BRITE Project Partners:

CSIRO

QUT

University of Western Sydney
Bringing knowledge to life

ARUP

Queensland Government
State Development

Queensland Government
Department of Public Works

Queensland Government
Department of Main Roads

BRITE Project Supporters:

acif
Australian Construction Industry Forum

Construction Best Practice

ACEA
The Association of Consulting Engineers Australia

CCF

Movement for Innovation M4I

Further information:

Dr Karen Manley
BRITE Project Leader
Cooperative Research Centre for Construction Innovation

Research Fellow
School of Construction Management and Property
Queensland University of Technology
GPO Box 2434
Brisbane Qld 4001
Australia

ph: 61 7 38641762
email: k.manley@qut.edu.au

www.brite.crcci.info

THE BRITE PROJECT

Innovation Case Study No 1

Outstanding Whole-of-Life Gains Without Higher Up-front Costs

This series of innovation case studies has been developed by the BRITE Project of the Cooperative Research Centre for Construction Innovation. The case studies demonstrate the benefits of innovation and successful implementation strategies in the Australian Building and Construction Industry.

Who should read this? Participants in the building and construction industry, particularly commercial property developers, public-sector commercial building clients, and mechanical and electrical engineering consultants.

CRC AUSTRALIA

CRC Construction Innovation
BUILDING OUR FUTURE

Outstanding Whole-of-Life Gains Without Higher Up-front Costs

A suite of air-conditioning innovations on a new government office building in Cairns – William McCormack Place – is delivering substantial estimated benefits compared to a more conventional approach, including:

- 37% savings in energy costs; and
- 61% savings in air-conditioning capital and maintenance costs.

These and other innovations incorporated in the building demonstrate that environmental sustainability can be addressed without compromising quality, cost, time or scope.

The Project

William McCormack Place is a 4568m^2 (net lettable area) four-storey commercial office building in Cairns, Australia. It was built by a private sector construction manager under a two-stage, design and construct, guaranteed maximum price contract with an overall budget of $17.5m including fitout and public art. The building was opened in September 2002, delivered on time and within budget, after an 18-month design and construction program.

The adoption of advanced technologies was also facilitated by the construction management style of contract, which involved the builder very early in the design process. Their early involvement meant no 'rude shocks' when it came to advanced technologies being incorporated into the design.

The guaranteed maximum price element of the contract ensured that the design was as thorough as possible, to reduce the builders' risk, and to ensure that the final design was 'buildable'.

Lessons Learnt

Environment

- Up-front costs associated with environmental improvements can be modest and manageable within the context of overall design and construction of a building.
- Environmentally sustainable technologies offer significant improvements in the performance of commercial buildings.
- Clear environmental objectives and thorough design processes reduce risk for both the builder and the client.

Local Firms

- Local firms can offer significant value on large projects, particularly in terms of understanding local conditions.
- Local firms are not always 'behind the game' and can in fact be technology leaders.

Clients

- Informed clients facilitate the adoption of advanced technologies and practices through their ability to expertly cross-check innovative proposals.
- Clients willing to entertain acceptable risks can lead the industry in demonstrating the benefits of innovation.

Innovation Processes

- The early involvement of users (eg. facility managers) can lead to optimal outcomes (eg. building performance).
- Attention to international developments is an effective way for industry participants to gain competitive advantage.
- Standards can drive innovation, particularly when set just beyond current capabilities.
- Innovation, via adoption of existing advanced technologies and practices, sits alongside original innovation, as a powerful driver of performance improvement.

Selected Project Participants

Client	Queensland Department of Public Works (DPW)
Project Manager	DPW
Design Audit	DPW
Managing Contractor	Barclay Mowlem Construction Ltd
Architects	Cox Rayner and C.A. Architects
Structural/Civil/Fire Engineers	ARUP
Mechanical/ Electrical Engineers	MGF Consultants (NQ) P/L (MGF)

Organisations consulted in preparing this report: DPW and MGF

Cover photo: William McCormack Place, Cairns

Overcoming Difficulties

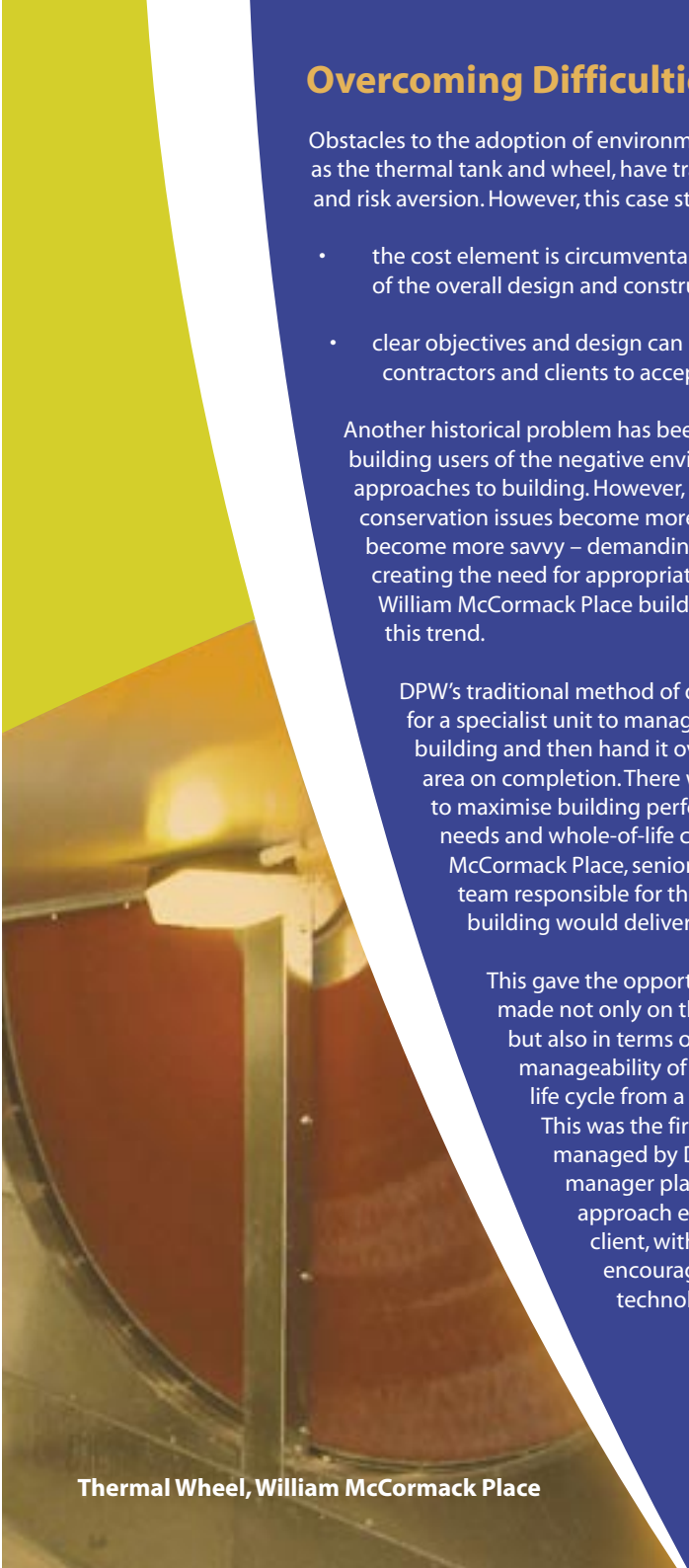
Obstacles to the adoption of environmentally friendly technologies, such as the thermal tank and wheel, have traditionally been high up-front costs and risk aversion. However, this case study has shown that:

- the cost element is circumventable when addressed in the context of the overall design and construction of a building; and
- clear objectives and design can reduce the risks for both managing contractors and clients to acceptable levels.

Another historical problem has been the lack of awareness from building users of the negative environmental impacts of conservative approaches to building. However, as concerns about energy and other conservation issues become more prominent, building users have become more savvy – demanding energy-minimising buildings and creating the need for appropriate project delivery mechanisms. The William McCormack Place building illustrates the positive impacts of this trend.

DPW's traditional method of delivery of new office buildings was for a specialist unit to manage the design and construction of a building and then hand it over to the property management area on completion. There were few drivers within this system to maximise building performance, particularly in terms of user needs and whole-of-life costs. In the case of William McCormack Place, senior management decided that the team responsible for the ongoing management of the building would deliver the project.

This gave the opportunity for project decisions to be made not only on the basis of time, budget and quality, but also in terms of the functionality and manageability of the property based on the building life cycle from a facility management perspective. This was the first time a major contract was managed by DPW in this way, with the facility manager playing such a significant role. The approach enhanced DPW's role as an informed client, with the required awareness to encourage the adoption of advanced technologies.



Thermal Wheel, William McCormack Place

The Achievement

Queensland Department of Public Works (DPW) wanted to demonstrate that an office building could be constructed to meet strict environmental sustainability targets while remaining commercially viable. The Department stipulated that the building must meet a minimum 4-star energy rating under the Australian Building Greenhouse Rating Scheme, administered by the Sustainable Energy Development Authority (SEDA). In fact, the building has exceeded this standard without compromising commercial objectives.

An extensive energy audit conducted in August 2003 found that William McCormack Place has achieved a 5-star energy rating, which is the maximum possible under the SEDA scheme. William McCormack Place is the first commercial office building in Australia to be awarded this rating.

The client and project team have succeeded in designing and constructing a commercial building which minimises life-cycle costs without increasing project costs. The building cost no more to build than a comparable conventional building and will be nominated for the Facility Management Association of Australia, Awards for Excellence, 2004.

Graham Messenger, Acting Manager, Portfolio Branch, Building Division, DPW: *'... the secret was the integration of best practice, rather than a grand invention'.*

The Innovations

The 'innovation' on the William McCormack Place project is the adoption of a unique package of proven technologies and advanced practices, many of which had not previously been employed on DPW projects.

The Department notes that often, improved building performance is 'not a case of the development of complex or costly new technologies but one of effectively using a combination of existing technologies'.

The improvement in life-cycle costs at William McCormack Place is largely due to a collection of well-combined advanced and proven air-conditioning technologies, comprising:

- *chilled water thermal storage tank:* eliminating the need for a low-load chiller and associated prolonged periods of inefficient low-load operation of chiller sets
- *moisture absorbing thermal (heat exchanger) wheel:* used to recover cool and dehumidified outside spill air energy to precondition incoming hot, moist ventilation air
- *variable speed motor drives applied to air-conditioning pumps and fans:* so that only the amount of air or water required at any time is mobilised
- *'duty-standby' operation of the two 100% chiller sets:* reaping efficiency gains over the suggested alternative 'lead-lag' configuration of two sets at 70% each, plus a low-load set
- *rotary screw chillers and low fan power cooling towers:* facilitating high efficiency chilled water generation

The thermal tank and wheel are the most novel and influential elements of the air-conditioning system, and the focus of this case study. Internal and external quantity surveyors' reports on William McCormack Place indicate that the cost of a commercial building with environmental enhancements, such as those listed above, need be no greater than the cost of a comparable building without such enhancements.

The cost of some additional plant at William McCormack Place directly resulted in cost savings in other plant. For example, the cost of the thermal wheel was partly offset by an associated reduction in the required capacity for the refrigeration plant. Additional modest cost savings were achieved through a Value Management study.

The Benefits

The thermal tank and wheel are major contributors to significant energy savings. Energy costs for William McCormack Place are currently 37% less (on a per square metre net lettable area basis) than the energy costs for similar North Queensland government properties. The savings arise largely from the air-conditioning technologies, assisted by the building structure's thermal qualities.

These substantial whole-of-life gains are augmented by savings in capital and maintenance costs due to adoption of the thermal tank in preference to a low-load chiller. Comparison of the projected hardware and service costs over 45 years shows savings of 61%. Over that period, the low-load chiller would require on-going maintenance, including a complete rebuild or replacement, while the thermal tank is largely maintenance free.

Overall, DPW wanted to show that an environmentally sustainable office building could be commercially viable. They are on their way to achieving this – the lower energy and maintenance costs for William McCormack Place will increase its capital value and attract higher rents, without having cost more to build.

The above project benefits have been achieved by the adoption of proven advanced technologies and practices, rather than through the development of original innovations. The extent of benefits indicates the significant value of adopting innovations that are simply new in a particular context, rather than necessarily 'new to the world'.

Thermal Tank, William McCormack Place

The Implementation Process

A key driver for adoption of the thermal tank and wheel was DPW's desire to improve the energy efficiency of its buildings, while the mechanical and electrical engineer, MGF consultants, was motivated by the potential improvement to their reputation and the belief that this would enhance their competitive position in the marketplace.

Thermal Tank

DPW's original brief suggested that three chiller sets be installed to manage air-conditioning requirements; however, MGF's experience indicated a more efficient system would be to replace the third low-load chiller with a thermal tank to get maximum efficiency from the chillers. MGF designed the first large-scale tank in Australia in the late 1990s roughly a decade after the first use of tanks overseas. They were motivated to do so after having monitored tank performance internationally via industry newsletters and networks.

MGF understood the technology and had 'runs on the board' proving its effectiveness and the accuracy of payback periods. DPW audit engineers reviewed the design and agreed that energy performance was likely to be significantly improved by the thermal tank. The adoption decision was made against the climatic backdrop of the building. The heat and humidity in Cairns is quite extreme, demanding the use of innovative technologies in order to minimise environmental impacts.

Thermal Wheel

MGF introduced the first total enthalpy thermal wheel into Queensland in 1986 and has since designed several hundred. They were early adopters of this technology, as the wheels only emerged globally in the mid 1980s.

Graeme Standfield, Director, MGF:
'... none of this is rocket science, it's just having a green attitude and knowledge of available international technologies'.

The company's ability to encourage client use of the wheels was assisted by their review of developments overseas. Their knowledge and experience enabled them to strongly champion the use of a thermal wheel on the William McCormack Place project, and DPW was able to confirm the value of the technology with internal mechanical engineers who knew they were widely used in Europe.

The Queensland Government had an interest in local employment for this regional project through its Local Industry Participation Policy, which provided MGF with the opportunity to be involved. MGF was a local firm with considerable expertise and experience with the often extreme local weather conditions, whilst also having linkages with the technical experts in Australia, America and Europe. The success of this project demonstrates that regional firms can be technology leaders and that knowledge can be gained from them, rather than merely imparted to them.