



Cooperative Research Centre for
Infrastructure and Engineering Asset Management

Annual Report 2010–11

For reporting period: 1 July 2010 – 30 June 2011

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1 Executive summary

The 2010-11 reporting period saw the launch of the three-year CIEAM extension (CIEAM II) after a successful re-bid effort during the Round 12 selection process. During the year, CIEAM II activity has been driven by its commitment to complete commercial-ready prototype products and solutions that have evolved from CIEAM projects demonstrating commercial potential. The ultimate goal of CIEAM's commercialisation and utilisation activities during the period has been to maximise the likelihood of producing mature, robust technologies with adequate IP protection in place, for commercialisation during the life of the Centre.

In summary the achievements of CIEAM during the period ended 30 June 2011 include:

- Publication of 46 books, book chapters, refereed journal and conference articles;
- Conduct of 18 Centre and three third party projects with several leading to utilisation of its outputs at this time;
- Conduct of one public benefit project the Australian Asset Management Collaborative Group (AAMCoG);
- Completions of five doctoral candidates and a total of 34 graduates involved at the end of the period;
- Completion and promotion amongst CIEAM participants of the integrated engineering asset management body of knowledge as a wiki, accessible through the CIEAM website;
- Conduct of six professional development and training workshops;
- Springer-Verlag's publication of the WCEAM 2010 proceedings;
- Publication of the Engineering Asset Management Review by Springer Verlag through the CIEAM initiated International Society of Engineering Asset Management (ISEAM).

1.1 Achievements

Key appointments

As the extension of CIEAM essentially represents the launch of a new centre, all key staff can be considered new appointments, even if they came across from CIEAM I. On this basis, key staff appointments made to the CIEAM Head Office roles were:

- Chief Executive Office, Professor Joseph Matthew from CIEAM I;
- Business and Commercial Manager, Doug Dunstan, also staying on from CIEAM I;
- Finance and Operations Coordinator Suzanne Hunt; and
- Communications and Marketing Coordinator, Susan Lambe.

Program Leaders were appointed as follows:

- Co-leader Program One, Sustainability and organisational performance – Professor Kerry Brown
- Co-leader Program One, Sustainability and organisational performance – Adjunct Professor David Hood
- Leader, Program Two, Integration and interoperability – Professor Andy Koronios
- Leader, Program Three, Capability optimisation – Professor Lin Ma
- Leader, Program Four, Structural integrity – Professor Rhys Jones

World Congress on Engineering Asset Management

CIEAM was proud to host the Fifth World Congress on Engineering Asset Management (WCEAM) from 25-27 October, 2010 in partnership with the International Society of Engineering Asset Management (ISEAM) and the Australian Green Infrastructure Council (AGIC). The congress attracted 326 delegates, including 85 from 22 overseas countries and was held at the Brisbane Convention and Exhibition Centre. The WCEAM 2010 made a profit of \$48,585 after distributing \$20,000 to AGIC as a profit share in appreciation for their efforts in co-host their Annual Conference with WCEAM.

The CIEAM Chair Mr Ted Scott opened WCEAM 2010 while The Hon Sterling Hinchliffe MP, Minister for Infrastructure and Planning, Queensland opened the combined WCEAM-AGIC congress. The theme of WCEAM-AGIC 2010 was “Engineering Asset Management and Infrastructure Sustainability” and continued the asset lifecycle and a sustainable future theme of the 2009 congress in Greece. The management of engineering assets over its lifecycle, undergirded by sustainability principles is a crucial element for global business sustainability. Seven selected plenary speakers of world repute shared in their learning and experiences in key topics of interest to participants of the congress. They were:-

- Professor Margot Weijnen Technical University of Delft, The Netherlands, “Whole Life Asset Management in interconnected infrastructure systems”.
- Mr Des Pearson, Victorian Auditor General’s Office, Australia, “Managing infrastructure assets: lessons from Australian public sector audit”.
- Professor Roger Venables Chief Executive of CEEQUAL Ltd, UK, “The Influence of Sustainability Assessment & Awards Tools on Sustainability in Civil Engineering & the Public Realm”.
- Dr Woobang Lee, Korea Hydro-Nuclear Power Company and EAM Forum, Korea, “Plant Asset Management Today and Tomorrow”.
- Professor Michael Pecht Center for Advanced Life Cycle Engineering, USA, “Information Systems Safety and Availability – A New Time-Bomb”.
- Professor Rhys Jones Monash University, Australia, “Predicting Short Crack Growth in Aircraft Alloys”.
- Mr Greg Picker – AECOM, Australia, “National & State Policy Responses to Impacts of Climate Change: Insuring that Infrastructure is Climate Resilient”

CRC Association conference

With CIEAM CEO Professor Joe Mathew chairing the organising committee, the annual CRC Association conference 2011 held on 17-19 May 2011 at the Brisbane Convention and Exhibition Centre, was arguably one of the best yet, according to feedback provided by CRCA CEO Tony Peacock, as well as many of the delegates.

With a range of stimulating and well-attended workshops and presentations, the conference served to re-iterate the inherent strength of the CRC Program, and the strong support of all participants, including the steadily increasing cohort of industry collaborator.

Financially, the conference proved to be one of the most successful yet, generating a profit in the order of \$135,000 – a very pleasing result.

Transition planning - submission of transition plan to the Commonwealth

CIEAM successfully achieved its interim transition planning milestone by submitting the proposed plan defining the optimal business model to the Commonwealth CRC Programs branch by the end of the reporting period. All CIEAM Participants were involved in the development of the plan though the Centre’s Research Committee and Program Leaders and Industry Advisors Network (PLIAN).

Written in accordance with the requirements of the Cooperative Research Centres Program’s “Guidance for Preparing Transition Plans, May 2011”, the plan provides a detailed analysis of the rationale and methodology utilised in developing the preferred structure of an independent international asset management organisation. The development of a detailed implementation plan commenced during the period, and is scheduled for submission to the CRC Branch by 30th September 2011. The engagement of an independent project manager to drive the implementation process will be undertaken by selective tender with a planned commencement in late October 2011.

International Society for Engineering Asset Management (ISEAM)

The Board of ISEAM met twice during period, on 25 October 2010 and 18 April 2011. CIEAM CEO Professor Joseph Mathew was re-elected to the Board for a further three year term and remains as Board Chair until October 2011. The society continues to grow its membership through Fellowship by invitation only and twelve new Fellows were admitted at the 2010 World Congress on Engineering Asset Management (WCEAM). These were:

- Professor Amy Trappey, National Taipei University of Technology, Taiwan, China.

- Mr Andy Hess, The Hess PHM Group, USA.
- Professor Andy Tan, Queensland University of Technology and a CIEAM project leader.
- Professor Hloindo Kondo Adjallah, Ecole Nationale d'Ingénieurs de Metz, France.
- Dr Khaled Obaia, Syncrude Canada.
- Professor Ming Liang, University of Ottawa, Canada.
- Professor Wang Wenbin, University of Salford, UK.
- Professor Gerard Ledwich, Queensland University of Technology and a CIEAM project leader.
- Professor Hong-Zhong Huang, University of Electronic Science and Technology of China.
- Professor Markus Stumptner, University of South Australia and a CIEAM Project Leader.
- Adj/Professor David Hood, Queensland University of Technology and a CIEAM Program Leader.
- Professor David MBA, Cranfield University, UK.

The first volume of the Engineering Asset Management Review (EAMR) series was released by Springer Verlag at the 2010 World Congress. The title of the publication is "Engineering Asset Management Reviews – Definitions, Concepts and Scope of Engineering Asset Management", ISBN 978-1-84996-177-6.

The Australian Asset Management Collaborative Group (AAMCoG)

Since its reinvigoration during the previous period, AAMCoG has been extremely energetic in its activity and achieved some significant outputs during the period. Its member organisations for the period are listed below.

Membership of AAMCoG

AAMCoG Participants
Australian Local Government Association (ALGA)
Australian Green Infrastructure Council (AGIC)
Australasian Council of Auditors- General (ACAG)
Australian Procurement and Construction Council (APCC)
Australian Water Association
Austroroads
CIEAM
CPA Australia
Defence Material Organisation (DMO)
Eastern Regional Organisation for Planning and Human Settlements (EAROPH)
Energy Networks Association (ENA)
Planning Institute of Australia (Corresponding Member)
Water Services Association of Australia (WSAA)

The growing connections between AAMCoG members and the expansion of its network, have led to greater strategic national and international linkages. For example, the network has expanded to include: the Eastern Regional Organisation for Planning and Human Settlements (an NGO with linkages to UN Habitat); representatives of the Gosford and Wyong Cities' council and water bodies; and linkages with broader international infrastructure issues, following the participation of David Hood and Robyn Keast at the Future of Airport international colloquium with the Durban University of Technology.

Interactive forum on public asset management

The group coordinated an interactive forum at WCEAM 2010 which explored some pressing issues pertaining to public asset management. Convened by Professor Margot Weijnen of the Next Generation Infrastructures Foundation at Technical University of Delft in The Netherlands, the panel was a departure from the conventional conference approach, where panellists provided a set of questions to which they were invited to respond. Audience members were encouraged to participate in and contribute to the debate.

The Panel comprised:

- Mr Des Pearson (Auditor-General of Victoria)
- Prof Kerry Brown, CIEAM Program Leader, SCU
- Mr Glen Mullins (QR National)
- Mr David Edgerton (CPA Australia)
- Ms Jane Montgomery-Hribar (Australian Procurement and Construction Council)

The topic and format were hugely successful, with conference delegates reporting great value derived from the discussion. As a result, there are plans to repeat this style of interactive discussion at the 2011 AAMCoG forum, to be held in conjunction with the CIEAM annual conference in November 2011.

National asset management framework

A further outcome of the panel was a commitment by AAMCoG members to review, update and reproduce the National Asset Management Framework originally developed by the Australian Procurement and Construction Council (APCC). This work was embarked upon in conjunction with CIEAM Program One Co-leader, Professor Kerry Brown. The resulting publication, *The Integrated Strategic Asset Management Guide* builds on and extends the original framework, and addresses contemporary asset management issues. The development of a contemporary national asset management framework will be an important contribution to the asset management field both nationally and internationally. The Guide is scheduled to be launched at the CIEAM annual conference and showcase in November 2011.

Presence and profiling

In alignment with communication and marketing efforts centred on increasing the profile of CIEAM with relevant audiences, CIEAM CEO Professor Joseph Mathew was invited to lead and participate in a number of events this year. They were:

- The 2010 International Conference on Reliability Safety and Hazards, 14-16 December 2010 organised by the Bhabha Atomic Research Agency in India. (Keynote), "Confronting and Managing the Sleeping Giants".
- Science Industry Australia, Laboratory Managers Conference, 23-24 November 2010, Brisbane. (Invited Speaker) "Next Generation Management of Infrastructure & Engineering Assets".
- Nanyang Technological University, Singapore, Seminar on Engineering Asset Management 20 December 2010.
- Second International Conference on Utility and Safety Management Specialists, 8-10 March 2011 (Keynote), "New Paradigms in Infrastructure and Engineering Asset Management".
- The Asset Management Council, Brisbane Chapter meeting, 12 April 2011.
- AWC Malaysia, Subang Jaya, Malaysia, 6 April 2011. AWC is a facilities manager of building services in Malaysia and the presentation was made in an effort to explore the potential to expand CIEAM into that country.
- Inti International University, Subang Jaya, Malaysia, 7 April 2011.
- Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia, 8 April 2011.
- SKF Research Centre, Nieuwegein, The Netherlands, 26 May 2011.

CIEAM Program Leaders have also made public presentations to various stakeholder groups, as follows:

- David Hood, Co-leader, Program One
 - July 2010: Presentation to Malaysian industry conference on AGIC scheme, and CIEAM research input, Kuala Lumpur;
 - August 2010: Presentation to Northern NSW Group of Engineers Australia on AGIC and CIEAM work Grafton;
 - October 2010: Presentation to Climate Change Adaptation conference on AGIC/CIEAM program, Canberra;
 - October 2010 Presentation and workshop at World Engineering Congress on AGIC scheme and CIEAM research, Buenos Aries;
 - November 2010: Presentation to Sustainability Conference on AGIC/CIEAM work, Auckland;
 - March 2011: Presentation to FutureNet Group on CIEAM research, Sydney;
 - April 2011: Presentation to Transport conference on AGIC/CIEAM work, Kuala Lumpur;
 - May 2011: Two industry workshops on CIEAM Sustainability in Infrastructure project, Sydney and Brisbane;
 - June 2011: Industry workshops on CIEAM Sustainability in Infrastructure project, Melbourne; and
 - June 2011: Presentation to the Australian Sustainable Built Environment Council (ASBEC) on AGIC/CIEAM collaboration;
- Lin Ma, Leader ProgramThree:
 - Keynote at International Conference on Quality, Reliability, Risk, Maintenance, and Safety Engineering (ICQR²MSE 2011), June 2011, China. Topic: *Advanced research in integrated asset management decision support*.
 - Keynote at 2010 International Conference on Manufacturing Engineering and Automation, Guangzhou, China December 2010. Topic: *System health management for productivity and reliability*.

CIEAM Commercialisation and utilisation

The Centre is making good headway towards commercialisation of its research project outputs. This activity is also inextricably linked to the development and implementation of the strategy for transitioning from the CRC Program to an independent international asset management organisation, which is well underway. The Australian Institute for Commercialisation (AIC) who has been engaged to drive the transition plan deliverables will address commercialisation outcomes within the implementation plan for this deliverable.

In terms of specific commercialisation activity, CIEAM has commenced a dialogue with QUT's technology and commercialisation company, Bluebox, with regards to promoting broader utilisation and commercialisation of its key research outputs. Investigation of channels through which to promote utilisation of CIEAM's research is an ongoing priority. CIEAM's annual conference, planned for November is centred on a showcase of the project outputs which have been identified as showing potential for broader utilisation and/or commercialisation. CIEAM has targeted a number of end users to attend the conference and take part in the showcasing activities.

The following licenses of Project IP have provided the following SMEs with a royalty-free, irrevocable right to use Project IP for Internal Purposes:

- QMI Solutions Limited
- Vinsi Partners Pty Limited
- Synengco Pty Ltd
- Advanced Dynamics (Australia) Pty Ltd
- ICS Pty Ltd
- Albany Interactive Pty Ltd

In respect of Mainpac Pty Ltd, a core participant, a research contract has been executed that gives rise to the following licence outcomes:

- CIEAM assigns to Mainpac all Intellectual Property Rights in the Project Results.
- Mainpac in turn has granted to CIEAM a royalty free non-exclusive licence to use the Participant IP for the purpose of carrying out the Centre Activities, and to all Participants pursuant to clause 23.5 (internal purpose clause) of the Centre Agreement.
- In the event that any CIEAM Participant requires access to the Mainpac's software for commercial purposes, CIEAM will notify that Participant and the Mainpac that they will need to enter into a user license between them governing the use of that software, upon terms that they shall agree.

Education and training – workshops & subsequent development of eLearning module

CIEAM's Education and Training portfolio delivered a range of workshops and short courses during the period. The courses ranged from in-house provision of asset management short courses to Centre Participants; to facilitation of industry forums; and the delivery of sustainability workshops, made publicly available to key stakeholders in the infrastructure industry.

CIEAM is also developing a graduate e-Learning module on engineering asset management, using the intellectual property and expertise developed and accumulated from its research outputs and has engaged Open University of Malaysia to drive this deliverable.

International standards organisation

The 16th Plenary meeting of the Condition Monitoring and Diagnostics Committee of the ISO (ISO/TC 108/SC 5) was held in London, UK from 20-24 September 2010. CIEAM was represented by the CEO, Professor Joseph Mathew; Professor Markus Stumptner; and Professor Lin Ma. Mr Leith Hitchcock, a CIEAM Fellow, served as Convenor on the Thermal Imaging and Tribology working groups and was also present at this London meeting. This year's meeting also coincided with meetings of all the other Subcommittees of the parent committee, TC 108, Mechanical Vibrations and Condition Monitoring.

Overall, the membership of this committee now totals 21 Participating and 13 Observer member countries. It has to date published 17 standards and two more progressed to Final Draft International Standards (FDIS) status after the London meeting.

Professor Mathew was re-elected as Chairman of the Committee for another three years to the end of 2013.

SME engagement

CIEAM's SME partners are actively engaged across a range of projects. Advanced Dynamics is collaborating on a number of the Sustainability and Organisational Culture projects in Program One, particularly in relation to the development of the organisational culture survey and the specific tailoring of the instrument for use in participant organisation, Queensland Rail.

Albany Interactive and ICS are involved with outputs from the Education and Training portfolio, including the delivery of workshops to industry partners and the development of a graduate e-Learning module on asset management. Specialist consultancy Synengco has made considerable contribution to the Asset Performance Decision Indicator project, while Vinsi and Partners have been working with the corrosion sensors group and have also provided access to a range of structures for user testing.

1.2 Risks and impediments

CIEAM continues to monitor its risks and impediments on a regular basis through its Risk, Audit and Finance Committee and maintains an updated risk register. While the committee oversees all known risks, close attention is devoted to the highest risk elements, including the following:

- Loss of key participants;
- Loss of senior management due to reduced funding period (three years);
- Breach of IP security;
- Participants cash and in-kind contributions not being met in full;
- Failure to achieve outcomes, outputs and milestones in the respective programmes (timing, achievement dates);
- IP leakage from within the programs;

- Project milestones not being met;
- IP leakage from within the projects;
- Inability to recruit and select PhD research students undertaking projects of suitable relevance to the CIEAM research and development program.
- Inability to consistently develop and deliver training courses of an appropriate quality and relevance to industry;
- Industry unable to utilise technology; and
- Major Commonwealth deliverables not being met.

While CIEAM has identified these risks, it has also established controls around each of these through implementing effective procedures and systems, which are reviewed on a regular basis.

As an example, early in the start up of CIEAM II, the Centre experienced delays in receiving participant contributions. This has the potential to present some considerable obstacles to CIEAM II becoming operational and meeting reporting deadlines as well as upheaval in operation of the centre. To counter any further delays of this nature, Business and Commercial Manager Doug Dunstan implemented a robust regime of debt administration and follow up, to ensure contributions are made in a timely manner.

1.3 End user environment

CIEAM Participants in defence, transport, utilities and other asset-intensive industries are under pressure to produce large operational savings to free capital for future asset acquisitions. Auditors General are insisting that acquisition proposals must be based on the whole-of-life cost, including maintenance.

Concurrently, climate change impacts require new approaches to define and achieve best-practice economic, environmental and social performance. 'Business-as-usual' approaches such as cost-cutting cannot achieve timely outcomes of the magnitude required. Rather, they can be counter-productive, resulting in inadequate maintenance, overly optimistic life expectancies, and in the worst case, catastrophic failures. However, current tools to support whole of life management are inadequate.

A paradigm shift is needed in the approach of asset-intensive industries to managing assets – one that: (a) features a holistic approach to strategy, management and skills; (b) involves asset owners, operators and suppliers; and (c) includes new technology that gives business operators the knowledge to operate effectively, efficiently and sustainably.

The challenge for CIEAM is to transform and optimise the performance of asset-intensive industries in this increasingly complex, demanding, and carbon-constrained operating environment, globally.

CIEAM is playing a significant national and international role in developing engineering asset management as an innovative discipline, and in developing its science as well as commercial opportunities. Through its four research programs, CIEAM is formulating a cohesive holistic and strategic approach to the transformation of the management of Australia's critical public and private infrastructure and engineering assets.

Over the past twelve months, the imperative to deliver a comprehensive commercial approach to research outputs has served to galvanise involvement and collaboration between industry participants. All program leaders have strengthened integration links between projects and across programs. The over-riding strategic imperative of direct utilisation and commercialisation of CIEAM research outputs has brought a fundamental shift in the relationships with end users.

CIEAM's annual conference, scheduled for November 2011 is being treated as an opportunity to showcase products with potential for utilisation within an end-user environment. A number of the products to be featured at the event have already been trialled by end users with positive results.

It is worth noting that the 2011 software release of one of CIEAM's IT provider participants, Mainpac, was earmarked to incorporate a number of CIEAM research outcomes. Development of the new release was not initially part of CIEAM's work program and the request for the Centre to contribute necessitated a welcome variation to the work program. It is significant that the Centre's industry partners, such as Mainpac, are deriving value in their collaboration with CIEAM and all of its partners.

The depth of collaboration with China's largest software provider and CIEAM end user Neusoft is such that a joint research centre has been established and is scheduled for launch in Beijing in late November 2011. The CIEAM-Neusoft Research and

Development Centre (CNRDC) will form an extension of the Centre's work with Neusoft in Beijing, and provide a lucrative channel for commercial utilisation of research outcomes.

Back home in Australia, CIEAM's education and training portfolio has been working to deliver in-house asset management short courses to Queensland Rail. CIEAM's organisational culture projects have also been collaborating closely with Queensland Rail as they work together to specifically tailor the organisational culture survey tool for use in that organisation.

1.4 Impacts

At the conclusion of CIEAM I, the Centre conducted an independent and objective economic impact assessment. The outcomes of this evaluation considered the value of CIEAM's outputs that were suitable for utilisation and commercialisation in excess of \$2 billion, once introduced into the market place. These findings have been used as frameworks for the CIEAM II round of projects. CIEAM is in the process of extracting all the commercially viable aspects of its research outputs and will conduct an impact assessment of these through the implementation of the transition plan.

2 Governance and management

2.1 Governance – Board, committees and key staff

CIEAM Organisational Structure

CIEAM II has retained the structure of its predecessor which was established as an unincorporated joint venture (CIEAM) with an associated incorporated management company limited by shares (CIEAM Pty Ltd), which manages the overall activities of CIEAM. In particular, CIEAM Pty Ltd manages intellectual property created by CIEAM research projects on behalf of all participants.

Each of the four research programs is managed by a Program Leader, with Program One driven by two co-leaders. All program leaders report to the CEO and are supported by a network of industry advisors who assist in formulating and developing projects, maintaining links with industry and advising on industry related issues and shaping utilisation outcomes.

The Business and Commercial Manager also reports to the CEO and is responsible for maintaining the day-to-day financial and some administrative activities of CIEAM, including: the preparation of the business plan and budget for the approval of the Centre Board; keeping the CEO fully informed on all matters relating to the operations and interactions of CIEAM; and leading the Development and Commercialisation program. The duties within the Education and Training portfolio are undertaken by Adj/Professor Jimin He who occupies the role of CIEAM Postgraduate Coordinator and Training Manager.

The CIEAM Organisational Chart is presented in the following figure.

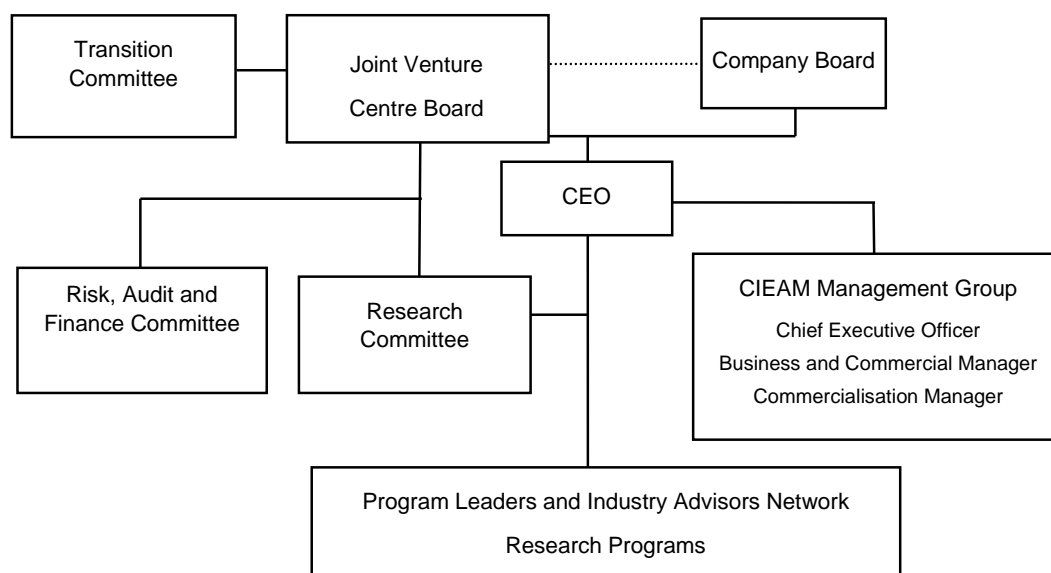


Figure 1 - CIEAM Organisational Chart

CIEAM Board

The Centre Board of Management of the unincorporated joint venture (the Centre Board) consists of 12 members, including the independent Chair. The membership of the Centre Board is nominated from the core participants and elected by all participants. Each of the Industry and Researcher Groups elects their members separately, as follows:

Distribution of CIEAM Board of Management	
Independent Chair	1 Director
Sponsor Director (QUT)	1 Director
Industry Research Group	3 Directors
Research Providers Group	3 Directors
SME's Representative	1 Director
Independent Director	1 Director
Appointed Directors (Core)	2 Directors

The main responsibilities of the Centre Board are to:

- Ensure the Centre observes best practice governance, policies, procedures and guidelines.
- Appoint the Chair of the Centre Board and the CEO
- Oversee the activities of a Research Committee
- Approve the Strategic Directions of the CRC developed by the Research Committee
- Approve the research projects recommended by the Research Committee
- Approve an annual operating plan and budget
- Approve utilisation and commercialisation plans for project intellectual property
- Ensure that the risk management plan is correctly implemented
- Review performance of CIEAM against objectives, outcomes, outputs and milestones
- Ensure compliance with CIEAM's contractual obligations, including those with the Commonwealth, and compliance with government regulation
- Appoint external advisory committees and panels as required
- Develops statements of duties and responsibilities for the Chair and the CEO.

The CEO reports to the Centre Board, and is responsible for the overall operations of the CRC.

CIEAM Board Members 2010-11			
Name	Role	Key skills	Independent/ Organisation
Mr Ted Scott AM	Independent Chair	Expert in power industry and HR management	Independent
Mr Peter Dowling AM	Independent Board Member; Deputy Chair	Expert in financial management and corporate governance(FCA,FCPA)	Independent
Mr Darren Hayman	Industry Group Representative	Senior executive in water industry and expert in asset and infrastructure management	Allconnex Water
Mr Glen Mullins	Industry Group Representative	Senior VP & Executive Manager of the nation's largest rail freight haulage operator	QR National

CIEAM Board Members 2010-11			
Name	Role	Key skills	Independent/ Organisation
Mr James Kirk	Industry Group Representative	Chair of Software provider for Asset Management solutions	Mainpac
Mr Jim Walker AM	Industry Group Representative	CEO of semi government institute specialising in the manufacturing industry	QMI Solutions
Mr Limin Wang	Industry Group Representative	Senior executive of large software manufacturer China	Neusoft
Mr Stephen Saladine	Industry Group Representative	Senior executive of one of the nation's largest power generation companies	Delta Electricity
Professor Brett Kirk	Research Group Representatives	Assoc Deputy Vice Chancellor (R&D) of a major Australian University focussing on R&D and innovation	Curtin University
Dr David Lyster	Research Group Representatives	Manager Research partnerships of a major Australian University.	Monash University
Prof Andrew Parfitt	Research Group Representatives	Pro VC Division of Information Technology, Engineering and the Environment in a major Australian University	University of South Australia
Professor Arun Sharma	Sponsor Board Member	DVC Research and Commercialisation of a major Australian University	QUT
Mr Douglas Dunstan	Secretary	Expert in financial management and corporate governance (FCIS,FCPA)	CIEAM

Board meetings attendance				
Attendees	3 September 2010	26 November 2010	1 March 2011	3 June 2011
Mr Ted Scott AM	✓	✓	✓	✓
Mr Darren Hayman	-	✓	✓	✓
Mr Glen Mullins	✓	-	✓	✓
Mr James Kirk	✓	-	✓	✓
Mr Jim Walker	✓	-	✓	✓
Mr Limin Wang	✓	✓	-	-
Mr Stephen Saladine	✓	✓	-	✓
Professor Brett Kirk	✓	✓	✓	✓
Dr David Lyster	✓	✓	✓	✓
Professor Andrew Parfitt	✓	-	✓	-
Professor Arun Sharma	-	✓	✓	-

Board meetings attendance				
Attendees	3 September 2010	26 November 2010	1 March 2011	3 June 2011
Mr Peter Dowling AM	✓	✓	✓	✓
Mr Douglas Dunstan	✓	✓	✓	✓

Program Leaders and Industry Advisors Network (PLIAN)

A key element of the management structure is the nomination of at least one industry advisor to each research program. These industry advisors support the program leaders in formulating and developing projects, maintaining links with industry and advising on industry related issues. These industry advisors and program leaders meet weekly with the CEO as a network, known as the Program Leaders and Industry Advisors Network (PLIAN).

PLIAN's main functions are to advise the CEO on relevant matters, including:

- Progress against milestones across all programs;
- Financial and budgetary status of CIEAM;
- Advise on the forward research program estimates;
- Assist with the development of the budget for consideration by the Centre Board; and
- Generally advise the Centre Board on the operations of CIEAM

This network has been meeting on a weekly basis for most of this financial year.

Committees

The Centre Board establishes committees as required, to advise on a range of matters, including financial disclosure, risk management, IP management and commercialisation, and program management. Each committee wholly represents participant organisations and functions in an inclusive and consultative manner. The contribution of such committees continues to prove highly valuable in ensuring good governance.

Research committee

Given the fact that not all core participants are represented directly as members of the Centre Board, and in order to ensure that all participants have an opportunity to participate in the development of policy and design of the research and other programs, the Centre Board established a Research Committee, with representation from all participants.

The Research Committee is responsible for implementing and reviewing the Centre's strategic Research Management Plan, as well as incorporating the Centre's research directions, strategies, priorities and key performance indicators.

Membership of the Research Committee comprises; Centre Board Member — Industry Group (Chair), Chief Executive Officer, and one representative nominated by each of the core and supporting participant organisations.

Members of the Program Leaders and Industry Advisors Network (PLIAN) may also attend meetings and represent their participant organisations, as the nominated representative.

The Research Committee met four times during the 2010–2011 period to oversee the research work program for CIEAM and advise, report and make recommendations on CIEAM research activities to the Centre Board. The committee works with CIEAM Management, which is responsible for preparing the Centre's program of research and associated budgets for the Centre Board's consideration.

Research Committee			
Name	Role	Key skills	Independent/ Organisation
Darren Hayman (Chair)	Chairman	Asset management – water infrastructure	Allconnex
Dr Margaret Law	Member	Innovation management	ASC
Professor Joe Mathew	CEO	Condition monitoring, asset management	CIEAM
Prof Andy Koronios	Program Leader	Integration and interoperability	University of SA
Prof Arun Kumar	Member	Infrastructure management	QUT
David Hood	Program Leader	Sustainability and asset management	QUT
David Lyster	Member	Research partnerships & commercialisation	Monash
Ms Elizabeth Chapman	Member	Rail infrastructure management	QR National
Mr David Mengel	Member	Process architecture – asset management	QR National
Mr Andrew Frikken	Member	Facilities and infrastructure management	ANSTO
Mr Graham Brown	Member	Rail asset management	QR
Prof Ian Howard	Project Leader	Condition monitoring	Curtin
Mr Justin Weligamage	Project Leader	Road asset management	ODTMR
Ms Kelly O'Halloran	Member	Water asset management	Allconnex
Mr Warwick Robinson	Member	Electricity asset management	Delta Electricity
Mr Doug Dunstan	Member	Business and Commercial	CIEAM
Prof Kerry Brown	Program Leader	Organisational performance & human capability	SCU
Prof Mark Jones	Member	Pneumatic conveying & bulk solids handling	UNC
Michael Tons	Member	Information Communication Technology	Mainpac
Steven Rigby	Member	Asset integrity in energy infrastructure	Origin
Rob Keogh	Member	Water asset management – utilities infrastructure	Sunwater
Suzanne Hunt	Secretary	Operations & finance	CIEAM

Risk, audit and finance committee

CIEAM's long standing Risk, Audit and Finance Committee, originally appointed by the Centre Board in its first year, continues its vital function advising on financial and risk issues affecting the CRC in its latest iteration. During 2010-11 the committee was chaired by Mr Jim Walker CEO of QMI Solutions, an SME group member on the Centre Board. Over the reporting period the committee met four times.

Risk Audit and Finance Committee			
Name	Role	Key skills	Independent/ Organisation
Mr Jim Walker	Chair	CEO of semi government institute specialising in manufacturing industry	QMI Solutions
Mr Ted Scott	Member	Expert in power industry and HR management	CIEAM Chair
Mr Peter Dowling	Member	Expert in financial management and corporate governance (FCA,FCPA)	Independent
Mr Glen Mullins	Member	Senior VP & Executive Manager the nation's largest rail freight haulage operator	QR National
Professor Joseph Mathew	Member	CEO of Centre recognised as global expert on EAM	CIEAM (CEO)
Mr Douglas Dunstan (Secretary)	Member	Expert in financial management and corporate governance (FCIS,FCPA)	CIEAM(Business & Commercial Mgr)

Transition committee

The Transition Committee is a sub-committee of the Centre Board which meets on a quarterly basis and as required. The role of the committee is to oversee the transition of CIEAM as defined in Commonwealth Agreement as follows:

Item 1.3.1	Complete the design for the preferred structure of the independent international asset management organisation.
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Accordingly, the Committee has been integral to the process of addressing the requisite milestone within CIEAM's Agreement with the Commonwealth to develop a transition plan and was furnished to the CRC Branch by the due date 30th June 2011.

The Transition Plan provides a detailed analysis of the rationale and methodology utilised in developing the preferred structure of an independent international asset management organisation which was completed by the Australian Institute for Commercialisation (AIC) who were engaged after an extensive transparent tender process.

The plan is compliant with the requirements of the Cooperative Research Centre Program's 'Guidance for Preparing Transition Plans, May 2011' and includes a detailed implementation plan based on the business model embarked upon by AIC and at the end of the reporting period was on track for submission to the CRC Branch by 30th September 2011. The engagement of an independent project manager to drive the implementation process will be undertaken by selective tender with a planned commencement in late October 2011.

Membership of the Transition Committee is detailed below.

Transition Committee			
Name	Role	Key skills	Independent/ Organisation
Mr Darren Hayman	Industry Group Representative - Chair	Senior executive in water industry expert in asset and infrastructure management	Allconnex Water
Mr Ted Scott (AM)	Member	Expert in power industry and HR management	CIEAM
Professor Brett Kirk	Research Group Representatives	Assoc Deputy Vice Chancellor R&D focussing on R&D and innovation	Curtin University
Mr Douglas Dunstan (Secretary)	Member	Expert in financial management and corporate governance (FCIS,FCPA)	CIEAM

Key staff

CIEAM is headed by Professor Joseph Mathew in the role of Chief Executive Officer. Professor Mathew reports to the Centre Board and is responsible for the overall operations of CIEAM. He is assisted by Douglas Dunstan, Business and Commercial Manager/Board Secretary. Six additional positions located in CIEAM's QUT Headquarters supported the activities of the organisation. Five Program Leaders also report to the CEO and participate on matters relating to the operational management of the research projects.

CIEAM's key staff during 2010-11 are listed below:

Name	Organisation	CRC Position/role	Time Committed
Prof Joseph Mathew	CIEAM	Chief Executive Officer	Full time
Mr Douglas Dunstan	CIEAM	Business & Commercial Manager & Board Secretary	Full time
Dr Jimin He	CIEAM	Education and Training Manager	Part time
Mr Steven Hadlow (until Dec 2010) Ms Suzanne Hunt (from Dec 2010)	CIEAM	Finance & Operations Coordinator	Full time
Ms Jane Davis (until Dec 2010) Ms Susan Lambe (from Jan 2011)	CIEAM	Communications and Marketing Coordinator	Full time
Ms Lydia Lee	CIEAM	Executive Officer - Business and Commercial	Full time
Betty Goh	CIEAM	Executive Assistant to the CEO	Full time
Sherrie Garcia	CIEAM	Senior Administration Officer	Full time
Adj/Prof David Hood	AGIC/QUT	Co-Leader, Sustainability and organisational performance program	60%

Name	Organisation	CRC Position/role	Time Committed
Prof Kerry Brown	SCU	Co-Leader, Sustainability and organisational performance program	100%
Prof Andy Koronios	UniSA	Leader, Integration and interoperability program	60%
Prof Lin Ma	QUT	Leader, Capability optimisation program	80%
Prof Rhys Jones	Monash Uni	Leader, Structural Integrity program	60%

2.2 Participants

CIEAM operates as an unincorporated joint venture between its industry, research organisations, educational institutions and government agencies. During 2010-11, 19 organisations were involved in CIEAM. Of these, 15 organisations were core participants; and four were supporting participants. The following table outlines CIEAM's participating organisations over the past year.

Participants during the reporting period

Participant's Name	Participant Type	ABN or ACN	Organisation Type (or Individual)
ASC Pty Ltd	Essential/Core	64 008 605 034	Industry/Private Sector
Australian Nuclear Science & Technology Organisation (ANSTO)	Essential/Core	47 956 969 590	Industry/Private Sector
Curtin University of Technology	Other/Supporting	99 143 842 569	University
Delta Electricity	Essential/Core	67 139 819 642	Industry/Private Sector
The Southern SEQ Distributor-retailer Authority (Allconnex)	Essential/Core	80 769 308 350	Industry/Private Sector
Mainpac	Essential/Core	50 095 976 177	Industry/Private Sector
Monash University	Essential/Core	12 377 614 012	University
Neusoft Corporation	Essential/Core	N/A	Industry/Private Sector – International
Origin Energy	Essential/Core	30 000 051 696	Industry/Private Sector
Perth Hospitality Professionals (ASTHM)	Other/Supporting	58 009 369 797	Industry/Private Sector
QR National	Essential/Core	146 335 622	Industry/Private Sector
Queensland Department of Transport and Main Roads	Other/Supporting	39 407 690 291	State Government
Queensland University of Technology (QUT)	Essential/Core	83 791 724 622	University
Queensland Rail Limited	Essential/Core	71 132 181 090	Industry/Private Sector
Southern Cross University	Essential/Core	41 995 651 524	University
Sunwater	Other/Supporting	17 020 276 523	Industry/Private Sector
University of Newcastle	Essential/Core	15 736 576 735	University

Participant's Name	Participant Type	ABN or ACN	Organisation Type (or Individual)
University of South Australia	Essential/Core	37 191 313 308	University
University of Western Australia	Essential/Core	37 882 817 280	University

Changes to participants

The participants who were party to the Centre agreement remain intact at the conclusion of this reporting period. There have been no changes.

2.3 Financial management

Cash expenditure

Cash expenditure for YTD at the 30th June 2011 was \$6.725 million against a \$6.765 million budget (under spend of \$0.04 million against budget).

Research participants furnish tax invoices for research project funding on a regular quarterly cycle which are paid promptly.

In-kind effort

YTD In Kind totalled \$11.092 million which is tracking well against the YTD budget of \$11.560 million (a minor shortfall of \$0.468 million). Actual In Kind is tracking very positively against Commonwealth pledges for In Kind effort which stand at \$10.786 million or \$0.306 million greater than pledged. This result is comprehensively assisted by the workflow approval process for both cash and in-kind effort reporting that is an integral feature of Centric. The governance processes ensure that each researcher and industry advisor is tracked by a sophisticated workflow processes which carefully prompts quarterly research effort and ensures an on-line multiple approval process. Key users continue to register high levels of satisfaction with the Centric system.

Project and financial management systems

At the 30th June 2011 the Centric project management system was fully reconciled to the MYOB financial accounting system providing a sound internal control for the Centre's substantive project expenditure. From this point forward all project related transactions will be driven by Centric which affords a comprehensive project management reporting suite based on agreed salary and project costs.

Cash receipts

Core Contributions from participants totalling \$2.785 million were received in total and have been reflected in the financial tables accordingly. The agreed Commonwealth contribution of \$4 million was received during the reporting period, providing agreed total contributions inclusive of participants' contributions of \$6.785 million.

Debtors and other events

Normal trade debtors as at 30th June 2011 were nil, this is a particularly pleasing result and is a first since the Centre has operated.

Comprehensive debt monitoring systems are in place that will ensure debt is adequately controlled. Some of the previous challenges are outlined as follows:

- Neusoft core contribution technicalities discussed with the CRC Branch arising from in the PRC taxation system which seeks to impose 15.5% taxation on funds transfers both ways has been overcome by establishing a PRC based CIEAM Bank Account in PRC which has been approved by the Commonwealth CRC Branch
- The engagement with ASTHM which was initially problematical and was raised with CRC Branch has now been resolved and that organisation is now fully engaging with a detailed project plan now in place.

2.4 Communications

During the reporting period, CIEAM's communication and marketing function has focussed on supporting the strategic business objectives of the centre by providing planned, timely and transparent communication strategies and outcomes. The overarching communication strategy is to position CIEAM as preferred partner for the development and commercialisation of industry driven, innovative asset management technologies. To this end, the portfolio continues to nurture relationships with key internal and external stakeholders, and actively seeks opportunities to profile CIEAM's research outputs to date.

Internal communication and collaboration

CIEAM's internal communication efforts over the year have endeavoured to utilise a range of channels to facilitate collaboration and sharing of information.

Secure 'participant-only' web page

The establishment of a secure participant-only area, built in to the new CIEAM website, provides a range of opportunities for sharing information within the CIEAM community, while protecting valuable intellectual property.

Final reports from CIEAM I projects were completed and authorised by industry partners for publication within the participant-only environment on the CIEAM website, enabling secure sharing of research outcomes within the CIEAM community.

The participant-only area of the website also hosts the portal to CIEAM's Asset Management Body of Knowledge (AMBoK) wiki, which may be accessed through a second layer of security. The AMBoK represents an amalgam of fundamental asset management data and information gathered by CIEAM since its inception. Its availability throughout the CIEAM community represents a generous sharing of knowledge. The wiki is also being utilised as a key element of projects within the Capability Optimisation program and for education and training content.

Also accessible via the participant-only web page are PhD theses completed during CIEAM I.

Newsletter and announcements

The CIEAM community's quarterly electronic newsletter was re-launched in March 2011 as the "CIEAM Communiqué". The newsletter is distributed to CIEAM stakeholder groups via direct email and features updates of the centre's activities, achievements, research outputs and events. The newsletter also has potential for even broader distribution by way of recipients forwarding to interested colleagues, thereby expanding CIEAM's existing database and network. The newsletter is replicated on the CIEAM website 'News' page.

Important announcements that fall outside of the newsletter publication cycle and are worthy of being highlighted individually - such as product releases, events, and notable individual and project accomplishments - are emphasised by a formal direct email to the CIEAM network and key stakeholders. This means that important events can be broadcast to the CIEAM community in a timely manner, rather than waiting for the next edition of the quarterly newsletter to be issued and losing relevance.

The newsletter and announcements are issued utilising an email marketing platform that captures subscribers from the CIEAM website and tracks emails for effective database management and provides valuable information about how the information is accessed.

Participant surveys

CIEAM's annual participant surveys for 2010 were completed and reported upon during the period. The surveys facilitate valuable feedback from participant organisations which contributes to the centre's management, governance and self-evaluation processes. The primary objectives of the survey are to gauge levels of participant satisfaction with the conduct and execution of CIEAM and its agreed outcomes; the degree to which participants' expectations are being met with regard to engagement; and the degree to which participants intend to remain involved with the centre in the future. The process of conducting the surveys also provides a valuable opportunity for face-to-face interaction between the centre's CEO and senior staff from all participant organisations. This quality face time is rare in an organisation where the locations of key players are geographically diverse.

External communication

Brand and identity

With the successful re-bid and subsequent kick-off of 'CIEAM II' in July 2010, a refresh of the CIEAM brand and overall look and feel was undertaken to incorporate the revised centre title and reflect the centre's new focus on commercialisation and transitioning beyond a CRC environment.

The re-branding exercise incorporated a re-design of the CIEAM website, which went live in conjunction with a 'soft' launch of CIEAM II. The website is CIEAM's external interface with the outside world and represents a platform for informing and connecting with both internal and external stakeholders. It provides a portal for the dissemination of branded collateral, news, and shared research outcomes.

Profile

CIEAM's communication and marketing plan has a strong emphasis on raising the centre's profile with new audiences and potential future stakeholders, as well as keeping CIEAM front of mind throughout existing networks. CIEAM is pro-active in identifying opportunities for national and international exposure of its research outputs by leveraging relevant association and conference events within target markets to create speaking and presentation opportunities.

Ensuring regular contact with external stakeholders via direct mail is a means to maintaining a profile with existing networks. The centre is working hard to build a stronger web presence and is represented across associate websites such as the International Society of Engineering Asset Management (ISEAM); World Congress for Engineering Asset Management (WCEAM); and the Australian Asset Management Collaborative Group (AAMCoG).

The centre's brand is further profiled and reinforced through prominent signage, merchandising and sponsorship opportunities at appropriate events and forums that address CIEAM's target audiences. Sponsorships taken up during the reporting period include the Australian Asset Management Council's International Conference on Maintenance Societies (ICOMS) and the CRC Association Annual Conference, Keeping Ahead of the Curve.

Media and advertising

During the period the centre embarked upon the development of a strategy to boost media and advertising presence. The strategy is likely to bear fruit in the reporting periods to follow, and seeks to identify new initiatives for regular contact with media/industry audiences to ensure CIEAM is 'top of mind' among relevant media when features are being prepared. The strategy also aims to leverage editorial coverage off targeted paid media exposure and seek out targeted advertising, media and branding opportunities leveraged from conference attendance; technical paper presentation; and presence as an exhibitor.

2.5 Intellectual property management

The broad target for CIEAM I was to establish an Australian asset management environment that would improve the effectiveness, and reduce the annual costs of maintenance and asset lifecycle considerations with direct savings to industry, resulting in a significant economic, environmental and social benefit and the potential for significant concomitant commercial outcomes.

The CIEAM II extension has built on the wealth of leading-edge technology that was generated in the life of CIEAM I

The broad commercial objective of CIEAM remains to deliver a range of products and services which will drive Australian industry to achieving a substantial reduction in the whole-of-life cost of engineering assets across all industry sectors, and enable the exporting of those products on a global basis.

CIEAM I's activities produced a range of sophisticated asset management tools, models and systems such as:

- Advanced fibre-optic and piezoelectric sensors and actuators that continually monitor wear, corrosion and other forms of degradation in both fixed and mobile industrial and defence assets.
- High-level data acquisition, quality and management systems that integrate with other corporate systems to optimise business decision making, within a capability to much improve the quality from which decisions are made.
- Fully integrated models and processes that facilitate asset management decision making from plant through to corporate level, and in some applications, automate it completely.
- Engineering asset management education and training programs for all levels of technical and professional staff, ensuring levels of skill that will optimise the technological advances achieved by CIEAM's other research outcomes, maximising assets' productive life, and minimising overall costs of ownership.

As in CIEAM I, CIEAM II intellectual property (IP) resources are managed at two separate levels — firstly, at the organisational or governance level and secondly, at the project management level. Both levels require different techniques to ensure IP is not only managed and protected but also utilised in a manner that brings maximum benefits to CIEAM participants, and to the nation as a whole.

Over the last three years CIEAM has:

- Engaged of the Australian Institute of Commercialisation (AIC) to undertake a comprehensive project on the Intellectual Property created under CIEAM projects to mine potential innovation that would have market place potential.
- Engaged QUT Bluebox to assist the CIEAM Management in the process of interacting with the researchers on the technical aspects of the projects and then to assist in the process of progressing these technologies to "market ready" products.
- During that time RMDSTEM, conducted an independent and objective economic impact assessment which placed a value of in excess of \$2 billion on CIEAM technology once introduced into the market place. These findings have been used as frameworks for the CIEAM II projects that have a comprehensive utilisation and commercialisation imperatives.

Since the commencement of CIEAM II, the Centre has enhanced IP recording using the detailed functionality integrated in the Centric project management system which is fully operational at this time. IP recording for all projects is comprehensive which will assist in defining all IP generated in projects and ensure that they are adequately protected.

CIEAM II has developed a compelling program which builds on the cutting edge outcomes in CIEAM I. The programs consist of:

- Program 1 Sustainability and Organisational Performance.
- Program 2 Integration and Interoperability.
- Program 3 Capability Optimisation.
- Program 4 Structural Integrity.

The deliverables covering transitional arrangements for CIEAM II have significant tangible commercialisation strategies to exploit CIEAM I and CIEAM II technologies. As at 30 June, 2011, CIEAM has one patent pending for a system and method for business decision making, or decision support tool, which originates from research program three. CIEAM has lodged an International Patent Application (PCT/AU2010/001465) for this invention in Australia and United States of America. Further,

CIEAM has identified significant opportunity to further exploit the IP of a range of current projects, which will be showcased at CIEAM's annual conference in November 2011. An additional and noteworthy opportunity to showcase CIEAM project outputs also exists in the launch of the joint CIEAM-Neusoft Research and Development Centre (CNRDC) planned for late November 2011. Neusoft is the largest IT company in China and as a Centre Participant is heavily involved across a range of CIEAM projects. The CNRDC is a noteworthy outcome of a highly successful collaboration.

3 Performance against activities

3.1 Progress against the key challenge/outcomes

The proper management of Australia's infrastructure and engineering assets is a major national challenge that has been described as the single largest business opportunity in the 21st century. CIEAM is on target to delivering deliver a range of enablers for industry to meet this challenge in three critical areas:

- Economic: CIEAM will deliver technology and management innovations for more efficient operations to extend the life of assets, increase their capability and whole of life value, and mitigate the risk of catastrophic failure.
- Environmental: Climate change brings assets closer to the limits of their design parameters. CIEAM will deliver new forms of management to reduce risk, and to address the carbon and sustainability challenges generated by the national asset base.
- Social: Management will be sensitised to societal concerns and will manage in conformance with international sustainability reporting regimes, delivering greater value to the community.

Over its first seven years as CIEAM I, the CRC enhanced the discipline of asset management with strong industry support, and established a leading world-class multidisciplinary collaborative research entity within an international network. CIEAM has engaged extensively with industry to develop software tools for constructing a unified information environment that captures, standardises and delivers information and knowledge for effective asset management and decision-making.

CIEAM II plans to transform its existing research into asset operation business models by combining the business and sustainability focus, structures and cultures within predominantly engineering focussed organisations with the skills required to manage and operate organisations holistically. An evolving CIEAM best practice capability model will guide transformation.

CIEAM and its industry participants and SME partners will complete the development of research outputs into commercial prototypes and products, working with its SME Participants and third-party suppliers where appropriate, to help organisations achieve best practice through incremental transformations.

During the reporting period, good headway has been made into the development of asset operation business models, primarily through the research outputs of Program One, Sustainability and Organisational Performance. Research outputs with potential for development into commercial products have been identified and flagged with relevant third party suppliers, including the commercialisation arms of participant universities. These outputs have been earmarked for showcasing at the CIEAM annual conference in November 2011 and will continue to be groomed for the marketplace.

3.2 Research

Research program one: Sustainability and organisational performance

This program is on target to achieve its research outcomes and is generally proceeding according to the outlined milestones. The individual projects are building to converge as the Asset Management Capability Maturity Model and the AGIC Sustainability Rating Scheme and it is anticipated that these key outcomes will be completed on schedule.

Key research achievements

Two conference papers have been generated by the Strategic Asset Management project and one by the Organisational Culture project team. All papers have been submitted for presentation at the World Congress on Engineering Asset Management (WCEAM).

Importantly, these conference papers provide a summary of the current research to date in the projects and demonstrate the achievement of the respective literature review milestones. The paper titles are: "Current Issues in Strategic Asset Management", "Strategic and Human Issues in Asset Management Models" and "Understanding Organisational Culture.

The production of an overarching industry 'tool' for strategic asset management has been undertaken in joint venture by the Australian Asset Management Collaborative Group (AAMCoG) and CIEAM, with the Australasian Procurement and Construction Council (APCC) leading the project. This effort has made significant progress and will be launched at the WCEAM

in October 2011. Preliminary workshops for the next case study with Allconnex Water have been held to match the guidelines/framework to industry including implementation. A roadmap has been developed for further workshops with Allconnex Water including the administration of Delphi survey to assess the effectiveness of policy.

Research is now well underway in three of the four theme areas of the Sustainability in Infrastructure project, with an early emphasis placed on developing the business case for incorporating sustainability considerations in the design, construction and operation of infrastructure. A literature search has identified a number of built environment and business sustainability assessment tools in use around the world all of which have features that may assist with the refinement of the AGIC scheme. Notably, the project director, David Hood made a number of presentations about the project's research initiatives and the relationship with the AGIC scheme at conferences in Australia and overseas.

Potential issues and technical impediments

Conflicting commitments of key resources on the Organisational Culture project, including the departure of a chief investigator, and subsequent slow recruitment of her replacement has resulted in a change to task completion dates. However progress is tracking to complete the project tasks ahead of schedule at this stage.

There has been a delay in finalising the interview schedule with case organisations for the Career and Succession Management project, which has impacted on the ability to meet milestone 1.3 - Draft career framework based on case organisations. It is planned to provide a list of key competencies that have emerged from the interviews analysed up to this point. The final career framework which is due on the 13th January, 2012 will be informed by further analysis of all the interviews and also by an extensive survey which will be administered in September, 2011.

Resourcing issues have also delayed the Sustainability in Infrastructure project, with the recruitment of research staff and post-graduate students proving very difficult, and resulting in delays to the start up of project work. This is believed to be due to the severe engineering skill shortage being experienced in Australia, and the fact that a consideration of sustainability outcomes is a relative new concept for the infrastructure industry that has traditionally viewed infrastructure as critical only from an economic standpoint. Finding researchers with appropriate qualifications, knowledge and experience across both infrastructure and sustainability has been challenging and has resulted in delays to commencement of project work.

End user involvement and meeting user needs

All projects have multiple end-users involved in developing the research program. Moreover, SME partners to CIEAM, Advanced Dynamics have significant involvement in the development of the survey tool, research protocols and strategy in the Strategic Asset Management and Organisational Culture projects. Similarly, SME partner Synengco is working with the Asset Performance Decision Indicator project to develop the research and associated software. These collaborations indicate that high levels of engagement have occurred and that the developing projects are highly relevant to end-user needs.

Participation by industry partners has also been supportive and valuable for the Sustainability in Infrastructure project, with a lead being taken by Allconnex Water which has considerable experience in sustainability assessment at the planning stages of its infrastructure programs. All CIEAM Industry partners were in fact brought into this project team and have been involved in two project development workshops (Dec 2010, and May 2011). These workshops greatly assisted the team in refining the project focus, the milestone tasks, and establishing research priorities.

Changes proposed to future research directions

The Asset Performance Decision Indicator team is investigating the possibility of funding a PhD or Masters student to assist with modelling. Synengco has indicated that they may be able to provide some financial support for a scholarship. Initial discussions have commenced with staff in the operations research area.

Career and Succession Management Project Leader Vicki Browning has accepted a new position within the SCU and another member of the team, Cameron Newton will undertake the Project Leader role.

The Sustainability in Infrastructure project plan has been significantly refined over the year following industry consultation and workshops and now consists of 12 milestone research tasks grouped under four primary research questions as in Figure 1 below.

Project Theme	Theme Milestones	Progress
1. Study of the current status of sustainability considerations in the operation of infrastructure.	1a. Identify to what extent consideration of sustainability outcomes and risk assessment influence the operation of infrastructure in Australia and around the world. 1b. Identify any differences in sustainability assessment for different classes of infrastructure assets. 1c. Identify the benefits that will accrue from the uptake of sustainability as a driver in the operational management of infrastructure. 1d. Review the current methodologies and metrics for the assessment of sustainability in infrastructure operation.	1a, 1b, and 1c commenced in last half of year.
2. Identify/develop methodologies that are appropriate for sustainability considerations in infrastructure operation.	2a. Confirm/redefine through survey research that the AGIC categories agreed by industry are appropriate for sustainability assessment in the operation of infrastructure. 2b. Identify/develop metrics, and methodologies that are appropriate in infrastructure operation for the sustainability assessment categories agreed by industry.	Ongoing Ongoing
3. Identify/Develop mechanisms (models) that aggregate category scores into an overall sustainability "score" for the operation of different classes of infrastructure taking into consideration economic, social and environmental factors in infrastructure operation.	3a. Review of existing models, if any, and then development of appropriate algorithms to feed into existing, or the development of new models to support the AGIC scheme in the operational area of infrastructure. 3b. Develop a business case for sustainable infrastructure operations.	Task 3b – Business Case for sustainability progressing well.
4. Development of training material for the training assessors and verifiers to ensure success of sustainability rating scheme.	4a. Review of current sustainability assessment training in the infrastructure industry. 4b. Deliver early sustainability awareness training to industry - short (one day) courses in Sustainability in Infrastructure as "lead in" training to the AGIC sustainability rating scheme. 4c. Develop training modules related to sustainability assessment and verification to support the AGIC Sustainability Rating Scheme. 4d. Deliver in association with AGIC, Training & Education modules related to sustainability assessment and verification to support the AGIC Sustainability Rating Scheme.	Task 4b commenced. Three industry training sessions completed.

Research program two: integration and interoperability

The majority of the projects in the Integration and Interoperability program were a continuation of research initiated in CIEAM I; therefore, there was little delay in making substantial progress in the research effort. All programs have been tracking well with minor slippage on meeting milestones.

Key research achievements

Research outputs from the interoperability project have been applied successfully at ANSTO and have also attracted attention from companies in North America. The wireless corrosion sensors project is proceeding well down the path of commercialisation and has undertaken further refinement of the wireless sensor logging system to provide industrial strength devices. Notably, a software tool has been developed for establishing interoperability between data analysis tools and enterprise resource planning systems. The tool is currently in test phase at ANSTO, Sydney and supports compliance checks for maintenance tasks and operational limits and conditions

The Information Management Toolkit project is generating some outcomes which will be validated with industry during the second half of 2011.

The majority of the Mainpac V5 development project milestones have now been completed and the product will be launched in the second half of 2011. The software release also incorporates outputs from the Standards Based Interoperability project and the Asset Management Information auditing and assessment methodology project.

The Enterprise Knowledge Portal for Engineering Asset Management project is at the requirements gathering stage has attracted utilisation interest from CIEAM partners.

Research program three: capability optimisation

In this reporting period, all three research themes - i.e., Asset Health Manager; Multi-criteria life cycle decision support and Harmonised Asset Management Integrated Service Hub (HAMISH) - have maintained an extremely high level of activity and continued to deliver on the targets originally established with dynamic adjustment to current industry needs.

Key research achievements

The Transformer Health Manager project has been focussed on the research and testing of on-line transformer condition monitoring technologies, which is frontier technology and has significant demand from power and heavy industry. The design improvement to the on-line dielectric instrument (developed in CIEAM I) has been completed so that the safety of the unit is improved, and the design documentation and software coding have been completed. The on-line vibration monitoring technique is also progressing well.

The Rotating Machinery Health Manager project has made significant progress on diesel engine diagnosis using acoustic emission (AE) and angular velocity. The baseline test of the diesel engine test rig has been completed and an event driven signal averaging technique has been developed to overcome the problem in averaging the quasi-periodic signal due to engine speed variation. The project outcome can be integrated to HAMISH to produce diesel engine health management services.

The Adaptive Multi-criteria Decision Support project has been conducting numerous stakeholder meetings for different industry cases and developing a range of new algorithms for different decision support models. All case studies will utilise real industry data, scenarios and expert knowledge, which is very valuable to generalise different decision support tools for a wider utilisation. The progress of this project is on target. Feedback from industry partners, such as Delta Electricity, Queensland Rail and Allconnex Water are very encouraging. In collaborating with HAMISH project, one decision tool is almost ready for early commercialisation trial through service-oriented software design.

The Road Maintenance Decision Support project has met all planned milestones. The initial outcomes of the research have produced very interesting findings and Queensland Transport and Main Roads is very satisfied with the outputs which have high commercialisation potential

HAMISH is undergoing a re-engineering process to re-design and implement a new service-oriented architecture based on the Asset Health Manager developed in CIEAM I, and prepare for the implementation of cloud computing technology. HAMISH is now offering a decision tool for trial with industry partners for utilisation and commercial services. The team is also developing

an alternate integration strategy, based on the “dot Net” component library, so that CIEAM service provider participants, such as Neusoft, Mainpac, and Synengco are able to integrate HAMISH into their software.

The research quality of this program can be represented through a number of refereed publications, some which have been published from A* or A journals with high impact factors (refer publications list for details).

Potential issues and technical impediments

A number of issues could cause delays or impact on the robustness of the technology:

Inadequate field testing opportunities for the transformer project has could potentially delay or impact on the robustness of the technology being developed in this project. Field testing with large industrial transformers is both time and resource consuming, mostly due to the significant safety concerns. Queensland Rail has made used transformers available old transformers to QUT’s laboratory for testing. Although this option is not equivalent to field testing, it represents an initial resolution and will greatly assist model validation.

Some significant organisational and business changes have occurred in the reporting period, within participant organisations. The resulting resourcing uncertainties are likely to delay data/information collection for case studies. A search of the literature and international data sources is currently underway in an effort to mitigate this situation.

The relatively short life of the CRC may impact on the ability to retain good quality researchers for the entire term of the centre, which has potential to adversely impact on the projects.

Level of end-user involvement and evidence the research is meeting end-user needs

Delta Electricity (DE) has been involved in a number of projects in this program, including the field transformer tests which also involved collaboration between QUT, UWA and Curtin University.

Past outage decision data from DE has been used to test the JOB decision tool. DE has indicated they are satisfied with the test results, which are representative of real life events and show real promise of saving costs. The real data for next outage planning has been sent to the research team for real testing of the decision model.

Queensland Rail has been working closely with research teams on a bridge health prediction project, as well as the development of a complex system model for analysing impact of train delays from an asset management point of view.

Research program four: structural integrity program

In this reporting period, all three research themes – that is Structural Integrity of Transport Assets; Corrosion sensors and Power Transformers have maintained a high level of activity and continued to deliver on the targets originally established with dynamic adjustment to current industry needs.

Key research achievements

The Structural Integrity of Transport Assets project has been focused on the research and testing of frontier technology in support of QR National. Here all the milestones have been met and a major project outcome has been the application of this technology to assess the durability of QR National rollingstock.

The Corrosion sensors project also has made significant progress. Commercialisation of these sensors is now underway and a local manufacturer for the ERS sensor has been found and engaged. Indeed, sensors have now been manufactured using the new processes and designs developed in this task. In-principle agreement for the installation and trial of this sensor on a number of Australian bridges has also been reached, and discussions are being held to identify the most appropriate sites. Discussions with AMSTED Rail international on the use of this technology in the US on rail infrastructure have also commenced.

Additionally, the Power Transformer project has made significant progress. The experimental program required to derive the coefficients (to develop the algorithm needed by the online dry-out system) for moisture measurement and the associated prognosis algorithm is now underway in conjunction with our industry partners. Taking into account the variables of the experiment, which must be individually controlled, we expect that it will run until December 2011. Following the successful conclusion of this work the next step is to code the software interface of the Portable Dry-out Moisture Unit (PDMU).

Potential issues and technical impediments

There are a number of issues that could cause delays or impact on robustness of the technology.

Inadequate field testing opportunities for the corrosion sensor project has the potential to delay or impact on the commercial outcomes of the technology derived from this research. Field testing on large/significant infrastructure is essential if we are to establish the commercial potential of this technology. However, this is both time and resource consuming and funds to ensure this aspect of the project are needed.

Level of end-user involvement and evidence the research is meeting end-user needs

QR National is heavily involved and is also driving the Structural Integrity of Transport Assets project. It has provided the usage spectra, detailed finite element models of rollingstock, CAD drawings, a wealth of related technical information and is involved in a day to day basis. Indeed, the outcomes of the project are feeding directly into fleet management decisions.

SME Participants, Vinsi and Partners are heavily engaged with the Corrosion Sensor Project team in-situ trials of the robustness of these sensors.

The PDMU Transformer project engages several third party participants through the Centre for Power Transformer Monitoring, Diagnostics and Life Management at Monash University. The consortium consists of a range of end users, commercialisation partners and a research organisation. The group includes: Wilson Transformer Company (WTC), Victoria; Dynamic Ratings (DR), Victoria; TJ|H2b Analytical Services, Victoria and USA; as well as nine electricity utility sponsors including SP AusNet; and Powercor/CitiPower; Powerlink; Ergon Energy; Energex; Country Energy; and Energy Australia.

3.3 Utilisation and commercialisation

CIEAM has commenced a dialogue with QUT's technology and commercialisation company, Bluebox, with regards to promoting broader utilisation and commercialisation of its key research outputs. There is a significant emphasis on these aspects embedded within the process of implementing CIEAM's transition plan, which was submitted to the Commonwealth on 30 June, 2011. Indeed, commercialisation is the cornerstone of CIEAM's planned transition beyond the CRC Program.

Investigation of channels for utilisation of CIEAM's research is an ongoing priority. CIEAM's annual conference, planned for November is centred on a showcase of the project outputs which have been identified as showing potential for broader utilisation and/or commercialisation. CIEAM has targeted a number of end users to attend the conference and take part in the showcasing activities. The showcase is seen as a marketing opportunity and will feature:

- Organisational culture in asset management firms;
- The guide to is an integrated strategic asset management;
- Data quality maturity self-assessment tool;
- A data quality rule repository for asset management organisations;
- An enterprise knowledge portal for asset management;
- Asset management integration service;
- Transformer health manager (dielectric monitoring, vibration monitoring, (fuzzy tree model));
- Rotating machinery health manager (low speed gear box, diesel engine, compressor, pump/motor);
- Pneumatic conveying pipeline health manager;
- Building/Infrastructure sensor information management;
- Optimal decision support tools;
 - Justification optimisation of budget (JOB),
 - Linear asset renewal decision support (LARDS),
 - Preventive maintenance decision,
 - Complex system modelling for linking data to asset management KPIs,

- Road skid resistance analysis and decision support tool,
 - HAMISH;
 - Corrosion sensors;
 - Wireless sensors; and
 - E-Learning module.

Additional opportunity for showcasing exists when CIEAM launches a joint research and development centre in Beijing, with its participant Neusoft. The CIEAM-Neusoft Research and Development Centre (CNRDC) is due to be officially opened at the end of November 2011.

3.4 Education and Training

Post graduate students

During the reporting period, five CIEAM PhD students successfully completed their research and graduated. Of the five, three are employed by industry and two have an academic career.

At the end of the reporting period, CIEAM had secured four new PhD students and had a total of 34 postgraduates at year end, the majority being PhD students. CIEAM's goal is to recruit an additional nine postgraduate students to undertake research over the duration of its three year funding period from 1 July 2010. The pace of recruitment of new PhD students is slower than expected, partly due to difficulty securing high quality candidates. The recruitment process has now been extended to the end of 2011.

A number of CIEAM PhD projects are closely linked to its industry participants. They are either co-supervised by industry experts or use data provided by industry, or both. For example, Ms Sandra Beach's PhD project, entitled "Do stakeholders influence the sustainability of network governance in public organisations, and how?" relies heavily on the data gathered and provided by the Main Roads Department of Queensland Government.

In addition to working closely with industry participants, students maintain involvement with CIEAM's activities through its scholarship program and involvement in such events as the Early Career Researchers awards, conducted as part of the annual CRC Association conference, for which CIEAM nominated Manindra Kephle and Diaswati Mardiasmo; and the annual CIEAM conference.

The annual CIEAM conference is also utilised as an opportunity for all post graduate students from around the country to come together and present their research to industry experts as well as their peers. Given the breadth of the field of asset management, the conference provides an ideal opportunity for students to gain a greater understanding, through the presentation of research findings, and through comments and feedback from a range of conference delegates, of the great depth and complexity of the field. The conference also represents a chance for students to interact on a less formal basis with each other, and with senior researchers and industry experts from across the entire CRC.

Education and training activities during the reporting period

- **September 2010:** An industry survey was conducted among CIEAM participants on the direction of industry training and a new online EAM course.
- **October 2010:** CIEAM organised a Korean delegation of eight to visit CIEAM industry participant QR National. The delegation visited QR National headquarters in Brisbane and the rolling-stock factory in Redbank, west of Brisbane. The aim was to showcase the industry asset management practice in Australia. The delegates consisted of representatives from Korean Standards Organisation; Korea Hydro & Nuclear Power Co., Ltd; and Korea Institute of Construction Technology.
- **26 October 2010:** A workshop was organised as part of WCEAM 2010, on the topic of an online Masters course for EAM. Six keynote speakers from both international and domestic institutions presented their views and formed a panel for discussion, including:
- **27 October 2010:** A further one-day workshop on "Open standards based interoperability for sustainable operations and maintenance of critical infrastructure leveraging" was organised by CIEAM at the WCEAM 2010. The workshop was convened by Alan Johnston, the President of MIMOSA in the USA and CIEAM Program Leaders, Prof Andy

Koronios and Prof Lin Ma contributed strongly as panel members. Others included David Thomassen of Bentley Systems, Australia and Toralf Mueller of ALCIM, Malaysia.

- **28 October 2010:** A one day post-congress short course was held in conjunction with 2010 World Congress on Engineering Asset Management (WCEAM). Twenty-three industry participants participated, including local attendees from Queensland Rail, and the Queensland Audit Office, as well as international attendees from Korea and Finland.
 - Dr Nick Hastings, Albany Interactive Pty Ltd, Australia (an SME Participant);
 - Prof Brett Kirk - UWA;
 - L Wang - Neusoft, China;
 - T Harikrishnan - Open University Malaysia;
 - Prof A Trappey - National Taipei University of Technology, (NTUT), Taiwan; and
 - Dr RF Stapelberg - ICS Pty Ltd (SME Participant).

The outcome of the workshop was that there was a general agreement that such an online course will be highly beneficial to EAM practitioners and industry at large.

- **May 2011:** Three sustainability awareness training workshops were delivered in Sydney, Melbourne and Brisbane as part of Project 1400, Sustainability in Infrastructure.
- **25 May 2011:** CIEAM conducted one day training course on asset management for its industry participant Queensland Rail.

Meeting end user requirements

CIEAM regularly updates its industry participants on completed PhD thesis work, which is taken up to varying degrees, dependent on the level of relevance to each participant's business.

Activities such as CIEAM's post WCEAM workshop held in October 2010 and the designated workshop for Queensland Rail held in April 2011 are examples of activities coordinated specifically for, and in response to requests from, end users. Notably, the sustainability awareness training workshops originating from project 1400 are specifically designed for end users who will be required to use the sustainability rating scheme being developed by that project.

In all cases, workshop attendance has been by representatives from various privately owned utilities, state government departments and international organisations.

3.5 SME Engagement

The CIEAM II SME engagement strategy focuses on SME practices aligned with research programs/projects. SMEs derive value in CIEAM in the following ways:

- Involvement in the next generation of asset management systems and technology;
- Access to CIEAM's IP, researchers and expertise;
- Collaboration across value chain to develop leading edge integrated solutions;
- Enhanced profile and greater exposure to national and global markets;
- Low cost research and ability to leverage resources;
- Accelerated innovation;
- Access to training and education programs;
- Potential for commercial alliances with other participants; and
- Bottom line improvement through implementation of Asset Management best practice.

Building on partnerships formed in CIEAM I, the engagement of SMEs is delivering fruitful collaborations across all CIEAM programs. Organisational consultancy Advanced Dynamics is working across a number of the organisational culture projects in Program One, particularly in relation to the development of the organisational culture survey and the specific tailoring of the instrument for use in participant organisation, Queensland Rail.

Albany Interactive and ICS are involved with outputs from the Education and Training portfolio, including the delivery of workshops to industry partners and the development of a graduate e-Learning module on asset management. Specialist consultancy Synengco has made considerable contribution to the Asset Performance Decision Indicator project, while Vinsi and Partners have been working with the corrosion sensors group and have also provided access to a range of structures for user testing.

3.6 Collaboration

Research program one: Sustainability and organisational performance

Collaboration on the Framework for Asset Management has been strong between researcher participants in the Strategic Asset Management and Organisational Culture projects. The majority of efforts are ultimately building into the development of the Asset Management Capability Maturity Model, with QUT developing the basis of the platform. The cross-over of projects at all levels, including PhD student collaboration has resulted in better utilisation of end-user time and effort to participate in research projects. PhDs are also better able to support each other and consolidate their data collection efforts. The Australian Asset Management Collaborative Group (AAMCoG) has also been a key contributor to the development of the Framework, as well as the production of a Guide to Integrated Strategic Asset Management which is due for release at the 2011 CIEAM Conference.

In terms of Participant collaboration, Allconnex Water has been particularly involved with research pertaining to the development of asset management policy, and the Asset Management Framework, as well as working with researchers to develop an understanding of organisational culture in asset management businesses. Queensland Rail has been active in an investigation of asset management culture change.

Program Co-leader, Professor Kerry Brown has a strong connection with the International Society of Engineering Asset Management (ISEAM) through her position on the Board of the society. This involvement provides access to the international engineering asset management research and practice community, allows dissemination of CIEAM research and promotes global interchange of ideas.

The Sustainability in Infrastructure project has seen a significant degree of collaboration, particularly with end-user participants, with all CIEAM industry partners brought onto the project team to contribute to project development workshops which assisted the team to refine project focus, milestone tasks and research priorities.

In particular, CIEAM has partnered with the Australian Green Infrastructure Council (AGIC) to assist with the development of one of the world's first full sustainability rating schemes for infrastructure. This collaboration provides CIEAM researchers with access to the growing member base of AGIC (currently approaching 100 organisational members across infrastructure designers, constructors, owners, and operators). In areas where specific expertise is located with industry partners, CIEAM researchers have worked alongside corporate experts to develop better understandings of industry needs. This has resulted in a sharper focus within CIEAM research projects to ensure that outcomes will be of immediate benefit to partners and to industry generally. For instance, Allconnex Water and Queensland Department Transport and Main Roads are collaborating with Program One on the development of metrics for the AGIC rating scheme, and on a decision support system that will allow asset managers to make maintenance and operational decisions that will achieve higher credits in the AGIC rating tool, and thus deliver more sustainability outcomes for the community.

Research program two: Integration and interoperability

The Interoperability and Integration project team has been working with Alan Johnston, President of the standards body MIMOSA to design standards-based data models for engineering asset management data. The collaboration has included joint workshops and has also involved other organisations and vendors. Leadership in this collaborative effort of the development and adoption of standards has strong potential to enhance the standing of CIEAM worldwide and could lead to significant consultancy opportunities for the resulting entity after CIEAM II ends.

The Data Quality project team is collaborating with Mainpac to enhance the Mainpac application redevelopment and include some of the research outputs into the new version. This type of collaboration is expected to lead to further enhancement of the tools as well as data quality assessment and improvement consultancy opportunities.

The team is also collaborating with the information quality research group of the Institute for Manufacturing at Cambridge University in the UK to further develop the data quality assessment and benchmarking tools.

The wireless sensor research team is working with QUT researchers on the corrosion sensor project to develop a new generation of wireless corrosion sensors.

Research program three: Capability optimisation

Researcher participants have collaborated comprehensively, both within project teams and across different projects. The rotating machine health management project and transformer condition monitoring project each involved three universities - QUT, Curtin University and UWA - which actively worked together. There was also a high level of interaction and collaboration across projects. For example, the HAMISH project team worked closely with the decision project team, as well as the rotating machine team (low speed rotating machine) and transformer team (fuzzy tree). The collaborations between researcher participants significantly enhanced the research capability.

In terms of collaboration between researcher and end-user participants, the decision support project team has actively worked with QR National and Queensland Rail to identify and compile case studies. Allconnex Water worked with the decision project team and the HAMISH team to deploy the renewal decision support tool for pipeline network management. This interaction resulted in the capture of valuable data, decision rules and feedbacks. Allconnex also closely worked with the asset health management team on the pump health management project.

Most program three project teams have experienced fruitful collaborations with Delta Electricity (DE) across a range of research areas, including maintenance budget allocation decision support by QUT; transformer condition monitoring by QUT, UWA and Curtin; and fly-ash pipeline wear modelling undertaken by the University of Newcastle. Delta Electricity provided data, assisted field tests and provided researchers valuable feedback. The asset health management project team facilitated two broad collaboration opportunities by conducting workshops for the asset health manager and HAMISH. The workshops brought together all related researchers and industry partners to review the progress, discuss challenges and explore solutions. The ongoing partnerships between researcher participants and end-user participants have greatly enhanced the research capability to meet the real needs of industry, and thereby increased the commercial potential of research outcomes.

Software development participants Neusoft and Mainpac have interacted closely with research participants across a range of CIEAM projects, including decision support and HAMISH. The establishment of the CIEAM-Neusoft Research Centre at Neusoft's head office in Beijing is a good indicator of the strength of the collaboration.

Researchers from both Neusoft and CIEAM are in regular contact and members of the decision support and HAMISH project teams have made several successful visits to Neusoft, with Neusoft managers also visiting CIEAM with fruitful outcomes. Several strategically significant documents have been generated from the collaborations.

CIEAM research teams and Mainpac have also maintained good communications with particular involvement of Mainpac in the Building Information Model project in CIEAM.

Collaborations between researcher participants and software development participants are significant in terms of commercialising and marketing CIEAM's research outcomes.

The researchers in Program Three have paid careful attention to strengthening external linkages with industries and researchers outside of CIEAM. Decision support researchers have attended international conferences in China and Norway to present and discuss CIEAM's research outcomes with global experts. The Program Leader has presented keynote addresses at the International Conference on Quality, Reliability, Risk, Maintenance, and Safety Engineering, and the International Conference on Manufacturing Engineering and Automation, both held in China, as well as at various industry forums.

Additionally, an ERA ranked (B) journal paper - *Maintenance chain integration using Petri-net enabled multi-agent system modelling and implementation approach* - has been published jointly by program three researchers; a professor from National Tsing Hua University, Taiwan; and a professor from National Chiao Tung University, Taiwan.

Research program four: Structural integrity program

Collaborations between researcher participants are significant in terms of both core partner outcomes and the commercialising and marketing of CIEAM's overall research outcomes. In this context, the Structural Integrity of Transport Assets project, on which Monash University and QR National are working together on a daily basis, provided usage spectra, detailed finite element models of rollingstock and CAD drawings, while Monash turned the usage spectra into technology which was subsequently used to assess the operational life of the asset.

In the Corrosion Sensors project, QUT is leading the manufacturing aspects of the sensor, whilst Monash is ensuring its application to large civil infrastructure and liaises with Australian and overseas industry so as to ensure this aspect of the program.

In the Power Transformers project, Monash is liaising with a diverse range of Australian industries to ensure the direct relevance of the program and is also coordinating this work with other related aspects at QUT.

The researchers in Program Four have paid great attention to strengthening external linkages with industries and researchers outside of CIEAM. Researchers have attended international conferences in both China and the US and discussed CIEAM's research outcomes and commercialisation goals with global experts as well as with major industry players. A journal paper in an ERA ranked journal has been published by researchers in the Structural Integrity of Transport Assets program and a paper in the Corrosion Sensors program is being written at the time of publishing this report.

Education and training

Collaboration has played a significant role in education and training outcomes during the reporting period.

As a participating CIEAM SME, Albany Interactive (Dr Nick Hastings) has been engaged to work on the production of the inaugural unit of an e-Learning course in asset management. This collaboration dates back to the early days of CIEAM I, with Dr Hastings' involvement as a CIEAM's Education and Training Manager and selected industry trainer for a range of CIEAM workshops and short courses. The current project utilises Dr Hastings' unique expertise alongside CIEAM intellectual property to produce a prototype course unit from which a full graduate certificate course for asset management is expected to be developed.

As a part of the endeavour to develop the e-Learning course, CIEAM has also received assistance and advice from Open University Malaysia through the extensive international network CIEAM has developed. OUM is a proven operator in e-Learning and has a significant market presence in Asia and mid-east.

CIEAM Participant, ASTHM is collaborating with CIEAM on the development of an e-Learning graduate certificate course in asset management. This project is focused on fully developing four course units required for the Graduate Certificate course and prepare them ready for online offering. The course will provide a timely platform for Australian industry practitioners, many of whom may come from current and past CIEAM participating industries, to up-skill themselves while earning a qualification at the same time. This course is expected to attract overseas students through the extensive international network CIEAM has developed. The following units have been selected for the Grad Cert:

- Asset Strategy and Planning;
- Financial Analysis and Asset Management Decisions;
- Through Life Sustainment; and
- Reliability, Maintenance and Risk management.

4 Other activities

There are no activities being undertaken by CIEAM which fall outside those specified in the Commonwealth Agreement.

5 Glossary of terms

EAM	Engineering Asset Management
AAMCoG	Australian Asset Management Collaborative Group
AGIC	Australian Green Infrastructure Council
ANSTO	Australian Nuclear Science and Technology Organisation
ASBEC	Australian Sustainable Built Environment Council
ASIC	Australian Securities and Investment Commission
ASTHM	Perth Hospitality Professionals trading as Australian School of Tourism and Hospitality Management
BIP	Background Intellectual Property
CCT	Control and Constraint Tree
CMMS	Computerised Maintenance Management System
CUP	Commercialisation and Utilisation Plan
CU	Curtin University
CRCA	Cooperative Research Centre Association
EA	Engineers Australia (also Institute of Engineers Australia)
ETM	Education and Training Manager
IAM	Integrated Asset Management
HAMISH	Harmonised Asset Management Integrated Services Hub
ICT	Information and Communication Technologies
ICOMS	International Conference on Maintenance Systems
IP	Intellectual Property
ISEAM	International Society of Engineering Asset Management
ISO	International Standards Organisation
PLIAN	Program Leaders and Industry Advisors Network
QR	Queensland Rail
QUT	Queensland University of Technology
SME	Small to Medium Enterprise
UniSA	University of South Australia
UWA	University of Western Australia
WCEAM	World Congress on Engineering Asset Management

6 List of publications and reports

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