

Projecting Change through Construction Innovation

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Summary

In projecting change for the critical Australian construction industry, the CRC for Construction Innovation envisions a culture of self improvement through applied research and technology transfer. Construction Innovation is driving research outcomes into business practice in areas such as innovativeness, sustainability, procurement, project diagnostics and site safety. The group has also led the formation of an international alliance to ensure its activities are hitting the mark nationally and internationally. Through initiatives like these, the CRC for Construction Innovation is already providing a potent vehicle for change.

This paper will briefly track the development of the CRC for Construction Innovation and highlight the collaborative processes in developing, managing and disseminating applied research; profile a number of its key outcomes to date; and discuss the future of applied research in Australia in the context of its Construction 2020 national initiative, its upcoming Second International Conference and the challenge of the Centre's renewal beyond 2008.

PAPER

Background

Australia's construction sector operates against a background of industry fragmentation and intense competition, with new challenges including IT advancements; increasing public expectations in environmental protection; increasing demand for packaged construction services; and moves toward private-sector funding of public infrastructure (Hampson and Manley, 2001). To increase its contribution to Australia's well-being and to capture new opportunities, the industry must respond positively. New challenges require new approaches. A more collaborative approach to industry-focused research and education is required (McCarthy, 2004).

Looking to the future is an important step in self improvement. The overarching vision being driven by the Australian Cooperative Research Centre (CRC) for Construction Innovation is for industry, government and research to work together through applied research and innovation. A culture of self improvement, mutual recognition, respect and support underpins this vision. By 2020 the inspirational vision is for the industry to be taking more responsibility for leading and investing in research and innovation. The tripartite collaboration between industry, government and research should develop a robust and viable national research and innovation capability delivering on-going value to Australian property and construction business.

This paper will briefly track the development of the CRC for Construction Innovation and highlight the collaborative processes in developing, managing and disseminating applied research; profile a number of its key outcomes to date; and discuss the future of applied

research in Australia in the context of its Construction 2020 national initiative, its upcoming Second International Conference and the challenge of the Centre's renewal beyond 2008.

CRC for Construction Innovation

The Australian CRC for Construction Innovation was created in 2001 from a leading group of industry, government and research organisations committing to change in the Australian property, construction and facility management industry. Their application to the Australian Government under the CRC Program was successful in securing significant long-term funding to deliver applied research and technology transfer to 2008. The Centre was offered Commonwealth funding over a period of seven years commencing 1 July 2001 totalling A\$14 million within the total Centre resources of A\$64 million. CRC for Construction Innovation was established to strengthen industry collaboration and to develop key technologies, tools and management systems to improve the effectiveness of the Australian construction industry.

The CRC for Construction Innovation research incorporates a balance of short, medium and long-term activities and a portfolio of projects that reflect the diversity of the property and construction industry and the lifecycle of the constructed product. Research projects require collaboration across at least two industry partners and two research partners. The integration of industry, government and researcher input provides for industry-focussed projects jointly managed over the project life, and a pathway for technology diffusion that capitalises on the complementary roles of each participant in the industry. Projects undergo a rigorous selection process based on their ability to make a real difference to industry; their research quality and compatibility with partner needs and capabilities; and their potential for industry development or commercialisation.

The CRC for Construction Innovation's collaborative research activities combine basic and strategic research and development in three integrated programs:

1. business and industry development,
2. sustainable built assets, and
3. delivery and management of built assets.

The use of advanced information and communication technology underpins each of these three programs. Figure 1 illustrates the three-program structure.

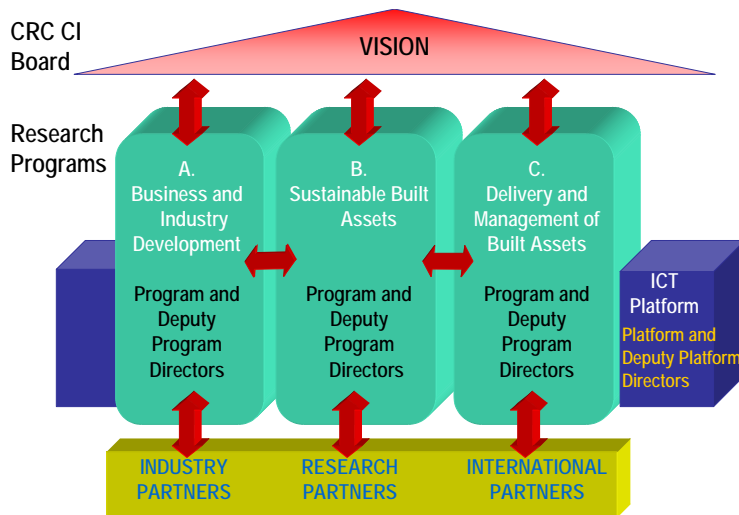


Figure 1 – CRC for Construction Innovation Research Program Structure

Research Programs and the ICT Platform are led by Directors and Deputy Directors. The Director derives from one of the CRC’s research partner organisations while the Deputy Director derives from industry partner organisations. Each Program and the ICT Platform are described in more detail below (Figure 2).

CRC for Construction Innovation Research Programs

Business and Industry Development

To improve the long-term effectiveness, competitiveness and dynamics of a viable construction industry in the Australian and international contexts through:

- Greater innovation in business processes,
- Strengthened human relations and ethical practices, and
- More effective interactions between industry and its clients.

Sustainable Built Assets

To drive healthy and sustainable constructed assets and optimise the environmental impact of built facilities through:

- 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, and
- Assessing human health and productivity benefits of smart indoor environments.

Delivery and Management of Built Assets

To deliver project value for stakeholders for the whole-of-life, from business need, design and construction through to ownership, asset management and reuse through:

- Improved communication and use of information,
- Increased productivity and value, and
- Effective delivery and management of whole-of-life assets.

ICT Platform

ICT is the fundamental enabler of process re-engineering in the property and construction industry. The ICT Platform integrates the ICT input and acts as a driver for change across the CRC for Construction Innovation's Research Programs.

Figure 2 - CRC for Construction Innovation Research Programs

Education and industry dissemination also forms a vital component of the CRC for Construction Innovation activities. The CRC offers research-based skill development to enhance the competitiveness of the Australian construction industry.

The 20 partners to the CRC represent leading industry, government and research organisations throughout Australia, and include:

Arup Australasia	Queensland Department of Public Works
Australian Building Codes Board	Queensland Department of State Development
Bovis Lend Lease	Queensland University of Technology
Brisbane City Council	Rider Hunt
Building Commission (Victoria)	Royal Melbourne Institute of Technology
CSIRO	Springfield Land Corporation
DEM Architects	University of Newcastle
John Holland	University of Sydney
Queensland Building Services Authority	University of Western Sydney
Queensland Department of Main Roads	Woods Bagot

Construction Innovation is headquartered at Queensland University of Technology (QUT) in Brisbane, with research nodes in Brisbane, Sydney, Newcastle, Canberra and Melbourne. It

has also recently entered into an international strategic alliance with leading research and development organisations in Europe and North America including: The University of Salford (UK), VTT (Finland), CSTB (France) and Stanford University (USA). This global alliance – ICALL (International Construction Research Alliance) – aims to drive excellence in built environment research to benefit industry and society. The Australian CRC for Construction Innovation is a core partner to this key group collaborating on applied research projects, conferences and workshops, student and researcher exchanges and joint international promotion.

Adding Value to Industry

Since 2001, Construction Innovation has developed and managed research projects in addition to disseminating the results within its partner network and industry generally. The network through the Australian Construction Industry Forum (ACIF) partners¹ has been invaluable in accessing extensive member networks available through these leading industry partners – especially for the important technology diffusion to SMEs².

In projecting change through construction innovation, six recent initiatives stand out.

The **first** has been the Construction 2020 initiative which set a leadership agenda for Australia's property and construction industry. Construction 2020 began with a series of workshops held from November 2003 to February 2004 in each capital city of Australia, seeking the views of industry leaders and members. Through a questionnaire and workshop process, respondents identified their visions for the industry, barriers to implementation and the research required to achieve their vision to the year 2020. They were also asked to define their best dreams and worst nightmares for the industry. The Construction 2020 workshop series and dissemination of the far-reaching document Construction 2020 — A Vision for Australia's Property and Construction Industry were launched in Parliament House, Canberra, by the Minister for Science, Peter McGauran, and the Minister for Industry, Tourism and Resources, Ian Macfarlane, on 23 June 2004. Three principal themes highlighting the ways in which the Australian property and construction industry can improve its competitiveness, performance and image emerged:

- improving the business environment
- addressing sustainable development and the full life cycle of assets
- harnessing the power of advanced information and communication technologies.

A culture of self-improvement, mutual recognition, respect and support underpins the ambitions of Australia's property and construction industry. By 2020, the vision is for industry to be taking more responsibility for leading and investing in research and innovation.

The **second** initiative has been consolidation of the International Construction Research Alliance (ICALL) bringing together leading international applied research and development

¹ ACIF comprises the following 13 lead industry organisations: Air Conditioning & Mechanical Contractors Association, Association of Consulting Architects Australia, Association of Consulting Engineers Australia, Australian Institute of Building, Australian Institute of Quantity Surveyors, Construction Industry Engineering Services Group, Engineers Australia, Facility Management Association of Australia, Master Builders Australia, National Electrical and Communications Association, Planning Institute of Australia, Property Council of Australia, The Royal Australian Institute of Architects

² The Australian Construction Sector comprises 93% of businesses employing fewer than 5 people with only 100 firms employing more than 20 people (DISR, 1999).

organisations that service property and construction throughout North America, the United Kingdom and Europe. Construction Innovation's founding membership of this key group confirms our CRC's important role in the international arena - confirmed at the Centre's first international conference in October 2004, themed Clients Driving Innovation.

The **third** initiative came to fruition in May 2004 with Construction Innovation's election to the International Board of the International Council for Research and Innovation in Building and Construction (CIB). As our CRC's nominee, the CRC Board Chair, John McCarthy, is providing a clear Australian research-user perspective in shaping the international research agenda for this influential group of more than 3000 members from 100 countries.

Fourth, at a national level, Construction Innovation has played a key formative role in the formation of ASBEC - the Australian Sustainable Built Environment Council. ASBEC has a charter of bringing together disparate regional, state and national organisations providing input to the sustainability agenda for the built environment, with the goal of unifying national guidelines for green development. Only in this way will Australia benefit from the well-intentioned energies of this wide variety of players. The CRC has worked with the Property Council of Australia and the Royal Australian Institute of Architects and other members of the Australian Construction Industry Forum in this initiative to deliver long-term benefits for sustainable development.

Fifth, is our CRC's investment in the intellectual capacity of our industry. Construction Innovation supports PhD and Masters students enrolled at our five university partners across the nation. Upon graduation, these scholars will provide Australia's property, design, construction, and facility management industry with significantly increased research capability. This is complemented by the CRC's developing input to the education curriculum at undergraduate and postgraduate levels in addition to training providers in the post secondary (TAFE and VET) and site training sectors. Our Construction 2020 results confirm that the lack of appropriate skill development is of crucial industry concern for the future.

Finally, the CRC for Construction Innovation is evaluating the economic impact of innovation in the construction sector. Analysis carried out by leading economic modellers, ACIL Tasman, provides the trend shown in Figure 3 following.

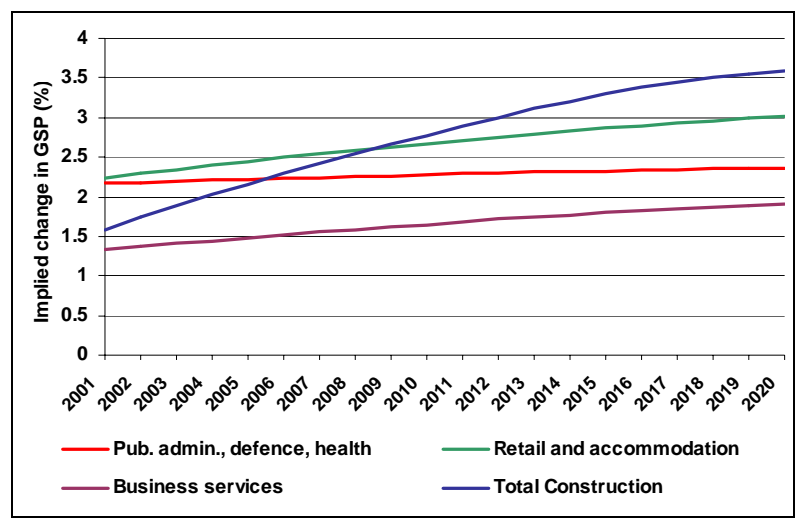


Figure 3: Impact of a one-off productivity improvement in selected sectors (Source: ACIL Tasman, 2004)

What has been modelled is a one-off productivity improvement in each sector of 10 per cent – in effect, a single innovation or bundle of innovations, such as might be delivered by the CRC for Construction Innovation within its life³. The four sectors represent large services sectors in the economy. Total Construction reflects the construction sub sectors. The pattern is striking. The initial impacts have construction towards the lower end of the range in terms of impact on Gross State Product or Gross Domestic Product. Innovation delivers a bigger initial bang for the buck elsewhere. However, for other sectors, most of the innovation effect is delivered very early, with only modest further gains in later years. For Construction, the impact runs through the economy well into the future. The primary reason is that the productivity gains continue to deliver services to all owners and users of the built infrastructure for many years after the construction is complete, and even after the innovation method is obsolete. Similar results attach to a range of other measures of economic performance. These effects constitute a powerful argument for looking to construction sector innovation to support general economic growth over the longer term.

Sample Research Outcomes

The CRC for Construction Innovation has 30 research projects underway across Australia. A summary of key projects providing benefits to the project management sector are:

Environmental Assessment Systems for Commercial Buildings (LCADesign)
(2001-006-B Project Leader – Selwyn Tucker, CSIRO)

This project provides a practical tool to assess the environmental impact of commercial buildings. This tool and associated database calculates the quantities of each material element in a building design described in 3D CAD model and the ecological footprint of those elements. Alternatives can be compared “real-time” under 3 major categories of impact: resource depletion; degradation of the physical environment, and harm to human population.

Investment Decision Framework for Civil Infrastructure Asset Management
(2001-010-C Project Leader – Arun Kumar, RMIT)

This project has developed an investment decision framework for asset management in the roads sector incorporating economic, environmental and social factors using multi-criteria analysis. The benefit of this research for the project management industry is the ability to better advise clients on effective investment choices and to identify and implement an investment decision framework for infrastructure asset management. During the first 12 months of the project, the research team has been able to identify significant potential savings for private and public civil asset owners.

Construction Site Safety Culture
(2003-050-A Project Leader - Dean Cipolla, John Holland)

The project team is conducting research in three key areas of safety management in construction sites in each of the metropolitan centres of Australia: 1) Which management and supervisory positions within a construction company/project are critical to safety performance; 2) What types of competencies / skills / knowledge / behaviours are required to shape the understanding, attitudes, behavioural competencies, norms and ultimate commitment of line management and supervision to site safety and culture; 3) What type of

³ The analysis could equally have used 1 per cent – the pattern would be unchanged, with only the scale on the axis altering.

training packages and learning tools are in place and link their effectiveness to individual site and industry OHS outcomes and safety performance.

Sustainable Subdivisions: Energy Efficient Design
(2002-063-B Project Leader - Michael Ambrose, CSIRO)

This project will determine the performance and priorities of options for achieving energy-efficient design in subdivisions and dwellings, including the connection of housing technology to subdivision technology in sustainable subdivisions, ventilation model rating energy efficiency in housing, and advice to industry on the adequacy of current design options in the context of emerging energy codes for residential buildings.

Regenerating Construction to Enhance Sustainability
(2003-028-B Project Leader - Peter Newton, CSIRO)

This project is designed to assist in the delivery of demonstrably superior green buildings in eco-efficient re-design: achieving a smaller ecological footprint within budget, Enhanced indoor environment quality and performance, reflected in improved health, well being and productivity of building occupants and waste minimisation (through re-design for dis-assembly).

Value in Project Delivery - Project Diagnostics
(2002-052-C Project Leader - John Tsoukas, ARUP)

Access to advanced warning software tool which explore reasons why construction projects fail to achieve their intended outcomes. The tool identifies areas of poor project health, then establishes probable root causes and provides suggested remedial measures. Its focus is to act as an advanced warning system for construction projects that are failing to meet predetermined objectives based on the critical success factors of cost, time, quality, safety, relationships, environment, and stakeholder value.

E-Business – Security and Legal Issues
(2002-067-A Project Leader - Martin Betts, Queensland University of Technology)

This project defines construction industry contract requirements for electronic information exchange and provides guidelines to facilitate on-line trading which conform to legal standards. It will enable construction organisations and their clients to be confident of the legal basis for their electronic business transactions.

Value in Project Delivery: Facilitating a Change in Culture
(2002-022-A Leader - Stephen Rowlinson, Queensland University of Technology)

Access to a definition of cultural attributes that contribute to success and assists the implementation of change within a client's project delivery team.

Innovation Potential, Directions and Implementation in Building and Construction
(2001-012-A Project Leader - Karen Manley, Queensland University of Technology)

Access to information to better equip organisations to strive for innovation best practice and improved business performance.

Further details of these and other projects can be obtained from the CRC for Construction Innovation's website at <http://www.construction-innovation.info/>

Projecting the Future

The CRC for Construction Innovation is entering its fifth effective year of operation. It is committed to submitting a renewal bid in early 2006 to secure the future of applied research and implementation in this critical sector through until 2014. Significant support from existing CRC participants has already been secured with a growing level of interest and commitment from fresh industry and Government participants. As this CRC's research outcomes are implemented in partner organisations, and training programs delivered through University and industry partnerships, the clear demonstration of business benefits arising from these CRC-developed solutions will be further evaluated. The documented benefits delivered at a project, firm, industry and community level will contribute to a more complete investment analysis on behalf of the CRC partners and the Australian Government.

One important initiative led by Construction Innovation in early 2006 will be the Clients Driving Innovation – Moving Ideas into Practice International Conference - bringing together clients, designers, constructors and facility managers from around the world. Moving Ideas into Practice will showcase technologies and practices developing by leading practitioners and researchers globally (www.2006conference.crcci.info).

Conclusion

In common with global trends, changing markets, new technology and rising client expectations are stimulating a radical rethink of how the Australian construction industry can be re-engineered to enhance its performance. The Australian Cooperative Research Centre for Construction Innovation provides a leading vehicle for change working at the interface of industry, government and research at a national and international level. The value derived from the CRC initiative is significant—its partners derive value directly from the applied research outcomes, technology diffusion and leadership offered through participation in the CRC; industry benefits through broader technology diffusion and industry up-skilling especially through strategic activities with industry associations; and the community benefits from economic growth fuelled by innovation in an industry that is shown to be influential in leading the economy in innovation-stimulated growth. Revaluing construction in Australia is continuing to develop through a culture of self improvement, mutual recognition, respect and support. The tripartite collaboration between industry, government and research is developing a robust and viable national research and innovation capability delivering real value to its stakeholders.

The construction sector is on the cusp of a new era in realising the benefits of a close industry/government/research institution relationship for a stronger national and international industry through improved innovation performance (Hampson and Manley, 2001). Australia is advancing in this new era with promising results. The impending renewal of the Australian CRC for Construction Innovation will test the Australian Government and its constituent industry in their resolve to provide a longer term base for this initiative to deliver more substantial benefits into the next decade.

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