | - | 18.0% | 18.0% | - | - | - | - |
| John Hayes | R | 2.5% | - | 2.5% | - | 2.5% | - | - | - | - |
| Mark Haynes | A | 0.5% | - | - | - | 0.5% | - | - | - | - |
| Ross Hayward | R | 3.3% | - | 3.3% | - | 3.3% | - | - | - | - |
| Matthew Humphreys | R | 5.0% | - | - | 5.0% | 5.0% | - | - | - | - |
| Audun Josang | R | 0.0% | - | - | - | 0.0% | - | - | - | - |
| Stephen Kajewski | R | 18.8% | - | - | 18.8% | 18.8% | - | - | - | - |
| Norm Katter | R | 2.0% | 2.0% | - | - | 2.0% | - | - | - | - |
| Rosemary Kennedy | R | 7.8% | - | 7.8% | - | 7.8% | - | - | - | - |
| Anne Krupa | A | 6.8% | - | - | - | 6.8% | - | - | - | - |
| Arun Kumar | R | 6.8% | - | - | 5.0% | 5.0% | 1.8% | - | - | - |
| Donald Lam | A | 4.1% | - | - | - | 4.1% | - | - | - | - |
| Yuefeng Li | R | 2.5% | - | 2.5% | - | 2.5% | - | - | - | - |
| Karen Manley | R | 30.0% | 30.0% | - | - | 30.0% | - | - | - | - |
| Lidia Morawska | R | 3.0% | - | 3.0% | - | 3.0% | - | - | - | - |
| Richi Nayak | R | 15.0% | - | 15.0% | - | 15.0% | - | - | - | - |
| Danny O'Hare | R | 7.5% | - | 7.5% | - | 7.5% | - | - | - | - |
| Steve Rowlinson | R | 6.8% | 6.8% | - | - | 6.8% | - | - | - | - |
| Neal Ryan | R | 10.0% | 10.0% | - | - | 10.0% | - | - | - | - |
| Anthony Tofoni | A | 0.3% | - | - | - | 0.3% | - | - | - | - |

**QUT continued**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Stephane Tywoniak | R | 2.5% | 2.5% | - | - | 2.5% | - | - | - | - |
| Yue Xu | R | 10.0% | - | 10.0% | - | 10.0% | - | - | - | - |
| Jay Yang | R | 5.0% | - | - | 5.0% | 5.0% | - | - | - | - |
| Jinglan Zhang | R | 0.1% | - | 0.1% | - | 0.1% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 350.3% | 191.8% | 59.1% | 69.2% | 344.3% | 6.0% | 0.0% | 0.0% | 0.0% |

**RMIT**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Guillermo Aranda-Mena | R | 25.3% | - | - | 25.3% | 25.3% | - | - | - | - |
| Nick Blismas | R | 31.3% | 7.5% | - | 23.8% | 31.3% | - | - | - | - |
| Rebecca Gravina | R | 5.0% | - | - | 5.0% | 5.0% | - | - | - | - |
| Helen Lingard | R | 20.0% | 20.0% | - | - | 20.0% | - | - | - | - |
| Tom Molyneaux | R | 11.3% | - | - | 11.3% | 11.3% | - | - | - | - |
| Sujeeva Setunge | R | 17.5% | - | - | 17.5% | 17.5% | - | - | - | - |
| Mark Vines | R | 3.6% | - | - | 3.6% | 3.6% | - | - | - | - |
| Ron Wakefield | R | 18.9% | 11.3% | - | 7.6% | 18.9% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 132.8% | 38.8% | 0.0% | 94% | 132.8% | 0.0% | 0.0% | 0.0% | 20.5% |

**The University of Sydney**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Kirsty Beilharz | R | 5.0% | - | - | - | 0.0% | 5.0% | - | - | - |
| Robert Czernkowski | R | 0.7% | 0.7% | - | - | 0.7% | - | - | - | - |
| Andy Dong | R | 20.0% | - | - | 20.0% | 20.0% | - | - | - | - |
| Leslie George | A | 3.0% | - | - | - | 3.0% | - | - | - | - |
| John Gero | R | 1.3% | - | - | - | 0.0% | 1.3% | - | - | - |
| Philip Granger | A | 2.0% | - | - | - | 1.0% | - | - | - | 1.0% |
| Megan Haig | A | 2.0% | - | - | - | 0.0% | - | - | - | 2.0% |
| Mary-Louise Huppatz | A | 1.0% | - | - | - | 0.0% | - | - | - | 1.0% |
| Thomas Kvan | A | 2.0% | - | - | - | 0.0% | - | - | - | 2.0% |
| David Leifer | R | 2.5% | - | - | 2.5% | 2.5% | - | - | - | - |
| Mary Lou Maher | R | 16.3% | - | - | 15.0% | 15.0% | 1.3% | - | - | - |
| Mercedes Paulini | A | 3.8% | - | - | - | 1.8% | - | - | - | 2.0% |
| Rick Moss | A | 1.5% | - | - | - | 1.5% | - | - | - | - |
| Suzanne Roberts | A | 10.5% | - | - | - | 0.0% | - | - | - | 10.5% |
| Lisette Tennant | A | 2.0% | - | - | - | 0.0% | - | - | - | 2.0% |
| Jason Thorne | A | 5.0% | - | - | - | 5.0% | - | - | - | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 78.5% | 0.7% | 0.0% | 37.5% | 50.5% | 7.5% | 0.0% | 0.0% | 20.5% |

# APPENDIX 4 – STAFF TABLES

**University of Western Sydney**

| Name | Main activity | Total % of Time | Program A | Program B | Program C | Research Total (%) | Education (%) | External Comm. (%) | Commercial-isation (%) | CRC Admin. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Don Dingsdag | R | 13.8% | 13.8% | - | - | 13.8% | - | - | - | - |
| Rosemary Dorrough | A | 4.0% | - | 2.5% | - | 2.5% | - | - | - | 1.5% |
| Mary Hardie | R | 2.5% | - | 1.3% | 1.3% | 2.5% | - | - | - | - |
| Lesley Hayes | A | 0.3% | - | - | - | 0.3% | - | - | - | - |
| Graham Miller | R | 12.8% | - | 7.5% | 5.0% | 12.5% | - | - | 0.3% | - |
| TOTAL CONTRIBUTED (% of PERSON YEARS) | | 33.3% | 13.8% | 11.3% | 6.3% | 31.5% | 0.0% | 0.0% | 0.3% | 1.5% |

Note: Research total includes Research Administration in some cases

**Staff Table 2 – CRC Paid Program Staff**

| Name | Employing organisation | Main activity | Total % of time | % spent on Research Program | | | | % spent on Education Program | % spent on External Comm. | % spent on Commer-cialisation | % spent on CRC Admin-istration |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Subprogram | | | Total on Research | | | | |
| | | | | A | B | C | | | | | |
| Sugiharto Alwi | QUT | R | 100% | - | - | 100% | 100% | - | - | - | - |
| Michael Ambrose | CSIRO | R | 44% | - | 44% | - | 44% | - | - | - | - |
| Guillermo Aranda-Mena | RMIT | R | 23% | - | - | 23% | 23% | - | - | - | - |
| Margaret Bates | RMIT | R | 7% | - | 7% | - | 7% | - | - | - | - |
| Nathan Bavinton | UN | R | 8% | 8% | - | - | 8% | - | - | - | - |
| Lorraine Bell | QUT | R | 20% | - | 20% | - | 20% | - | - | - | - |
| Thomas Bellamy | UN | R | 8% | 8% | - | - | 8% | - | - | - | - |
| John Bellas | QUT | R | 25% | - | - | 25% | 25% | - | - | - | - |
| Harminder Bhar | QUT | R | 20% | - | 20% | - | 20% | - | - | - | - |
| Richard Bird | RMIT | R | 50% | 28% | - | 22% | 50% | - | - | - | - |
| Fanny Boulaire | CSIRO | R | 39% | - | 23% | - | 23% | - | - | 16% | - |
| Peter Boxhall | CSIRO | R | 20% | - | 19% | - | 19% | - | - | 1% | - |
| Scott Brotherwood | Curtin | R | 11% | - | - | 11% | 11% | - | - | - | - |
| Steven Brown | CSIRO | R | 43% | - | 43% | - | 43% | - | - | - | - |
| TM Burrows | QUT | R | 25% | 25% | - | - | 25% | - | - | - | - |
| Laurie Buys | QUT | R | 5% | - | 5% | - | 5% | - | - | - | - |
| C Paredes Castillo | QUT | R | 50% | 50% | - | - | 50% | - | - | - | - |
| Jessica Chen | UN | R | 85% | 85% | - | - | 85% | - | - | - | - |
| Fiona Cheung | QUT | R | 51% | 51% | - | - | 51% | - | - | - | - |
| Agustin Chevez Bernaldo de Quiros | RMIT | R | 15% | - | - | 15% | 15% | - | - | - | - |
| Tracy Cooke | RMIT | R | 6% | 6% | - | - | 6% | - | - | - | - |
| John Crawford | RMIT | R | 14% | - | - | 14% | 14% | - | - | - | - |
| Yohann Daruwala | USYD | R | 15% | - | - | 15% | 15% | - | - | - | - |
| Lan Ding | CSIRO | R | 63% | - | - | 10% | 10% | - | - | 53% | - |
| Ben Egan | UN | R | 28% | 28% | - | - | 28% | - | - | - | - |
| Stephen Egan | CSIRO | R | 40% | - | 21% | | 21% | - | - | 19% | - |
| Michael Falta | QUT | R | 100% | 100% | - | - | 100% | - | - | - | - |
| Greg Foliente | CSIRO | R | 10% | - | 10% | - | 10% | - | - | - | - |
| Susan Fower | UN | R | 5% | 5% | - | - | 5% | - | - | - | - |
| Anne Francis | Curtin | R | 78% | 78% | - | - | 78% | - | - | - | - |
| Timothy French | RMIT | R | 20% | 20% | - | - | 20% | - | - | - | - |

**Staff Table 2 – CRC Paid Program Staff continued**

| Name | Employing organisation | Main activity | Total % of time | % spent on Research Program | | | | % spent on Education Program | % spent on External Comm. | % spent on Commer-cialisation | % spent on CRC Admin-istration |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Subprogram | | | Total on Research | | | | |
| | | | | A | B | C | | | | | |
| Tom Froese | RMIT | R | 7% | - | - | 7% | 7% | - | - | - | - |
| Craig Furneaux | QUT | R | 90% | 90% | - | - | 90% | - | - | - | - |
| Michelle Gane | QUT | R | 15% | - | 15% | - | 15% | - | - | - | - |
| Praveen Gauravaram | QUT | R | 89% | 89% | - | - | 89% | - | - | - | - |
| Ting (Esther) Ge | QUT | R | 100% | - | 100% | - | 100% | - | - | - | - |
| Carole Green | CRC HQ | A | 100% | - | - | - | 10% | 10% | 10% | 15% | 55% |
| Murray Hall | CSIRO | R | 42% | - | 32% | - | 32% | - | - | 10% | - |
| Mary Hardie | QUT | R | 20% | 20% | - | - | 20% | - | - | - | - |
| James Harley | RMIT | R | 2% | - | - | 2% | 2% | - | - | - | - |
| Keith Hampson | CRC HQ | R | 100% | - | - | - | 25% | 10% | 25% | 20% | 20% |
| Congrong He | QUT | R | 20% | - | 20% | - | 20% | - | - | - | - |
| Mike Hefferan | QUT | R | 20% | - | 20% | - | 20% | - | - | - | - |
| Usha Iyer-Raniga | RMIT | R | 7% | - | 7% | - | 7% | - | - | - | - |
| Payungsak Jailang | RMIT | R | 2% | - | - | 2% | 2% | - | - | - | - |
| Melissa James | CSIRO | R | 25% | - | - | - | 0% | - | - | 25% | - |
| David Jellie | RMIT | R | 9% | - | - | - | 9% | - | - | - | - |
| Mi Jeong Kim | USYD | R | 24% | - | - | 24% | 24% | - | - | - | - |
| Loretta Kivlighon | CSIRO | R | 31% | - | 31% | - | 31% | - | - | - | - |
| Soon Kam Lim | QUT | R | 25% | - | - | 25% | 25% | - | - | - | - |
| Robert Lopes | Curtin | R | 5% | - | - | 5% | 5% | - | - | - | - |
| Peter Love | Curtin | R | 8% | - | - | 8% | 8% | - | - | - | - |
| John Mahoney | CSIRO | R | 3% | - | 3% | - | 3% | - | - | - | - |
| Karen Manley | QUT | R | 70% | 70% | - | - | 70% | - | - | - | - |
| Stawomir Marcinski | RMIT | R | 14% | 14% | - | - | 14% | - | - | - | - |
| Andrew Martin | CSIRO | R | 29% | - | 29% | - | 29% | - | - | - | - |
| Kevin McDonald | CSIRO | R | 94% | - | 30% | 52% | 82% | - | - | 12% | - |
| Stephen McFallan | CSIRO | R | 26% | 21% | 5% | - | 26% | - | - | - | - |
| Cheryl McNamara | CSIRO | R | 83% | - | - | - | 0% | - | - | 83% | - |
| Jonathan Mentink | UN | R | 7% | 7% | - | - | 7% | - | - | - | - |
| Sarah Merrett | QUT | R | 3% | 3% | - | - | 3% | - | - | - | - |
| Damian Merrick | USYD | R | 10% | - | - | 10% | 10% | - | - | - | - |
| Anne Miller | CSIRO | R | 31% | - | 31% | - | 31% | - | - | - | - |
| Evonne Mitchell | QUT | R | 10% | - | 10% | - | 10% | - | - | - | - |
| Brett Mitchell | QUT | R | 20% | 20% | - | - | 20% | - | - | - | - |
| Trivess Moore | RMIT | R | 8% | - | 8% | - | 8% | - | - | - | - |
| Andrew Walker Morison | RMIT | R | 5% | - | 5% | - | 5% | - | - | - | - |
| Tim Muster | CSIRO | R | 16% | - | 16% | - | 16% | - | - | - | - |
| Anthony Nguyen | QUT | R | 3% | - | 3% | - | 3% | - | - | - | - |
| David Nielson | QUT | R | 13% | - | - | 13% | 13% | - | - | - | - |
| Gu Ning | USYD | R | 10% | - | - | 10% | 10% | - | - | - | - |
| Lisa Opray | RMIT | R | 1% | - | 1% | - | 1% | - | - | - | - |
| Phillip Paevere | CSIRO | R | 24% | - | 24% | - | 24% | - | - | - | - |
| David Paterson | CSIRO | R | 14% | - | 14% | - | 14% | - | - | - | - |
| Janet Pillay | QUT | R | 17% | 17% | - | - | 17% | - | - | - | - |

# APPENDIX 4 – STAFF TABLES

**Staff Table 2 continued – CRC Paid Program Staff continued**

| Name | Employing organisation | Main activity | Total % of time | % spent on Research Program | | | | % spent on Education Program | % spent on External Comm. | % spent on Commer-cialisation | % spent on CRC Admin-istration |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Subprogram | | | Total on Research | | | | |
| | | | | A | B | C | | | | | |
| Shaun Purcell | UN | R | 11% | 11% | - | - | 11% | - | - | - | - |
| Rachel Ryan | QUT | R | 25% | - | - | - | 0% | - | - | 25% | - |
| Rachel Ryan | QUT | R | 50% | 50% | - | - | 50% | - | - | - | - |
| Hans Schevers | CSIRO | R | 3% | - | - | 3% | 3% | - | - | - | - |
| Peter Scuderi | CRC HQ | R | 100% | - | - | - | 60% | 10% | 10% | 10% | 10% |
| Seomgwon Seo | CSIRO | R | 7% | - | 7% | - | 7% | - | - | - | - |
| Richard Seymour | Curtin | R | 66% | 66% | - | - | 66% | - | - | - | - |
| Abdulkader Sharabah | RMIT | R | 13% | - | - | 13% | 13% | - | - | - | - |
| Ashok Sharma | CSIRO | R | 1% | - | 1% | - | 1% | - | - | - | - |
| Vaughn Sheahan | UWS | R | 45% | 45% | - | - | 45% | - | - | - | - |
| Linden Spindler | QUT | R | 40% | 40% | - | - | 40% | - | - | - | - |
| Tony Stapeldon | CSIRO | R | 64% | - | 64% | - | 64% | - | - | - | - |
| Glenda Strong | QUT | R | 4% | - | 4% | - | 4% | - | - | - | - |
| Steve Su | QUT | R | 50% | 50% | - | - | 50% | - | - | - | - |
| Jenny Summerville | QUT | R | 10% | - | 10% | - | 10% | - | - | - | - |
| Alison Terry | RMIT | R | 25% | - | 25% | - | 25% | - | - | - | - |
| Srikanth Venkatesan | RMIT | R | 58% | - | - | 58% | 58% | - | - | - | - |
| Kendra Wasiluk | RMIT | R | 39% | - | 39% | - | 39% | - | - | - | - |
| Angela Williams | CSIRO | R | 54% | - | 23% | | 23% | - | - | 31% | - |
| Emily Yip | CSIRO | R | 8% | - | 8% | - | 8% | - | - | - | - |
| Kwok-Keung Yum | CSIRO | R | 17% | - | - | 17% | 17% | - | - | - | - |
| TOTAL CRC | | | 3045% | 1114% | 872% | 485% | 2565% | 30% | 45% | 320% | 85% |

**Staff Table 3 – Summary of Contribution in Person Years**

| | Total equiv. Person Years | Person Years Spent on Research Program | | | | Person Years spent on Education | Person Years spent on External Comm. | Person Years spent on Commer-cialisation | Person Years spent on CRC Admin. |
|---|---|---|---|---|---|---|---|---|---|
| | | Subprogram | | | Total on Research | | | | |
| | | A | B | C | | | | | |
| TOTAL CONTRIBUTED | 15.9 | 4.5 | 4.7 | 3.7 | 14.1 | 0.2 | 0.0 | 1.0 | 0.6 |
| TOTAL FUNDED BY CRC | 30.5 | 11.1 | 8.7 | 4.8 | 25.7 | 0.3 | 0.5 | 3.2 | 0.8 |
| GRAND TOTAL | 46.4 | 15.6 | 13.4 | 8.5 | 39.7 | 0.5 | 0.5 | 4.2 | 1.4 |
| Proportion of total professional staff resources | 100% | 34% | 29% | 18% | 86% | 1% | 1% | 9% | 3% |

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