



# **Project 2.7 - LEVERAGING R&D FOR THE AUSTRALIAN BUILT ENVIRONMENT**

## **Phase 2 – Case studies**

### **Part 3 - Case 2 – Green Buildings**

**Read in conjunction with Part 1 - Overview**

## Project 2.7 – Green building case study

### **Abbreviations:**

AGIC – Australian Green Infrastructure Council  
AIA – Australian Institute of Architects  
AMCA – Australian Mechanical Contractors Association  
APCC – Australian Procurement and Construction Council  
ARC – Australian Research Council  
ASBEC – Australian Sustainable Built Environment Council  
BCA – Building Code of Australia  
BEIIC – Built Environment Industry Innovation Council  
Bldgs - buildings  
EOI – Expression of Interest  
CIBSE – Chartered Institution of Building Services Engineers  
COAG – Council of Australian Governments  
CSIRO - Commonwealth Scientific and Industrial Research Organisation  
CUSP – Curtin University Sustainability Policy Institute  
DHW BMW – Department of Housing and Works, Division of Building Management and Works  
GBCA – Green Building Council of Australia  
GFC – Global Financial Crisis  
IAI - International Alliance for Interoperability now buildingSMART  
IPD – integrated project delivery  
NATSPEC - National Specification System of Australia  
PB – Parsons Brinkerhoff  
PS – Project Services  
RFPs – Request for Proposal  
SBEnc – Sustainable Built Environment National Research Centre

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## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	4
1. The initiative.....	5
2. Illustrating the case - interview findings.....	6
3. Links to theory .....	8
3.1. Dynamic capabilities .....	8
3.2. Absorptive capacity.....	9
3.3. Innovation .....	10
4. Discussion .....	13
5. Conclusions .....	15
6. Appendices.....	16
6.1. Timeline .....	16
6.2. Interview data .....	23
6.3. Bibliography .....	43

## EXECUTIVE SUMMARY

The Western Australian Government has taken a leadership role for a number of decades in developing more environmentally responsive buildings. In the past decade, considerable initiatives have been introduced to contribute to: (i) greening the stock of government buildings; and (ii) providing industry leadership.

A broad cross section of people from within the WA Government (WAG) have been identified as responsible for driving and delivering on these initiatives post 2001 including: (i) Past Premier Dr Geoff Gallop (2001-2006) through establishment of the Sustainable Policy Unit in 2002; (ii) staff from across 42 divisions who contributed to the WA State Sustainability Strategy (2003); (iii) Departments including Works and Housing, Planning and Infrastructure, and Education; and (iv) state agencies including LandCorp. This recent focus has been underpinned by a long-term awareness of such issues (e.g. the publication of *Energy Management in the Design of New Buildings* in 1980). In the past decade a several policies, regulations and guidelines have resulted from these initiatives. Development has been further informed by Commonwealth government initiatives. In addition the National Australian Built Environment Rating System (NABERS) and the GreenStar rating scheme (developed by the Green Building Council of Australia) have provided crucial tools to enable government and industry to quantify outcomes. The WA government's green building initiatives have also been informed by growing international awareness of issues associated with greening the built environment.

Section 2 presents a summary of data (gathered from 13 formal interviews) relating to the specific theme of each interview question. Section 3 presents data coded by researchers against specific criteria relating to organisational and innovation theory identified as significant to this research. Section 4 discusses then discusses this data in two parts. The first to build a better understand the initiative themselves and the context in which they were rolled out. The second part aims to build a deeper understanding of the capabilities apparent to interviewees in the course of their engagement with these initiatives.

Section 5 presents a series of conclusions based on the analysis of findings in line with organisational capabilities. Those particularly apparent from the analysis of interview data include: (i) the development of new products and processes as evidenced in the development of policies, regulations and guidelines; (ii) cost advantage and benefits evidenced in enhanced business case development and the inclusion of 'green' criteria in RFPs; (iii) ensuing cost savings associated with increased resource efficiency; (iv) the availability of new metrics for assessing innovation and performance through green building rating tools; (v) knowledge creation, exploitation and flows particularly in a project-related context; and the role of R&D engagement. Potential areas for enhancing outcomes typically relate to a possible limited focus on IP; technology; and risk sharing. These findings will be further considered in the context of Phase 4 of this current project, in establishing policy guidelines for future investment in the built environment.

Three appendices provide additional detail including: (i) a timeline of relevant international, national and state developments; (ii) a précis of relevant national and state strategies; and (iii) detailed data for those who which to delve deeper into the interview findings.

This report should also be read in conjunction with Part 1 Overview. Two additional parts report on the findings of the two concurrent case studies being: (i) the road construction safety initiatives of the Queensland Department of Transport and Main Roads; and (ii) the CADD to Integrated Project Delivery initiatives of the Qld Department for Public Works.

## 1. The initiative

The Western Australian Government (WAG) has taken a leadership role for a number of decades in developing more environmentally responsive buildings.

In the past decade, considerable initiatives have been introduced to contribute to: (i) greening the stock of government buildings; and (ii) providing leadership in the development of other non-residential buildings developed commercially. This role has been informed by global, national and internal initiatives and research in this area.

This case study investigates: (i) the nature of this leadership; and (ii) the role of R&D policy development; and (iii) the dissemination and impact of outcomes in the broader industry.

Specific issues which will be addressed in the course of this case study are:

- Defining the WA Government's leadership in this field.
- Drivers for R&D initiatives developed and implemented in the past 10-15 years.
- Influences of R&D from other sectors/disciplines.
- Collaboration
- Impact of initiatives

A broad cross section of people from within WAG have been identified as responsible for driving and delivering on these initiatives from 2001 (the time frame for most responses related to post 2001) including: (i) Past Premier Dr Geoff Gallop (2001-2006) through establishment of the Sustainable Policy Unit in 2002; (ii) staff from across 42 divisions who contributed to the State Sustainability Strategy (2003); (iii) WAG Departments including Works and Housing, Planning and Infrastructure, and Education; and (iv) WAG agencies including LandCorp.

This recent focus has been underpinned by a long-term awareness of such issues (e.g. the publication of *Energy Management in the Design of New Buildings* (1980). In the past decade a several publications have been informing this development. A key outcome of the Sustainable Policy Unit (supported by a whole-of-government approach) was of the *WA State Sustainability Strategy* (2003). In addition several state policies and guidelines have been produced including the *Office Accommodation Policy* in (2004); *Department of Housing and Works Sustainability Matrix* (2003); *Sustainable Non-Residential Buildings* policy (2008); and *Liveable Neighbourhoods Policy* (2007)

Further drivers were provided by national initiatives including: *National Strategy on Energy Efficiency* (an initiative of the Council of Australian Governments); the *Energy Roundtable*; *Online System for Comprehensive Activity Reporting (OSCAR)*; the Australian Building Codes Board and developments in the environmental and sustainability provisions of the *Building Code of Australia*; the *Solar Cities* program; and *Building the Education Revolution* funding.

The establishment of National Australian Built Environment Rating System (NABERS) formerly known as Australian Building Greenhouse Rating and Green Star rating scheme (in 2003) through the Green Building Council of Australia (GBCA) have also provide crucial tools to enable government and industry to quantify outcomes. Through referencing the use of these tools (where feasible) from 2004 the WA Government also provided a critical lever for achieving enhanced environment (and to some extent social) outcomes in the built environment.

Additional leverage has been achieved through the establishment of relationships with external parties. These include: other state and local planning authorities; research institutions; industry and supply chain; and industry associations.

The WA government’s green building initiatives were informed by growing international, national, state and community awareness of issues associated with greening the built environment. Appendix 5.1 provides a timeline of relevant developments. Section 5.2 provides a précis of relevant national and state strategies.

## 2. Illustrating the case - interview findings

This report is to be read in conjunction with Part 1 – Overview, which provides details of the research methods and tools used to gather the following data.

Data for this case has been gathered from face-to-face interviews<sup>1</sup> undertaken with 13 people from both within WAG and from those external to the organisation but with a high level of awareness of green building initiatives (Table 1).

<b>Role</b>	<b>Case 2</b>
Executive (internal)	1
Champion (internal)	-
Project Leader (internal)	1
Implementer (internal)	1
Allied Agency (internal)	2
Supplier (external)	1
Contractor (external)	1
Consultant (external)	3
Industry Rep. (external)	1*
Researcher	2
	13

\* Previously employed by WAG

The following tables (Table 2 - 10) provide a summary of data gathered relating to the specific theme of each interview question. A more detailed account of these is provided in Section 6.2.1

The right thing to do; awareness; political and social pressure
State government initiatives, policies and regulations
Commonwealth government initiatives, policies and regulations
Rating schemes
Industry
Cost savings and economic benefits
Reducing water and energy consumption

Application to projects life cycle (incl. procurement)
Monitoring and quantifying benefits
Cultural alignment
Developing and applying new skills and processes; capacity building
Development of a strategic approach
Relationship building

<sup>1</sup> The valuable assistance of Anna Evers (WAG) in conducting the green buildings interviews is acknowledged.

**Table 4 – New processes**

Aligning budget and requirements
Enhancing government processes (delivery agency identification; planning processes; creativity in policy making )
Training
Establishing and using ratings tools, benchmarks and reporting mechanisms
Embedding in core values
Leadership
Improved collaboration, coordination and stakeholder management
Contractor involvement at early stage
Getting exemplar projects built

Three types of impacts are being discussed: (i) impacts on the culture and values of the organisation; (ii) on the supply chain and industry; and (iii) the impact of major external changes on the development and delivery of the initiatives.

**Table 5 – Impact on values and culture**

Behavioural change
Breaking down (departmental and professional) silos
Getting triple bottom line (life-cycle) benefits
Building awareness and understanding
Foresight
Dealing with change
Valuing sustainability 'aesthetic'

**Table 6 – Impact on supply chain and industry**

Improved knowledge/skill levels across supply chain
Better needs definition (through guidelines, tools, performance data etc)
Recognition of commercial and competitive advantage
Proof of concept achieved

**Table 7 –major changes impacting on initiative**

GFC – multi-layered impact – both positive and negative
Introduction of NABERS <sup>2</sup>
Change in government - funding, legislation, people
Carbon tax discussion; move to green economy (including future proofing bldgs)
Commonwealth government initiatives

**Table 8 – successes**

Sustainability outcomes embedded in budgets and projects
Consultants on board
Better educated industry and market
Better understanding/awareness of environmental issues
Better guidelines, tools, monitoring and reporting
Reduced resource consumption and associated costs
Improvement in best practice

<sup>2</sup> National Australian Built Environment Rating System

**Table 9 – Barriers**

Better budget setting and business case writing required
Cost issues and perceptions
Whole of government leadership and mandate
Funding – lack of and split between agencies
Legislation and regulations – outdated, lack of incentives and clarity
Industry - resistance to change and capacity
Adapting research to practicalities
Accounting and monitoring
Loss of key people
Lack of foresight
Lack of awareness/knowledge – esp. in clients and customers
Management issues
Trade based industry

**Table 10 – R&D engagement and activities**

Departmental R&D funding goes towards university engagement
Look to R&D by other agencies; universities; and industry organisations
Several mechanisms within WAG
Tangible benefits tailored to industry required
Research can be slow and costly
Integrated in business practice in some consultants, manufacturers and suppliers
More R&D required to maintain leadership incl. policy based

### 3. Links to theory

The following tables (Tables 11 - 21) present data coded by researchers against specific criteria related to the three areas of theory identified as significant to this research (i.e. dynamic capabilities, absorptive capacity and innovation). The tables highlight the number of interviewees in five categories (i.e. Majority = >80%; Several = >50% but < 80%; Some = <50% but >20%; Minority = <20%; None) who were considered by the research team to have raised concepts related to the criteria indicated on the following graphs.

#### 3.1. Dynamic capabilities

Teece, Pisano and Shuen (1997) define *dynamic capabilities* ‘as the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments’ (p.516). Criteria for providing evidence of an organisation’s have been drawn from several papers in this field including Lawson and Samson (2001), Teece and Pisano (1994), Eisenhardt and Martin (2000), Davis and Walker (2009).

##### 3.1.1. Evidence of dynamic capabilities

Comments during interviews could be attributed to characteristics of the following dynamic capabilities (Table 11). For example, this is useful in the context of WAG’s ability to integrate and take advantage of innovations associated with green buildings.



**Table 11–Interviewees who raised issues relevant to evidence of organisational dynamic capabilities**

<b>Majority</b>	Product or process development Organisation learning External R&D engagement
<b>Several</b>	Internal R&D engagement Product or service differentiation Cost advantage through less waste Strategic decision making
<b>Some</b>	Technology transfer Alliancing Customer focus
<b>Minority</b>	IP creation Cost advantage through increased market intelligence

Majority = >80% Several = >50 but < 80% Some = <50% but >20% Minority = <20%

### 3.2. Absorptive capacity

#### Evidence of inbound absorptive capacity

Cohen and Levinthal (1990) introduce the concept of *absorptive capacity* as a ‘firm’s ability to recognise the value of new, external information, assimilate it, and apply it to commercial ends’ (p.128). They argue that absorptive capacity is ‘largely a function of prior related knowledge’ (p.131) that has been accumulated through effort, as prior knowledge facilitates the assimilation of new knowledge. Key criteria which shed light on the absorptive capacity of an organisation, have been drawn from key literature in this field (Cohen and Levinthal 1990, Zahra and George (2002), Nieto and Quevedo (2005), Flatten et al. (2011)).

This is relevant in terms of further understanding WAG’s capacity to value, assimilate and take advantage of green building-related knowledge

**Table 12 –Interviewees who raised issues relevant to evidence of inbound absorptive capacity**

<b>Majority</b>	Exploitation of knowledge Assimilation of knowledge into organisation Transfer of knowledge Knowledge acquisition from external sources Knowledge acquisition – internally generated
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Majority = >80% Several = >50 but < 80% Some = <50% but >20% Minority = <20%

#### Measures of absorptive capacity

The following measures of absorptive capacity (Table 13) have been derived from Cohen and Levinthal (1990), Zahra and George (2002), Nieto and Quevedo (2005), Flatten et al. (2011).

**Table 13 – Interviewees who raised issues relevant to measures of absorptive capacity**

<b>Several</b>	Awareness of customer needs Effort put into development of new products Capacity for technological development Effort put into cost reduction
<b>Some</b>	Staff skills - Investment in training Capacity to adapt technologies from other sources
<b>Minority</b>	High level of technological specialisation Noteworthy economies of scale Range of staff training
<b>None</b>	Awareness of competitors' technologies

Majority = >80% Several = >50 but < 80% Some = <50% but >20% Minority = <20%

### 3.3. Innovation

Chesbrough (2004) defines the *open innovation* paradigm as an assumption 'that firms can and should use external as well as internal ideas and internal and external paths to market, as they look to advance their technology' (p.23). He proposes that this increases the number of possible sources of innovation.

This approach better enables an organisation (in this instance WAG) to deal with the unknowable, and manage the risks associated with experimentation.

Chesbrough et al. (2005) was used as the source for the *features* of 'open innovation' presented in these case reports. Huizingh (2011) was the source for the criteria which have been used to illustrate the *nature* of open innovation exhibited in the delivery of initiatives. Categories of *factors resulting in benefit from innovation* project and team have been drawn from Ling (2003). Bossink (2004) discuss an extensive array of *drivers for construction innovation*. These have been used alongside interview responses to categorise drivers within each case study organisation.

#### Features of open innovation

Chesbrough et al 2005 was used as the sources for significant features of open innovation (Table 14).

**Table 14 – Interviewees who raised issues relevant to significant features of open innovation**

<b>Majority</b>	New metrics for assessing innovation capability and performance Purposive outbound flows of knowledge & technology
<b>Several</b>	Business model focus on converting R&D into commercial value Abundant underlying knowledge landscape Rise of innovation intermediaries
<b>Some</b>	Equal importance given to external knowledge, in comparison to internal knowledge
<b>None</b>	Proactive and nuanced role of IP management

Majority = >80% Several = >50 but < 80% Some = <50% but >20% Minority = <20%

### Nature of open innovation

Key relevant academic literature was the source for the following criteria which have been used to illustrate the nature of open innovation exhibited in the delivery of green building initiatives by WAG (See Part 1 Overview).

**Table 15 – Interviewees who raised issues relevant to the nature of inbound innovation**

<b>Majority</b>	Exploitation Knowledge Acquisition
<b>Several</b>	Outbound innovation (external exploitation of internal knowledge Retention Coupled activities
<b>Minority</b>	Pecuniary re acquiring, sourcing, selling, and revealing
<b>None</b>	Non-pecuniary

Majority = >80% Several = >50 but < 80% Some = <50% but >20% Minority = <20%

**Table 16 –Interviewees who raised issues relevant to effectiveness of innovation**

<b>Several</b>	Financial benefits
<b>Some</b>	Less waste Decreasing risks Lower costs Enhancing tech. effectiveness Access to new markets Stimulating growth
<b>Minority</b>	Shorter time to market Other measures.... Number of innovations Nonfinancial benefits

Majority = >80% Several = >50 but < 80% Some = <50% but >20% Minority = <20%

### Benefits of open innovation approach

The benefits of this approach for the project and team have been drawn from key academic literature (See Part 1 Overview). Those identified in Table 17 relate to the working environment.

**Table 17 – Interviewees who raised issues relevant to benefits of open innovation approach**

<b>Majority</b>	Working environment
<b>Several</b>	Capabilities of the people involved in the innovation Level of interest of project team members Formation of task groups

Majority = >80% Several = >50 but < 80% Some = <50% but >20% Minority = <20%

### Drivers for construction innovation

The academic literature discusses an array of drivers for construction innovation (See Part 1 Overview). These have been used to thematically code data from interviews.

The following tables (Tables 18 - 21) highlight areas where interviewees raised issues relevant construction innovation in the context of WAG’s green building initiatives.

Table 18 highlights the environment pressures which are considered to have existed.

**Table 18 – Interviewees who raised issues relevant to benefits of construction innovation – environmental pressures**

<b>Several</b>	Governmental clients with innovative demands Innovation stimulating regulations
<b>Some</b>	Market pull industry wide Government guarantee for markets for innovative firms Subsidies for innovative applications and materials

Majority = >80% Several = >50 but < 80% Some = <50% but >20% Minority = <20%

Table 19 highlights issues associated with technological capabilities which may have impacted.

**Table 19 – Interviewees who raised issues relevant to benefits of construction innovation – technological capability**

<b>Some</b>	Product evaluating institutions Finance the pilot projects
<b>Minority</b>	Programs promoting access to technology Technology leadership strategy
<b>None</b>	Technology fusion Technology push

Majority = >80% Several = >50 but < 80% Some = <50% but >20% Minority = <20%

Table 20 highlights issues related to the exchange of knowledge (such as an integrated and informal R&D function) which was raised by interviewees when discussing the role of WAG in the green building initiatives in that state.

**Table 20 – Interviewees who raised issues relevant to benefits of construction innovation – knowledge exchange**

<b>Majority</b>	Integrated and informal R & D function
<b>Several</b>	Lateral communication structures Stimulation of research Training of workers on the site Creation of knowledge networks Programs promoting collaboration
<b>Some</b>	Effective information gathering
<b>Minority</b>	Broad view of risk

Majority = >80% Several = >50 but < 80% Some = <50% but >20% Minority = <20%

Finally Table 21 presents data related to ‘boundary spanning’ which may also be considered as crossing over traditional boundaries (such as organisational silos).

**Table 21 – Interviewees who raised issues relevant to benefits of construction innovation – boundary spanning**

<b>Several</b>	Coordination of participating groups Explicit coordination of the innovation process Empowerment of innovation champions Empowerment of innovation leaders
<b>Some</b>	Strategic alliances in long-term relationships Integration of design and build Involvement of the client Innovations from suppliers
<b>Minority</b>	Mechanisms sharing financial risks and benefits

Majority = >80% Several = >50 but < 80% Some = <50% but >20% Minority = <20%

## 4. Discussion

The above data has been gathered and analysed in order to illustrate and better understand the WA government’s green building initiatives and environment in which they were rolled out.

As per the data presented in the previous section, this has been done in two parts. The first part has been designed to build a better understanding of the initiatives themselves and the context in which they were rolled out. This draws directly from responses to each of the interview questions (Tables 2 – 10). The second part has used a set of criteria from academic theory around dynamic capabilities, absorptive capacity and open innovation to thematically code data. This has been done to build a deeper understanding of the capabilities WAG exhibited in the course of these activities, and those capabilities which may not have been evident, but which may contribute to better outcomes into the future.

### 4.1.1. Understanding the initiatives

In summary key *drivers* of this initiatives include: a shift in community and industry values; the development of new government policies regulation and guidelines at both state and Commonwealth levels; the availability of new rating schemes and tools; and the drive towards resource efficiency and associated cost benefits.

Key *implementation* activities related to: the application of new initiatives throughout project life cycles, including procurement and performance monitoring; developing and aligning strategies, capabilities and culture to these new initiatives; and building relationships

New *processes* required to deliver on these initiatives include: aligning budgets and requirements; enhancing and developing new processes to take advantage of new ratings tools; providing coordination, leadership and training; building collaboration with new parties including contractors; and all to deliver exemplar projects showcasing benefits to the broader community.

*Impacts* were produced both internally on organisational culture and values, and externally on the supply chain. Internal impacts included: behavioural and cultural change (such as

breaking down departmental silos); considering triple bottom line (TBL) benefits; and building new understanding and awareness (associated with a broader and longer term focus). Impacts seen in the supply chain include: an improved knowledge and understanding of 'green buildings'; a better definition of associated needs and benefits; and recognition of commercial and competitive advantage as proof of concept was achieved.

*External impacts* upon the rollout of these initiatives included: the GFC (which impacted on the rate of change, both positively and negatively); the introduction and on-going changes to rating tools; the change of government in 2006; and the introduction of Commonwealth government initiatives in the past decade.

Key *successes* which were highlighted include: sustainability outcomes being embedded in budgets and projects; an improvement in best practice as community and supply chain awareness and knowledge has improved; better tools and monitoring/reporting mechanisms; and improved resource efficiency.

Considerable *barriers* were also identified including: the need for better budget setting and business case justifications; issues associated with real and perceived costs; issues of government mandate and commitment, and consistency of approach, funding and regulation; resistance to change in industry; accountability and monitoring of outcomes; skills and management.

In terms of *R&D engagement and activities* key issues which emerged included the key role of external engagement to boost that undertaken within government agencies in order to maintain leadership; and the need to tangible, practical, cost effective and timely R&D, including that focussed on policy initiatives.

#### **4.1.2. Exploring the links to theory**

Based on an analysis of interview responses, WAG has embedded dynamic capabilities which have facilitated their approach to green building development in that state. These include: the on-going development of new products and processes (such as new policies and guidelines); organisational learning; and engaging with external R&D agencies. This latter capability is further reinforced with evidence of inbound absorptive capacity through the exploitation and transformation and assimilation of knowledge into the organisation. Issues identified from the analysis in relation to identifying measures of absorptive capacity reinforce the effort put into new product development with a focus on cost reduction (for example savings on energy) and customer needs. The capacity for technological development to assist in this (for example through the use of available technologies through suppliers such as GreenSense) was also highlighted.

In terms of issues relevant to features of open innovation, the majority of interviewees discussed: the availability of new metrics for assessing innovation capability and individuals (i.e. NABERS and Green Star); and useful outbound flows of knowledge and technology (for example through interaction with industry organisations such as the GBCA; and the DHW Building Management and Works section (along with the Department of Education) energy monitoring trails of six schools). Several interviewees discussed: the business model focus on converting this new knowledge (acquired through R&D) into commercial value (through translation into business cases and Requests for Proposals (RFPs)); the abundance of underlying knowledge landscapes (such as the 50 PhD's informing the development of the State Sustainability Strategy); and the rise of innovation intermediaries in this field (for example SBEnc and the Curtin University Sustainability Policy Institute (CUSP)).

Regarding the nature of this open innovation, the acquisition and exploitation of knowledge was important, and financial benefits were identified as relevant to the effectiveness of this innovation.

Benefits of this approach for the working environment were clearly apparent from interviewee responses in relation to: capabilities; level of interest; and the formation of task groups.

The most commonly coded responses relating to the benefits of construction innovation include:

- innovations stimulating regulation (for example mandating the use of rating schemes)
- government clients with innovative demands (via RFPs)
- pilot projects (including the Schools' energy program)
- the role of product evaluating institutions (such as GBCA)
- the rise and coordination of lateral communications structures and collaboration (both internally and with external organisations)
- the role of integrated and informal R&D
- the training of workers and creation of knowledge networks
- the stimulation of research; and the empowerment of innovation leaders and champions (which occurred across a broad range of government agencies)

Those criteria which were coded in the minority or not at all in relation to dynamic capabilities are IP creation and cost advantage through increased market intelligence. With regards to absorptive capacity these are: technical specialisation; taking advantage of economies of scale; range of staff training; and awareness of competitors' technologies.

With regards to open innovation criteria these are: proactive and nuanced role of IP management; shorter time to market; number of innovations; and nonfinancial benefits. The least coded of the construction innovation criteria are: programs promoting access to technology; technology leadership strategies; technology fusion; technology push; broad view of risk; and mechanisms for sharing financial risks and benefits.

## 5. Conclusions

The criteria highlighted above illustrate areas in which past and recent activity has been successful and areas from which potential future benefit could be obtained.

There was a high level of focus on several criteria:

- Product and process development was evidenced in the focus on the development policies, regulations and guidelines (such as the State Sustainability Strategy), and contributed to organisational learning.
- Cost advantage and benefits were evidenced in references to enhanced business case development; the inclusion of 'green' criteria in RFPs; and ensuing cost savings associated with increased resource efficiency.
- Coupled with this is the availability of new metrics for assessing innovation and performance. This is evidenced through the relationship with the GBCA and the use of the Green Star tool (with certification) to set targets and report on green building outcomes.
- Knowledge creation, exploitation and flows (both internally and with external organisations) were seen in each of the above and also in the use of knowledge in the project context.
- R&D engagement (both formal and informal) with a cross spectrum of academic institutions and innovation brokers was also highlighted.

## Project 2.7 – Green building case study

Potential areas for enhancing outcomes typically relate to a possible limited focus on IP; technology; and risk sharing. These will be explored further: in conjunction with the Western Australian Government; in the context of the cross-case analysis; and alongside of the findings of the audit and analysis of past R&D investment in the Australian built environment.

Further verification (through additional and follow-up interviews) and analysis (through separation of internal and external interviewee findings) of these findings would yield additional learnings, and may be possible in the context of Case Study 4.

These findings will be further considered in the context of Phase 4 of this current project, in establishing policy guidelines for future R&D investment in the built environment.

## **6. Appendices**

### **6.1. Timeline**

The following timeline (Table 22) is an effort to place Western Australian government's development of green (non-commercial) building initiatives in the context of significant global and national developments in this field.



**Table 22 – Green (non-commercial) building initiatives timeline**

Date	International	National	Western Australian - State Government and other
1975			Public Works Dept.– Architectural Division. Sunlight Design Guide.
1980			Public Works Dept. – Architectural Division. <i>Energy Management in the Design of New Buildings: Guidelines and Standards</i>
1986		Garry Baverstock & Sam Paolino. <i>Low energy buildings in Australia: A design manual for architects and designers. Vol 1: residential.</i>	
1988			Solar Energy Research Institute Western Australia - <i>Design Guide for Energy Efficient Buildings in the North of Western Australia.</i>
1990	BREEAM (Building Research Establishment Environmental Assessment Method) developed and published		
1991			
1992	UN Framework Convention on Climate Change produces the International Environment Treaty	National strategy for ecologically sustainable development published	
1993	BREEAM expanded to factories & warehouses, retail, homes, & schools, both new & refurbishment		
1994	Environmental Profile, Norway launched	Energy Victoria. <i>Energy efficient commercial buildings.</i>	
1995		<i>Australian Urban &amp; Regional Development Review. Green Cities (Strategy Paper #3).</i> Australian Building Design Professionals publishes <i>Environmental Design Guides</i>	
1996	To 1999 - Review of environmental assessment methods by International Energy Agency (IEA). To 1998 - Green Building Challenge initiated - 2 yr process (14 countries) culminated in GBC '98 conference – Vancouver.		WA Building Management Authority. <i>WABMA Energy Standards: Standards for Building Envelopes.</i>

Project 2.7 – Green building case study

Date	International	National	Western Australian - State Government and other
1997	Amendment to UN Framework Convention on Climate Change – Kyoto Protocol		
1998	Office BREEAM issued		
1999	Curwell et al. <i>Green Building Challenge UK report</i> Environmental Profile, merged with another Norwegian building assessment method and launched	NATSPEC publishes <i>Sustainable Specifying – a plan for the greening of the national building specification.</i>	
2000	CIB W100 Environmental Assessment of Buildings International Conference Sustainable Building 2000, 22-25 October, Netherlands.	Australian Building Greenhouse Rating (ABGR) goes national	
2001	OECD/IEA joint workshop on design of sustainable building policies in Paris 28-29 June	RMIT Centre for Design runs first (annual) Green Building seminar. LCADesign development commenced – CRC CI NABERS launched To 2005 - Sustainability and the Building Code of Australia – CRC CI	WA Cleaner Production Statement launched Sustainable Energy Development Office established
2002	Haute Qualité Environnementale launched (France)-2 yr test period Environmentally sustainable buildings challenges and policies published by OECD	Green Bldg Council of Australia established	Energy Smart Government initiative announced
2003	OECD. <i>Environmentally Sustainable Buildings: Challenges and Policies.</i> CIB W100 review of environmental assessment methods in Australia, Norway, Sweden, Canada, France and Japan. Kats - <i>The Costs and Benefits of Green Buildings</i>	The Australian Building Codes Board introduces energy efficiency measures in BCA Volume Two GBCA & Property Council of Australia launch Green Star scheme	Western Australian <i>State Sustainability Strategy</i> launched <i>Better Planning: Better Services – A Strategic Planning Framework for the Western Australian Public Sector</i> launched
2004	OECD/IEA joint workshop on sustainable buildings: towards Sustainable use of building stock	ABCB introduces energy efficiency measures in BCA Volume One	<i>Leading by example - WA Sustainability Code of Practice for Government Agencies</i> launched <i>Office Accommodation Policies – Policy 14: Sustainability &amp; Gov. Accommodation</i> specifies min. ABGR ratings for gov. office bldgs State Supply Commission - <i>Environmental</i>

Project 2.7 – Green building case study

Date	International	National	Western Australian - State Government and other
			<i>Purchasing Guide</i> WA Greenhouse Strategy published.
2005		Department of Environment & Heritage & RMIT - <i>ESD Design Guide for Australian Government Buildings</i> NSW Dept. of Energy, Utilities & Sustainability selected to roll out NABERS	
2006		DEH & RMIT - Scoping study into improving the environmental sustainability of building materials 2nd edition of the <i>ESD Design Guide for Australian Government Buildings</i> published. Building Code of Australia Part J released CH2 Melbourne – 6* Green Star Brisbane Square, Brisbane, 5* Green Star	
2007		Australian Government ratifies Kyoto Protocol; <i>ESD Design Guide</i> – 3rd edition published BASIX (NSW) on all residential buildings above \$50K 30 The Bond Hickson Road Sydney - 5 * Australian Building Greenhouse Rating benchmark	
2008	International Energy Agency - <i>Energy Efficiency Requirements in Building Codes: Energy Efficiency Policies for New Buildings</i> .	Australian Sustainable Built Environment Council (ASBEC). <i>The Second Plank – Building a Low Carbon Economy with Energy Efficient Buildings</i> . LCADesign commercially released by CRC CI	<i>Sustainable Non-Residential Government Buildings Policy and Guidelines</i> released – using 4* GBCA and 4.5* NABERS
2009	UN Copenhagen Conference produces Accord - delegates agree 'to take note of' - not legally binding. Major Economies Forum on Energy and Climate. Technology Action Plan: Energy Efficiency – Buildings Sector.	Department of Climate Change - <i>CPRS Green Paper</i> . Property Council of Australia - <i>National Energy Efficiency Strategy for Buildings – Discussion Paper</i> . PRECINX - planning & design tool that analyses	Denmark Hospital – WA

Project 2.7 – Green building case study

Date	International	National	Western Australian - State Government and other
2010	Next 10. Untapped potential of commercial buildings. Energy use and emissions. Capturing wasted energy: efficiency, retrofits, and barriers. (California non-profit organisation.)	<p>potential sustainability of large, multiple-dwelling &amp; mixed-use projects at early design stage launched</p> <p>Senior Officials Group on Energy Efficiency - <i>National Strategy on Energy Efficiency - National Building Energy Standard-setting, Assessment and Rating Framework: Public Discussion Paper.</i></p> <p>Sellers and Lessors of office space &gt;2000sqm required to disclose current energy efficiency rating (Commonwealth Gov. legislation 1/11/10)</p> <p><i>National Green Leasing Policy</i> (First draft) released by NFEE, GPG and APCC</p> <p>Davis Langdon (for the GBCA). <i>The Road to 'Green Property'</i>. v2.0</p> <p>ASBEC. <i>The Second Plank Update: A review of the contribution that energy efficiency in the buildings sector can make to greenhouse gas emissions abatement.</i></p> <p>CitySwitch launched  <a href="http://www.cityswitch.net.au/?tabid=1131">http://www.cityswitch.net.au/?tabid=1131</a></p>	Main Roads office Albany WA
2011		<p>\$1 billion Tax Breaks for Green Buildings initiative</p> <p>COAG's <i>National Strategy on Energy Efficiency</i> - during 2011 a consistent, outcomes based national building energy standard will be established.</p> <p>NABERS ratings under review (extend to 7*)</p> <p>Building Energy Efficiency Certificate (BEEC) required from November.</p> <p>Flinders Medical Centre, New South Wing, Adelaide, 5 * Green Star – Healthcare Design v1 Certified Rating.</p>	<p><i>Energy 2031</i> directions paper</p> <p>one40william awarded the George Temple Poole award WA AIA Awards</p> <p>Albany Main Roads Great Southern Regional Complex awarded Award for Sustainable Architecture WA AIA Awards</p> <p>28 business and organisations in the City of Perth committed to CitySwitch (equivalent to 11% of office NLA)</p>

### 6.1.1. Green building strategies

Table 23 provides a summary of some key green building strategies in place across Australia, relevant to this case study.

**Table 23 – Green building strategies**

Initiatives	Date	Aim and Objectives
National		
ABCB and BCA	On-going	Australian Building Codes Board addresses issues relating to safety, health, amenity and sustainability in the design and performance of buildings (The Building Code of Australia) - and the development of effective regulatory systems and appropriate non-regulatory solutions.
Green Building Council of Australia (GBCA) - Green Star rating scheme	Launched 2002	GBCA's promotes green building programs, technologies, design practices & operations & the integration of green building initiatives into bldg design, construction and operation. Green Star rating tools help industry to reduce environmental impact of buildings, improve occupant health and productivity and achieve cost savings.
National Australian Built Environment Rating System (NABERS)		Performance-based system that rates existing buildings on the basis of their emissions-based impacts. Designed to provide a indication of how well environmental impacts are being managed in comparison to peers & neighbours. Formerly known as Aust. Bldg. Greenhouse Rating (ABGR).
Australian Green Infrastructure Council (AGIC)	2008 onwards	Member-based industry association aimed at delivering more sustainable infrastructure outcomes.
National Strategy on Energy Efficiency - OSCAR	2008 onwards	Aims to accelerate energy efficiency efforts, in preparation for the introduction of the Carbon Pollution Reduction Scheme. An initiative of COAG.
	2008 onwards	The <a href="#">Online System for Comprehensive Activity Reporting</a> - web-based data tool for used to collect energy and emissions data from a number of programs administered by Federal and State / Territory Governments and business - to record energy and emissions data for Government program reporting
Solar Cities	2007 onwards	Commonwealth government demonstration program to promote solar power, smart meters, energy conservation and new approaches to electricity pricing to provide a sustainable energy future in urban locations in Australia.
Building the Educations Revolution	2009	Targets 4* Green Star standard where possible.
National Green Leasing Policy (Final Draft)	Aug. 2010	Produced by the National Framework for Energy Efficiency; Government Property Group and the APCC. Facilitates environmentally beneficial practices & outcomes associated with the leasing of buildings (through Green Lease Schedule).
Western Australia		
Energy Management in the Design of New Buildings	1980	Guidelines and standards to ensure designs recognise the value of energy efficiency in both the bldg envelope and services.
Sunlight Design Guide	1975	Produced by WA Public Works Department to assist designers in determining sun paths and angles.
The WA State Sustainability	2003	Outlines actions associated with 6 goals of the A Government representing how sustainability can be applied across the whole of

Project 2.7 – Green building case study

Strategy		government.
Office Accommodation Policy	2004	Guide to the procurement and management of WA Government office accommodation, balancing service delivery with responsible use of funds. Addresses key areas of sustainability and access for people with disabilities.
DHW Sustainability Matrix	2003	Sustainability ratings targets to be achieved. Targets for both design and performance phases – for new and existing buildings – for both base bldgs and tenancies.
Sustainable Non-Residential Bldgs	Dec 2008	Requires all bldgs to incorporate relevant sustainability standards in their procurements documentation – representing best practice. Targets 4* Green Star or NABERS rating or energy report.
Primary School Brief	March 2012	Developed by DHW BMW – with targeted 4* Green Star rating.
Liveable Neighbourhoods	2007 onwards	Operational policy for the design and assessment of structure plans and subdivision for new urban areas in the metropolitan area and country centres.
<b>New South Wales</b>		
Sustainability Charter	2006	Covers demand for energy, water, transport and commodities along with growing pressure on land for development which are giving rise in particular to increased greenhouse gas emissions and biodiversity.
Sustainability statement		Aimed at the property of living systems, a manufacturing method, or a way of life. It includes: (i) living within the limits; (ii) understanding the interconnections; & (iii) equal distribution of resources & opportunities. The approach covers areas incl. industry participation, construction, resource usage, waste management and procurement.
Green Lease Guide	2011	Partnership between NSW Dept of Environment & Climate Change, Investa, City of Sydney, City of Melbourne & Institute of Sustainable Futures. A guide for office space selection in terms of building selection; designing a fit out; and identifying objectives for the working environment
<b>Queensland</b>		
Sustainable Homes Program (SHP)	2008	Provide communities with display homes incorporating principles of sustainable design; and performance aligned with Smart & Sustainable Homes Design Objectives
Green Building Skills Fund	2009	Aim to boost sustainability expertise within Queensland's building and construction industry - partnering with peak industry bodies to deliver accredited training courses.
Sustainable procurement policies & practices	2009	Provide information, resources, and practices to assist agencies and suppliers to implement sustainable practices.
<b>South Australia</b>		
Adelaide Green City Program	2008	Explores policy options for making Adelaide a green, sustainable city - shows wide range of new businesses and job opportunities could be created from a increase in resources efficiency - will also help reduce Adelaide's 'ecological footprint'.
<b>Victoria</b>		
Building Commission (BC) sustainability policy		Core part of the plan for sustainability in the built environment. Guided by a commitment to building sustainability in a number of aspects including: (i) promoting energy and resources efficient bldg designs to mitigate environmental impact throughout the project life cycle; (ii) partnering to improve the TBL performance; (iii) consumer information on environmental sustainability; (iv) build practitioner awareness & capacity.

## 6.2. Interview data

### 6.2.1. Understanding the initiatives

#### 6.2.1.1. Drivers

##### Identified by internal interviewees

- The right thing to do
- State government policies including *Sustainable Non-residential Buildings policy*, *State Sustainability Strategy*, mandating a 4\* Green Star minimum requirement, *Liveable Neighbourhoods* and *Government Office Accommodation Policies*
- State government agencies including Western Australia Planning Commission, LandCorp, Office of Energy and Department of Water
- Commonwealth government policies including *Solar Cities*, *National Strategy for Energy Efficiency*; *Building Codes of Australia*, and the mandatory disclosure of *Energy Efficiency for Commercial Buildings*
- Industry drivers including case studies from GBCA and overseas; Australian Sustainable Built Environment Council (ASBEC), design professionals, and industry rating schemes

##### Identified by external interviewees

- Industry including GBCA
- Regulatory drivers including minimum NABERS rating in *Government Office Accommodation Policy*; *Building Code of Australia*
- Policy drivers including State Sustainability Strategy and the Minister for Department of Housing and Works
- The right thing to do; awareness of environmental issues, climate change and social benefits
- Generational change in the electorate; political and social pressure from the electorate
- 2001 drought
- Cost savings, economic benefits, becoming part of the green economy and reduction in life-cycle costs (included materials)
- Reduction in energy use; energy monitoring in public schools
- Client interest

#### 6.2.1.2. Delivery - implementation activities

##### Identified by internal interviewees

- application to projects through a number of avenues including:
  - rating tools
  - pilot projects showcasing green building elements and benefits of policy initiatives
  - use of request for proposals to inform consultants;
  - cost benefit analysis
  - tender documents
  - engagement of consultants
  - design reviews
  - research in LandCorp business
  - monitoring of energy and water use in Dept. of Education schools
  - to achieve energy savings (main focus for Dept. of Treasury and Finance)
- push towards maintenance minimisation and recycling
- strategic development to support government mandate through policies, regulations and business tools
- relationship building and stakeholder involvement

### **Identified in external interviewees**

- making abstract concepts work; R&D into products
- developing and applying new skills and processes
- encouraging behavioural change; capacity building
- engagement with industry and testing rating tools (GBCA and AGIC)
- reuse and recycling opportunities - making intangible resource consumption tangible
- energy savings
- development of *State Sustainability Strategy*
- preparing business cases and feasibility studies to determine value for money; cost benefit analysis and quantifying benefits
- exemplar projects
- embedding design standards into expressions of interest and request for proposals

#### **6.2.1.3. Processes**

### **Identified by internal interviewees**

- understanding organisational position; identifying delivery agency; inter agency collaboration
- aligning budget definition with request for proposal requirements
- training in new processes both internally and in industry
- development and use of benchmarks and rating tools
- developing monitoring mechanisms
- embedding sustainability core values
- establishing sustainability committees

### **External interviewees**

- collaboration
- effective consultation and stakeholder management
- contractor involvement at an early stage
- government policy based on creativity and innovation
- rigorous reporting mechanisms
- implementing schemes that get results (e.g. GBCA rating tool)
- getting projects built – leads to better understanding
- focus on implementation
- leadership
- improved planning approvals process

#### **6.2.1.4. Impacts**

Three types of impacts are being discussed: (i) impacts on the culture and values of the organisation; (ii) on the supply chain and industry; and (iii) the impact of major external changes on the development and delivery of the initiatives.

### ***Culture and values-based impacts***

### **Identified by internal interviewees**

- behavioural change required to mainstream sustainability
- breaking down departmental silos
- build understanding around reasons for changes
- get triple bottom line benefits, value externalities and apply to business cases



### **Identified by external interviewees**

- increase awareness of need to live within limits of natural environment i.e. sustainability and tools (energy conservation not currently top of WAG agenda)
- need for foresight (those who pay for projects do not necessarily pay running costs)
- dissemination of information - does not 'belong' to facility managers
- dealing with change
- valuing aesthetics of sustainability
- better understanding of peak load demand management

### ***Impacts of initiatives on supply chain and industry***

#### **Identified by internal interviewees**

- better consultant availability, responsiveness and quality
- more educated supply chain including companies specialising in green building elements (though still some remaining difficulties in influencing suppliers)
- enhanced needs definition increasing ability to influence industry using logical business case
- rating tools have increased understanding of commercial value
- more proof of concept, guidelines (e.g. Sustainable Infrastructure Decision Model) and tools (incl. for new buildings and maintenance) available
- increased understanding and acceptance of sustainability
- change in way projects delivered (i.e. sustainability less of an extra)
- increased emphasis on energy efficiency (e.g. Building Code of Australia)

#### **Identified by external interviewees**

- green building work has raised profile of companies who are now recruiting sustainability positions
- best practice being communicated through guidelines and training
- broader industry understanding through training (e.g. Green Star training courses)
- waste minimisation and recycling maximisation
- emerging market competition likely to increase
- increased awareness of more efficient products; recognition of green economy by industry;
- better relative access to materials
- better access to performance data and quantification of benefits
- investment in CAD and BIM platforms to facilitate green outcomes
- clear statements of needs e.g. Green Star, BCA
- move from small-scale beginnings to different (more complex) types of buildings

### ***Major changes impacting on initiative***

#### **Identified by internal interviewees**

- Global Financial Crisis – fewer green star applications presented opportunity to rationalise green star; fewer buildings, slowed research; more emphasis on speed of delivery forcing return to old business model; industry partners less able to invest; increased workload due to Commonwealth governments stimulus initiatives
- introduction of NABERS
- change of government - certain projects did not proceed; more reliance on national strategies; change in language and attitudes
- changes in funding; changes in legislation
- carbon tax discussion leading to a resurgence in research
- Commonwealth government initiatives including National Strategy For Energy Efficiency and Energy Roundtable

### **Identified by external interviewees**

- popularity of Green Star rating system and NABERS
- move to new green economy (regulation needs to be ramped up to drive this)
- GFC created age of scarcity
- implementing changes in regulation and making provision for future changes in building structure and servicing
- consequences of change in government - new Minister; environmental components rolled back; champions moved on; changes in funding; winding back legislative changes

#### **6.2.1.5. Successes**

### **Identified by internal interviewees**

- now embedded in budget and project
- consultants on board
- better educated market
- better understanding and awareness of environmental issues
- better guidelines and tools e.g. Sustainable Infrastructure Design Model and Green Star process
- National Strategy For Energy Efficiency enables continuing monitoring and reporting
- maintaining or reducing utilities costs
- healthy and a more vibrant participation in built environment;
- better understanding of industry needs
- encouraging conservative industry partners to take risks; working with partners to address significant infrastructure problems
- sustainability being implemented across a broad range of areas

### **Identified by external interviewees**

- redefining and refocusing work with other consultants
- increased consideration of evidence based design; acceptance of tools
- highly trained industrial body experienced in implementing initiatives
- up skilling through involvement with high-grade green buildings;
- better industry and market understanding of sustainable concepts
- improvement in what is considered best practice e.g. 3 or 4 new office buildings with 5\* rating in the past 12 months
- tangible outcomes including: removing toxins from environment; more efficient buildings and appliances; decrease in use of cars, electricity and water per capita
- real-time data gathering
- achieving savings through Schools energy challenges by up to 40%
- sustainability being looked at the front-end of project; integrated transport planning

#### **6.2.1.6. Barriers**

### **Identified by internal interviewees**

- better budget setting and business case writing required
- cost effectiveness
- no strong whole of government leadership and mandate; lack of political support; lack of funding;
- split between funding and delivery agencies; departmental silos
- outdated legislation e.g. health act
- motivation; resistance to change in industry
- lack of leadership sending conflicting signals to industry

## Project 2.7 – Green building case study

- lack of industry capacity
- adapting research to practicalities
- lack of accountability and monitoring
- loss of key personnel

### **Identified by external interviewees**

- nervousness about taking on new untested ideas; individual opposition; fear of change; personal interests; misunderstandings; scepticism; cultural differences
- lack of foresight
- client not seeing the value
- lack of customer awareness and interest
- management issues
- cost issues and perceptions; valuing benefits; upfront versus ongoing costs; sustainability first to go in budget; focus on bottom-line
- lack of incentives and regulations; lack of clear government policy
- forcing collaboration
- lack of building tuning – consultants not involved past project completion
- lack of knowledge
- specialism in trades makes it hard to implement

### **6.2.1.7. R&D engagement and activities**

#### **Identified by internal interviewees**

- Department hasn't had R&D budgets except for funding towards universities including SBEnrc, CRC Construction Innovation, Murdoch University, Curtin University and RMIT;
- look to what others have done for example SBEnrc, CRC for Construction Innovation, Worley Parsons; Syrinx, Curtin University, PB, Peter Newman and CUSP; other government agencies across the country; GBCA, ABGR and NABERS; Office of Energy, Sustainable Energy Development Office
- Research Officer position
- Building Research and Technical Services Branch has value;
- Need to show real benefits when research tailored to industry needs
- restraint is funding and resources
- research can be slow and costly
- better evidence and research is the way to go

#### **Identified by external interviewees**

- part of business practice (some consultants, manufacturers and suppliers) including demonstration projects, talks and seminars
- GBCA; SBEnrc; AGIC; NABERS; CIBSE; RMI T; Australian Building Codes Board; Institute for Sustainable Futures; CUSP; Environmental Technology Centre - Murdoch
- Department of Premier and Cabinet and Sustainable Policy Unit (2001-2006)
- more R&D required to maintain leadership and cohesive organisational structure
- policy research needs to be done constantly based on best practice

### **6.2.2. Links to theory**

The following tables present the detailed data summarised from interviews considered relevant to specific criteria related to the three aspects of theory identified as significant to this research.

### 6.2.2.1. Dynamic Capabilities

**Table 24 – Summary of comments from interviews considered relevant as evidence of organisational dynamic capabilities**

Dynamic Capability	Examples
<b>Product or process development</b>	<ul style="list-style-type: none"> <li>- <b>improved budgets and increased cost effectiveness</b>; cost benefit analyses</li> <li>- <b>procurement innovation</b> incl. Request for Proposals (RFPs), EOIs; tender documents, consultant engagement, design/project reviews; setting targets with clients; 5* plus requirements</li> <li>- <b>supply chain innovation</b> - chain of custody issues; optimise facades &amp; mech/elec systems; involvement of design team for building tuning; measurement tools; more efficient products; new structural systems</li> <li>- <b>project innovation</b> - trialling green building elements; demo projects</li> <li>- <b>rating tool development and requirements</b> - rationalisation of GBCA tools; NABERS</li> <li>- <b>monitoring, measurement, reporting, target setting and adjusting</b></li> <li>- <b>Government sustainability initiatives</b> - State Sustainability Strategy and follow-on policies; climate response policy; sustainable infrastructure design model</li> <li>- <b>social policy initiatives</b></li> <li>- <b>policy oriented R&amp;D</b></li> <li>- <b>creativity in government</b> - creative regulation; opportunities for private sector partnerships</li> <li>- <b>training and capacity building</b></li> <li>- <b>communication &amp; collaboration</b> – incl. inter-agency</li> </ul>
<b>Organisation learning</b>	<ul style="list-style-type: none"> <li>- <b>use of rating tools and pilot projects</b>- quantifying benefits</li> <li>- <b>improved budgeting and brief definition</b></li> <li>- <b>building whole government direction</b></li> <li>- <b>learning organisation</b> - creation of Sustainability Policy Unit &amp; State Sustainability Strategy; initiatives suggested by mid-level people taken up higher up; developing &amp; applying new skills/processes; sustainability steering committees &amp; groups;</li> <li>- <b>education initiatives</b> - office education programs; training putting innovation in context</li> <li>- <b>research</b> - especially energy-saving; research officer position/s; embed research into business; adapting research to practicalities; engagement with SBEnrc &amp; AGIC;</li> <li>- <b>industry engagement</b> – adoption of: ASBEC the second plank; COAG initiatives; National Strategy for Energy Efficiency</li> <li>- <b>leadership</b> – ministerial direction; establishing stronger leadership influence; how to bring the best new technology and push the envelope</li> <li>- <b>engagement with supply chain</b> - understanding chain of custody issues; supply chain more educated</li> <li>- <b>cultural change</b> - overcoming resistance to change</li> </ul>
<b>External R&amp;D engagement</b>	<ul style="list-style-type: none"> <li>- <b>Academic</b> - SBEnrc and CRC CI; Curtin University; Peter Newman and CUSP; RMIT; Institute for Sustainable Futures; ISTP; Environmental Tech. Centre at Murdoch University</li> <li>- <b>Industry &amp; associations</b> - ASBEC; GBCA; ABGR &amp; NABERS; WorleyParsons; Syrinx; PB; Institute of engineers, CIBSE; AGIC; ABCB</li> <li>- <b>National strategies</b> - National Strategy for Energy Efficiency; Energy Roundtable; other government agencies in Australia; COAG</li> <li>- <b>Supply chain engagement</b> – e.g. Blue Scope (developing greywater recycling systems, solar water heaters)</li> </ul>
<b>Strategic decision making</b>	<ul style="list-style-type: none"> <li>- <b>finding the right fit</b> – e.g. or solar cities program;</li> <li>- <b>positions and empowerment</b> - sustainability officer; sustainability champions</li> <li>- <b>up-skilling</b> - through involvement in high-grade green building; improvement in staff performance; improved staff performance as driver</li> <li>- <b>R&amp;D required</b> to maintain leadership</li> <li>- <b>own the assets</b> for reduction in life-cycle costs; upfront versus ongoing costs</li> <li>- <b>leadership initiatives</b> – creation of Sustainability Policy Unit (2001) incl. sustainability steering committee at group level, chaired by managing director; pilot projects; executive level top-down drivers incl. (Sustainability Policy Unit and at LandCorp); LandCorp Board initiative; State Sustainability Strategy development;</li> <li>- <b>responding to electorate</b> - 2000 there was an incredible shift in expectations –</li> </ul>

Project 2.7 – Green building case study

	Premier pushing for sustainable design, Minister pushing for change
<b>Cost advantage through less waste</b>	<ul style="list-style-type: none"> <li>– <b>not enough focus on maintenance</b></li> <li>– <b>Resource use</b> - had to be effective; get environmental along with energy benefits; maintained or reduced utilities costs; opportunities to minimise waste maximise recycling</li> <li>– <b>change to a triple bottom line approach</b> - valuing externalities and using in business cases</li> <li>– <b>longer-term cost benefits</b> needed to be thoroughly present; look at different products; more efficient designs; value assessed where possible; energy cost increases motivation for change</li> <li>– <b>adopting national strategies</b> - energy efficiency;</li> <li>– <b>state strategies</b> - for energy and water conservation; schools energy monitoring;</li> <li>– cost benefit analysis</li> </ul>
<b>Product or service differentiation</b>	<ul style="list-style-type: none"> <li>– <b>awareness</b> - extends to the wider community creates better broader outcomes</li> <li>– <b>government initiatives</b> – 5* plus; NABERS; LandCorp sustainability initiatives; climate response policies; Sustainable Infrastructure Design Model; building initiatives in industrial developments; how tender documents put together; engagement of consultants; design/project reviews; embed research into business</li> <li>– <b>engagement with GBCA</b> - green star became popular - big marketing tool; setting targets with clients; development of new structural systems with engineers;</li> <li>– <b>R&amp;D required to maintain leadership</b></li> <li>– <b>supply chain impact</b> - innovative company flying the flag is good advertisement; recognition of green economy; demo project for a carbon and water neutral shopping centre; chain of custody issues</li> <li>– <b>emerging market</b> - more competition is likely to occur very soon; market advantages for companies specialising in elements of green building</li> </ul>
<b>Internal R&amp;D engagement</b>	<ul style="list-style-type: none"> <li>– <b>Initiatives</b> - internal applied research arm; research officer position; Sustainable Energy Development Office; Office of Energy; monitoring outcomes and adjust accordingly; climate response of policy; green building affordability; Sustainable Infrastructure Design Model; localised energy production; the ecological footprint development; cost-effective building initiatives in industrial developments</li> <li>– <b>State sustainability strategy</b> – policy oriented R&amp;D – 50 Ph.D.s, Masters and undergraduate students; 40 background papers and case studies on alternatives and options</li> <li>– <b>Department has not had R&amp;D budgets</b></li> </ul>
<b>Customer focus</b>	<ul style="list-style-type: none"> <li>– <b>funding and resources</b> - sponsor agencies have the funding we provide the Project Management service; resources had to be used effectively; business cases/feasibility studies to determine value for money and decide project outcomes; business cases/feasibility studies to determine value for money and decide project outcomes; Dept. of Education and schools program</li> <li>– <b>influence</b> - Target setting with clients; influence over implementation of initiatives person paying the bills have the final say</li> <li>– <b>political and social pressure from electorate</b></li> </ul>
<b>Alliancing</b>	<ul style="list-style-type: none"> <li>– <b>research</b> SBEnrc; ARC grants; Curtin University and CUSP</li> <li>– <b>supply chain</b> - the whole of the supply chain has to deliver</li> <li>– <b>Industry</b> - – Green building Council of Australia, Worley Parsons, Syrnix and LandCorp creating opportunities for private sector partnerships</li> <li>– <b>Other agencies</b> - New South Wales Department of Planning</li> </ul>
<b>Technology transfer</b>	<ul style="list-style-type: none"> <li>– <b>RFPs</b> - as levers with consultants</li> <li>– <b>literature, proof of concept and guidelines</b> now more available</li> <li>– <b>trailing green building elements</b></li> <li>– <b>technological changes</b> - implemented to the extent financially possible</li> </ul>
<b>Cost advantage through increased market intelligence</b>	<ul style="list-style-type: none"> <li>– <b>sustainability less of an extra</b></li> <li>– <b>resources had to be used effectively</b></li> <li>– <b>benefits became better documented</b> - around 2005</li> </ul>
<b>IP creation</b>	<ul style="list-style-type: none"> <li>– <b>supply chain IP</b> - design teams optimise facades &amp; mech/elec systems; Greensense tools</li> </ul>

**Table 25 – Number of interviewees who discussed issues considered related to organisational dynamic capabilities**

	Observed Yes/No
Product or process development	13 of 13
External R&D engagement	11 of 13
Organisation learning	11 of 13
Strategic decision making	9 of 13
Cost advantage through less waste	8 of 13
Product or service differentiation	7 of 13
Internal R&D engagement	7 of 13
Alliancing	6 of 13
Customer focus	6 of 13
Technology transfer	3 of 13
IP creation	2 of 13
Cost advantage through increased market intelligence	2 of 13

### 6.2.3. Evidence of absorptive capacity

**Table 26 – Summary of comments from interview considered relevant to providing dimensions of absorptive capacity**

Dimensions of absorptive capacity	Examples
Exploitation of knowledge	<ul style="list-style-type: none"> <li>– <b>existence of ratings tools</b> mean people understand its commercially good value</li> <li>– <b>specialisation gives companies competitive edge</b>; benefits in terms of rents productivity, ease of lease etc; applied research; better project deliverables; desire not to miss out on the green economy future</li> <li>– <b>State sustainability strategy</b> main driver of green initiatives; lead to office accommodation having a sustainability priority</li> <li>– <b>national initiatives</b> - Office of Energy grants available to agencies to study energy use; National energy efficiency policies</li> <li>– collected <b>case studies</b> from elsewhere</li> <li>– <b>benefits</b> include maintained or reduced utilities costs better building environment for staff; environmentally aware staff; opportunities for putting photovoltaic cells on staff housing; water recycling in our staff housing; always monitoring outcomes in adjusting accordingly; measurable decreases in car use electricity and water use per capita – more efficient buildings and appliances; opportunities for Dept. of Education to monitor and reduce costs</li> <li>– <b>TBL</b> – change from purely economic considerations to a triple bottom line approach valuing externalities and using these business cases; improved value engineering</li> <li>– <b>applied R&amp;D</b> for example a demonstration project; embedding in EOIs and RFPs; cost benefit analysis; created opportunities and set sustainability agenda</li> <li>– <b>interagency collaboration</b> and the non-potable water example</li> <li>– <b>change in government</b> lead to loss of champion, winding back of legislation</li> </ul>
Transfer of knowledge	<ul style="list-style-type: none"> <li>– <b>supply chain education</b> - RFPs to define consultants approach to project; supply chain has become more educated; industry guidelines and training</li> <li>– <b>stakeholder education</b> - trialling green building elements; educating stakeholders on the reasons for introducing green initiatives; worked on industry seminars and conferences to communicate importance of introducing green building initiatives in projects; work with partners to address significant infrastructure problems across the State</li> <li>– <b>Sustainable Energy Development Office</b> active in education grants and research</li> <li>– <b>tools</b> - produced tools such as the sustainable infrastructure design model;</li> <li>– <b>R&amp;D</b> into projects for example a demonstration project</li> <li>– <b>organisational learning</b> - State Sustainability Strategy - the built environment was about half of the document; Flow of knowledge through hierarchy; people who were involved now in other positions in industry; embedding design standards into EOIs and RFPs; improved planning approvals process; information dissemination e.g.</li> </ul>

Project 2.7 – Green building case study

	<p>energy consumption data traditionally seemed to belong to facilities management;</p> <ul style="list-style-type: none"> <li>– <b>lack of clear government policy</b>; lack of consumer awareness; focus on bottom line profits</li> </ul>
Knowledge acquisition from external sources	<ul style="list-style-type: none"> <li>– <b>Associations</b> – APCC; ASBEC; GBCA; CIBSE, Institute of Engineers, AGIC</li> <li>– <b>educational/research</b> – CRC CI, SBEnrc; CUSP and Curtin University; 50 Ph.D.s, Masters and undergraduates coming to work in the Premier's office; Murdoch University, RMIT, Institute for Sustainable Futures, ISTP, Environmental Tech. Centre at Murdoch</li> <li>– <b>private Sector</b> - Greentrac audit of computers; Worley Parsons; Syrinx; PB;</li> <li>– <b>national and other state governments</b> - ABGR and NABERS; COAG; National Strategy for Energy Efficiency; Energy Roundtable, ABCB</li> </ul>
Knowledge acquisition – internally generated	<ul style="list-style-type: none"> <li>– <b>state Sustainability Strategy</b> - creation of Sustainability Policy unit; agency feedback/rewrites/contributions – two thirds of returned material was new outlining sustainability issue is already occurring in agencies</li> <li>– research officer position; State Energy Government Office Education Program;</li> <li>– <b>National Strategy For Energy Efficiency</b> supported initiatives developed in-house</li> <li>– see range of R&amp;D projects undertaken</li> <li>– <b>Sustainability Steering Committee</b></li> <li>– <b>sustainability design standards</b> for Eol and RFPs</li> <li>– <b>improved planning approvals processes</b></li> </ul>
Assimilation of knowledge into organisation	<ul style="list-style-type: none"> <li>– <b>improved budgets and RFPs</b>;</li> <li>– <b>new tools</b> - use general rating tools as a guide; worked very hard at LandCorp to try and develop tools to change</li> <li>– <b>initiatives</b> suggested by mid-level people and taken up by people at a higher level; part of the group to try to establish a much stronger leadership influence in WA; accountability and monitoring mechanisms to ensure that even within our own business and our projects' project managers for managing and introducing these initiatives as best they could;</li> <li>– <b>new policy</b> - Sustainable Non-Residential Buildings policy (2005); driving that policy and guidelines in our planning approvals process; implementing changes in regulation – without training people become suspicious that regulations will be oppressive</li> <li>– <b>new positions and skills</b> - research officer positions; project managers taking up the workout project level; teams that were culturally aligned; up-skilling practice through involvement with high rated green building; external research involvement with opportunities arose; creation of Sustainability Policy unit and Manager for Sustainability at LandCorp</li> <li>– <b>information dissemination</b> - State Energy Development Office weekly website that recorded sorts of initiatives in the area;</li> <li>– <b>mandate to deliver</b> - sustainability outcomes including buildings</li> <li>– <b>assimilation of state and national policies</b> - sustainability committee to share information about ideas within the agency and provide information about why the government initiatives; Q3 seeing people get suddenly switched on and understand potentials and opportunities; Q5 –; Q6 attempt to use the lessons and to go back and do a review of a green building</li> <li>– <b>change of government</b>, champion moved on, change in focus, winding back of legislative changes</li> </ul>

**Table 27 – Number of interviewees who discussed issues considered related to dimensions of absorptive capacity**

<b>Dimensions of absorptive capacity</b>	<b>Observed Yes/No</b>
Exploitation of knowledge	13 of 13
Knowledge acquisition – internally generated	12 of 13
Knowledge acquisition from external sources	12 of 13
Transfer of knowledge	12 of 13
Assimilation of knowledge into organisation	11 of 13

### 6.2.4. Measures of absorptive capacity

**Table 28 – Summary of comments from interview considered relevant measures of absorptive capacity**

Measures of Absorptive Capacity	Examples
Effort put into development of new products	<ul style="list-style-type: none"> <li>– <b>projects initiatives</b> - pilot projects, trialling green building elements; energy benchmarking projects; low ecological footprint developments; develop design standards for inclusion in EOIs and RFPs; trying to quantify benefits</li> <li>– <b>new policy and initiatives</b> - Sustainable Non-Residential Buildings Policy; Sustainable Infrastructure Design Model; Climate Responsive Policy; developing tools for change</li> <li>– <b>some local R&amp;D</b> - for example blue Scope developed water tanks; developing greywater recycling systems; solar water heaters;</li> <li>– <b>industry based demonstration projects</b> - e.g. carbon and water neutral shopping centre</li> </ul>
Effort put into cost reduction	<ul style="list-style-type: none"> <li>– <b>GBCA</b> rationalisation of tools</li> <li>– <b>cost effectiveness</b>; quantify benefits; identify and analyse opportunities cost benefit analysis; lowering prices and costs for the consumer household or building owner; commercial value and delivering a sustainable building realised so cost becomes the main driver</li> <li>– <b>TBL</b> – economic arguments triple bottom line approach valuing externalities and using these business cases</li> <li>– <b>business cases</b> and feasibility studies to determine value for money. Decisions are made based on available budget and decide project outcomes</li> <li>– <b>schools initiatives</b> - opportunity for Dept of Education to reduce costs in running those facilities</li> </ul>
Capacity for technological development	<ul style="list-style-type: none"> <li>– <b>out-dated legislation</b> means lack of support from utility companies' lack of political support; technology doesn't bring about these changes... Never underestimate the role of regulation in achieving civilisation change</li> <li>– <b>R&amp;D initiatives</b> including localised energy production; low and ecological footprint developments and others</li> <li>– <b>supply chain</b> - consultants interested in technology and structures and how to bring the best new technology and push the envelope; R&amp;D has gone to products, it has created a whole market; some local R&amp;D e.g. blue Scope developed water tanks; developing greywater recycling systems; solar water heaters; demonstration project for carbon and water neutral shopping centre; emerging market there are lots of opportunities</li> </ul>
Awareness of customer needs	<ul style="list-style-type: none"> <li>– <b>lack of</b> - Department of Housing asking the green standards – always told they can't do it</li> <li>– <b>support from suppliers</b> - suppliers pursue other suppliers of a similar mind; e.g. Perth Arena project – government encouraged us to push the boundaries and design – initiated a workshop to set up objectives for the building with the aim of demonstrating world's best practice in sustainable design</li> <li>– <b>client support</b> - by setting that the target for our client (with great support) developed expertise; schools energy-saving is initiative</li> <li>– <b>asset ownership</b> - the fact that they actually own the asset is a reduction in life-cycle costs involvement in star performance, engagement production comfort and that sort of thing is something of a driver; Q6 business cases and feasibility studies to determine value for money; project manager or project control group will make the decision</li> </ul>
Staff skills Investment in training	<ul style="list-style-type: none"> <li>– <b>engaging staff with new skills</b> – Project Champion - Master of arts in Germany heritage and sustainability</li> <li>– <b>Sustainable September</b> – Dept. of Education</li> <li>– <b>consultants</b> - publish a technical paper each month to just inside the company to let people know what's going on in the studies that completed; accredited professionals GBCA</li> <li>– <b>training</b> - is on-going through the whole change process</li> </ul>
Capacity to adapt technologies from other sources	<ul style="list-style-type: none"> <li>– <b>rating tools</b> - GBCA, ABGR, and NABERS</li> <li>– <b>implementing technological changes</b> - to the extent financially possible e.g. photovoltaics and grey water recycling</li> <li>– <b>Greenrac audits</b> – Dept. of Education</li> <li>– <b>consultants</b> – e.g. design teams optimise facades and mechanical and electrical systems</li> </ul>



## Project 2.7 – Green building case study

Range of staff training	<ul style="list-style-type: none"> <li>– <b>culture</b> - permeates through all levels</li> <li>– <b>Green Star training</b></li> </ul>
Noteworthy economies of scale	<ul style="list-style-type: none"> <li>– <b>sustainability infrastructure solutions</b> - a lot of work on creating a Sustainable Infrastructure Decision Model (energy, water, waste-water) in towns in regional WA – worked closely with BHP Billiton</li> </ul>
High level of technological specialisation	<ul style="list-style-type: none"> <li>– <b>engaged Greensense</b> for schools program - based on software</li> </ul>

**Table 29 – Numbers of interviewees who discussed issues considered related to measures of absorptive capacity**

	Observed Yes/No
Effort put into development of new products	10 of 13
Effort put into cost reduction	9 of 13
Capacity for technological development	8 of 13
Awareness of customer needs	7 of 13
Staff skills - Investment in training	5 of 13
Capacity to adapt technologies from other sources	4 of 13
Range of staff training	2 of 13
High level of technological specialisation	1 of 13
Noteworthy economies of scale	1 of 13
Awareness of competitors' technologies	0 of 13

### 6.2.5. Features of open innovation

**Table 30 – Summary of comments from interview considered relevant to significant features of open innovation**

Significant features of 'open innovation'	Examples
New metrics for assessing innovation capability and performance	<ul style="list-style-type: none"> <li>– <b>rating tools</b> – Green Star (now 3* or 4*, new 5* office buildings in Perth); NABERS (minimum NABERS rating was driven by Dept. of Housing and Works for government office accommodation); BASIX</li> <li>– <b>clearer metrics</b> – Green Star, EnviroDevelopment standards; BCA standards; Australian Standards; thermal performance rating systems</li> <li>– <b>monitoring mechanisms</b> - to overcome a lack of accountability &amp; monitoring (when introducing new legislation; Schools program)</li> <li>– <b>rigorous reporting required</b> - too easy to not produce rigorous results they should probably be about 12 months of reporting on operation; positive</li> <li>– <b>evidence-based design</b> - starting to see a lot more consideration to this in health care and education e.g. daylight, thermal comfort and acoustic performance</li> <li>– <b>measurable decreases</b> in car use electricity and water use per capita; increase in public transport; more efficient buildings and appliances</li> <li>– <b>embedding design standards in EOIs and RFP</b>,</li> <li>– <b>cost benefit analyses</b></li> <li>– <b>making intangible resource consumption tangible</b> to encourage behavioural change</li> </ul>
Purposive outbound flows of knowledge & technology	<ul style="list-style-type: none"> <li>– <b>sustainability requirements in RFPs</b></li> <li>– <b>schools program</b> – energy monitoring</li> <li>– <b>strategic approach including relationship building</b> and stakeholder involvement; LandCorps approach to partnering</li> <li>– <b>industry education</b> – seminars and conferences to communicate importance of sustainability and encourage partnerships with government</li> <li>– <b>interaction with GBCA</b></li> <li>– <b>working with educated consultants/suppliers</b></li> <li>– <b>demonstration projects</b> including social housing, hospitals, sports facilities, etc.</li> <li>– <b>State Sustainability Strategy</b> - requirements on agencies to implement</li> </ul>

Project 2.7 – Green building case study

Significant features of 'open innovation'	Examples
	<ul style="list-style-type: none"> <li>– sustainability plans and report against KPI's in annual reports government</li> <li>– <b>accommodation policies</b> (2004) - energy and water efficiency introduced the leasing and procurement of government buildings; increased interest in the agencies associated with water and energy from Office of Energy and Department of Water to look at policies strategies and potential regulations to increase broader building efficiency</li> <li>– <b>difficulties with outdated legislation</b> - lack of support from utilities companies and political support barriers; introducing suddenly on building sites</li> <li>– state and federal government could do more</li> </ul>
Abundant underlying knowledge landscape	<ul style="list-style-type: none"> <li>– <b>State Sustainability Strategy</b> - formation of Sustainability Policy Unit ; 50 Ph.D.s, masters and undergraduates coming to work in the Premier's office; Q6 – agency feedback rewrites contributions</li> <li>– <b>skills development</b> – incl. engagement of research officers</li> <li>– <b>interactions with industry associations</b> - ASBEC; ABGC and others</li> <li>– <b>agency staff as sustainability champions</b> - initiatives driven from bottom-up sometimes difficult to get support from upper management</li> <li>– <b>range of internal and external R&amp;D</b> – both projects and relationships</li> <li>– <b>interaction with industry associations</b> - GBCA, CIBSE, Institute of Engineers</li> <li>– <b>highly trained industrial body</b> –with experience in implementing sustainable design initiatives (initial shift in (2000)); interested in technology and structures; applied research</li> <li>– <b>sustainability committees</b></li> <li>– <b>links to external research agencies</b></li> </ul>
Rise of innovation intermediaries	<ul style="list-style-type: none"> <li>– <b>links to researchers</b> – CRC CI, SBEnc, Curtin University, CUSP, RMIT, Murdoch University (Env. Tech. Centre), ISTP</li> <li>– <b>links to private sector</b> - WorleyParsons; Syrinx; PB;</li> <li>– <b>links to industry associations</b> - GBCA, NABERS, CIBSE, Institute of Engineers, ABCB</li> </ul>
Business model focus on converting R&D into commercial value	<ul style="list-style-type: none"> <li>– <b>relevance of rating tools to commercial value</b></li> <li>– <b>need to quantify benefits and \$ value</b> - economic as well as social benefits</li> <li>– <b>examples</b> including six star building ,new communities performance tool, new structural system</li> <li>– <b>applied research</b></li> <li>– <b>schools program</b> - opportunity to reduce running costs – using innovative technology from supplier (development project with Ausindustry)</li> <li>– <b>lowering prices and costs</b> for the consumer, household or building owner;</li> </ul>
Equal importance given to external knowledge, in comparison to internal knowledge	<ul style="list-style-type: none"> <li>– <b>use of rating tools</b></li> <li>– <b>range of research activities</b> both internally and externally</li> </ul>

**Table 31 - Numbers of interviewees who discussed issues considered related to significant features of open innovation**

	Observed Yes/No
New metrics for assessing innovation capability and performance	12 of 13
Purposive outbound flows of knowledge & technology	11 of 13
Abundant underlying knowledge landscape	10 of 13
Rise of innovation intermediaries	9 of 13
Business model focus on converting R&D into commercial value	8 of 13
Equal importance given to external knowledge, in comparison to internal knowledge	3 of 13
Proactive and nuanced role of IP management	0 of 13

### 6.2.6. Nature of open innovation

Table 32 – Summary of comments from interview considered relevant to the nature of open innovation

Nature of open innovation	Examples
Inbound innovation (internal use of external knowledge)	
<b>exploitation</b>	<ul style="list-style-type: none"> <li>– <b>procurement requirements for consultant engagement</b> – RFPs, GBCA and NABERS rating tools</li> <li>– <b>Culture shift</b> - do this in all of its business, identify and analyse opportunities (e.g. Main Roads)</li> <li>– <b>work with partners</b> - address significant infrastructure problems across the State</li> <li>– <b>application of applied R&amp;D</b></li> <li>– <b>State Sustainability Strategy</b> – establishment of Sustainable Policy Unit; Government Office Accommodation Policies; Dept. of Water and use of non-potable water</li> <li>– <b>National energy strategies</b></li> <li>– <b>Schools program</b> - 10 to 40% savings through energy challenges</li> <li>– <b>Negative impact of change of government</b> - loss of key personnel; reduced funding; lack of staff and mandate</li> </ul>
<b>Knowledge Acquisition</b>	<ul style="list-style-type: none"> <li>– <b>relationship with external organisations</b> – SBEnrc, APCC, CUSP, GBCA, COAG, National Strategy Energy Efficiency; AGIC, Energy Roundtable, CIBSE, Institute of Engineers</li> <li>– <b>use of ratings tools</b> – Green Star and NABERS</li> <li>– <b>Sustainability Policy Unit</b> - Department of premiers and Cabinet we carried out policy oriented R&amp;D producing over 40 background papers and case studies on alternatives and options</li> <li>– <b>R&amp;D</b> - various formal, informal and/or applied R&amp;D activities</li> <li>– <b>agency projects</b> – e.g. energy monitoring in schools; Dept. of Water and use of non-potable water</li> </ul>
<b>Retention</b>	<ul style="list-style-type: none"> <li>– <b>development of RFPs</b></li> <li>– <b>Building Research and Technical Services</b> section - energy benchmarking projects</li> <li>– <b>Dept. Main Roads</b> - changed culture; identify and analyse opportunities</li> <li>– <b>work with conservative industry partners</b> - take initiatives on</li> <li>– <b>application of applied R&amp;D on projects</b></li> <li>– <b>staff</b> - sustainability steering committee; research positions</li> <li>– <b>State Sustainability Strategy</b></li> <li>– <b>change in government</b> - forced back to old business model; loss of key personnel; reduced funding; lack of staff and mandate</li> </ul>
<b>Outbound innovation (external exploitation of internal knowledge)</b>	<ul style="list-style-type: none"> <li>– <b>procurement requirements</b> - GBCA rating tools; use of RFPs for consultant engagement; <b>NABERS</b> change transition well handled and communicated</li> <li>– <b>work with partners</b> - to address infrastructure problems</li> <li>– <b>work with industry</b> - to take initiatives on board; better understanding in the market of sustainable concepts; increased knowledge and understanding in the supply chain</li> <li>– <b>communicate best practice</b> - through industry guidelines and training</li> <li>– <b>Dept. of Health initiatives</b> - started lots of green building initiatives – WA hospitals are leading in the commercial sector;</li> <li>– <b>implementing changes in regulation</b></li> <li>– <b>demo projects</b></li> <li>– <b>Department of Water</b> and use of non-potable water;</li> <li>– <b>State Sustainability Strategy</b> leading to government office accommodation policies;</li> <li>– <b>implementing national energy strategies</b></li> </ul> <p><b>Negatives</b></p> <ul style="list-style-type: none"> <li>– <b>outdated legislation</b> - lack of support from utilities companies ;</li> <li>– <b>change in government</b> - lack of political support presented barriers; loss of key personnel; reduced funding; lack of staff and mandate;</li> <li>– <b>resistance to change construction industry</b> – conservative; average</li> </ul>

Project 2.7 – Green building case study

Nature of open innovation	Examples
	age in industry is getting older, – <b>silos</b> - sustainability has to be about getting past we do our bit and you do yours
<b>Coupled activities</b>	– <b>Federal government initiatives</b> – COAG; National Strategy Energy Efficiency; Energy Roundtable – <b>links with external partners</b> - WorleyParsons Syrinx; PB; GBCA – <b>links with other government agencies</b> across Australia – Interagency cooperation – Dept. of Water, Dept. of Health, Water Corporation, LandCorp; schools project ( Building Management And Works, Dept. of Education and Greensense) – <b>links with external research agencies</b>
<b>Pecuniary re acquiring, sourcing, selling, and revealing.</b>	– <b>use of RFPs</b> for consultant engagement – <b>engaged Greensense</b> for Schools project based on software
– Effectiveness	
<b>financial benefits</b>	– <b>office accommodation</b> - has a higher sustainability priority, ratings tools mean people understand it's commercially good value – <b>companies specialising in elements of green building</b> - to give themselves a market advantage and make themselves more competitive – <b>pursuit of return on investment</b> – <b>better understanding</b> - of the built environment and innovation, we can do it with 50% less carbon and 75% less water thus reduced energy and water costs; schools project saving opportunities identified; solar city school project achieving 10 to 40% savings
<b>Access to new markets</b>	– <b>creation of new markets</b> - Green Star, NABERS and 14,001 certification; carbon and water neutral design – <b>local suppliers</b> - pitch on how green their product is and why it is greener than competitor – <b>desire not to miss out on the green economy future</b> – <b>commercial buildings</b> will lift local governments to push for higher star ratings – focus on implementation – new processes should focus past design, construction, commissioning and occupation
<b>Decreasing risks</b>	– <b>attended risks with R&amp;D</b> and with green buildings in particular – <b>budget</b> – sustainability is usually the first to go – <b>we now understand the built environment and innovation</b> - we can do it with 50% less carbon and 75% less water – <b>sustainable infrastructure solutions</b> in towns and regional WA
<b>Stimulating growth</b>	– <b>ESD initiatives become mainstream</b> – <b>sustainable infrastructure solutions in towns and regional WA;</b> initiative about green building and sports facilities in country areas – <b>NABERS implementation</b> (2004/05) almost single-handedly transformed the industry in WA - clients who have been working on commercial office projects overnight adapt or change their briefs to achieve the minimum government accommodation requirements
<b>Enhancing technological effectiveness</b>	– <b>longer tuning period required</b> - initiatives may not work properly as intended – <b>resource consumption</b> - we can do it (building) with 50% less carbon and 75% less water – <b>information dissemination</b> – traditionally belonged to facilities managers
<b>Less waste</b>	– <b>maintenance minimisation</b> – <b>opportunities to minimise waste, maximise recycling</b> - separate waste as per Green Star – <b>decreased car electricity and water use</b>
<b>Lower costs</b>	– <b>GBCA cost of implementation is a big issue</b> – <b>Solar City School project</b> achieving 10 to 40% savings – <b>economic benefits</b> as well as social benefits – <b>reduced energy and water costs</b>
<b>nonfinancial benefits</b>	– <b>removes toxins from air</b>

Project 2.7 – Green building case study

Nature of open innovation	Examples
	– <b>KPI's in annual reports</b> - State sustainability strategy - agencies required to implement sustainability plans and report
Other measures....	– <b>not necessarily legislation needed, but certainly regulation</b> – <b>carbon and water neutral shopping centre demonstration project</b> - made no economic sense but in terms of sustainability there was nothing like it
number of innovations	– Star plus; Liveable Neighbourhoods; Climate Response Policy; Sustainable Infrastructure Design Model; Localised Energy Production; Low Ecological Footprint Development; greywater recycling and solar water heaters
Shorter time to market	– <b>much longer tuning period required</b> - than usually allowed - quite difficult to get buildings functioning properly.

Table 33 - Numbers of interviewees who discussed issues considered related to nature of open innovation

Nature of open innovation	Observed Yes/No
<b>Inbound innovation (internal use of external knowledge)</b>	
Knowledge Acquisition	11 of 13
Retention	10 of 13
Exploitation	11 of 13
<b>Outbound innovation (external exploitation of internal knowledge)</b>	
Coupled activities	7 of 13
Pecuniary re acquiring, sourcing, selling, and revealing.	2 of 13
Non-pecuniary	
<b>Effectiveness</b>	
Lower costs	3 of 13
Shorter time to market	1 of 13
Less waste	3 of 13
Number of innovations	2 of 13
Financial benefits	8 of 13
Nonfinancial benefits	2 of 13
Access to new markets	5 of 13
Enhancing technological effectiveness	3 of 13
Stimulating growth	4 of 13
Decreasing risks	4 of 13
Other measures....	2 of 13

6.2.7. Benefits of open innovation approach

Table 34 – Summary of comments from interviews considered relevant to benefits of open innovation approach

Category of factors	Examples
Working environment	<ul style="list-style-type: none"> <li>– <b>partnerships</b> - for many years looking at sustainability or energy to use building efficiently</li> <li>– <b>covert implementation</b> - no authoritative structure, more covert and embed it within branches</li> <li>– <b>State Sustainability Strategy</b> – agency feedback/rewrites/contributions– two-thirds of the returned materials outlined initiatives already occurring in agencies; main implementation device for me was not a final cabinet, yes... but an adoption by agencies themselves</li> <li>– <b>10% group who will demonstrate the value in a change</b> - big group in the middle will go either way</li> </ul>

Project 2.7 – Green building case study

Category of factors	Examples
	<ul style="list-style-type: none"> <li>– <b>regulation</b> - needs to be set in a way that isn't just for the leader</li> <li>– <b>empowerment</b> - directors empowered staff agency staff able to be proactive champions e.g. travel smart; driven at project level - support of management</li> <li>– <b>Department of Housing and Works</b> established a sustainability committee to coordinate and provide information to people in the agency – enabled agency to take control of this agenda - not imposed</li> <li>– <b>LandCorp</b> - Minister strong in driving the mandate –certain board members drivers in making sure it was first and foremost in operational and strategic thinking; trying to establish a much stronger leadership influence in WA</li> <li>– <b>new government</b> - don't appear to be actively engaged in demonstrating leadership</li> <li>– <b>applied research</b></li> <li>– <b>benefits</b> - during occupancy e.g. reduced absenteeism</li> </ul>
Level of interest of project team members	<ul style="list-style-type: none"> <li>– <b>bottom and middle level staff initiated initiatives</b> and made it happen; taken up at a high-level; project level interest - more difficult at strategic level</li> <li>– <b>Minister</b> (LandCorp) and certain board members strong in driving the mandate</li> <li>– <b>green building zone</b> has been really useful driver</li> <li>– <b>State Sustainability Strategy</b> - agency feedback/rewrites/contributions returned – two thirds of the returned materials you outlining sustainability initiatives already occurring in agencies</li> <li>– <b>directors empowered staff</b> - able to be proactive champions e.g. travel smart</li> <li>– <b>Department of Housing and Works</b> - sustainability committee – took control of this agenda</li> <li>– <b>energy challenges</b></li> </ul>
Capabilities of the people involved in the innovation	<ul style="list-style-type: none"> <li>– <b>bottom-up</b> from people with a role and knowledge who could see the benefit of sustainability initiatives</li> <li>– <b>supply chain become more educated</b>; more literature proofs, guidelines and specialists available</li> <li>– <b>skilled staff</b> – employed people with specific sustainability and research</li> <li>– <b>Main Roads</b> - sustainability person supported by champions in each business unit</li> <li>– <b>applied research</b></li> <li>– <b>making information widely</b> accessible to staff increases the changes you can make e.g. energy consumption data traditionally belonged to facilities management – necessary to bring about behavioural change</li> </ul>
Formation of task groups	<ul style="list-style-type: none"> <li>– now a sustainability section with more of a sustainability policy focus</li> <li>– involvement with the APCC</li> <li>– LandCorp sustainability team</li> <li>– support group for previous GBCA state manager</li> <li>– sustainability committees</li> <li>– government agencies set up their own sustainability committees and directorates so they could begin to own it</li> </ul>

Table 35 - Numbers of interviewees who discussed issues related to benefits of open innovation

Category of factors	Observed
Working environment	11 of 13
Level of interest of project team members	10 of 13
Capabilities of the people involved in the innovation	9 of 13
Formation of task groups	7 of 13

### 6.2.8. Drivers for construction innovation

**Table 36 – Summary of comments from interview considered relevant to construction innovation drivers (from National Strategy for Energy Efficiency)**

Driver	Examples
<b>Environmental pressures</b>	
Innovation stimulating regulations	<ul style="list-style-type: none"> <li>– <b>General awareness</b> this was the right thing to do;</li> <li>– <b>engagement</b> with APCC</li> <li>– <b>barriers</b> such as outdated legislation in the health; lack of support from utility companies for renewable energy and lack of political support</li> <li>– <b>State Sustainability Strategy</b> – main document that was driving with initiatives – led directly to the take-up of NABERS benchmark and commercial building rating schemes; strategy lead to Government Office Accommodation Policies;</li> <li>– <b>Stakeholder relationships</b> - worked very hard on these to change values sets</li> <li>– <b>integrate research into LandCorp's business practices and strategic direction</b> – established design guidelines that accommodate a lot of these initiatives</li> <li>– <b>Star plus</b> –never fully embedded into industry/regulation but forced industry to recognise need</li> <li>– getting a formal <b>GBCA rating</b> is a pain but it makes design teams deliver on the promise, get results (30 the Bond –spawned the GBCA rating tools)</li> <li>– <b>NABERS being mandated</b></li> <li>– <b>Department of Water</b> - a lot of effort to deliver non-drinking water policies;</li> <li>– <b>implementation depends on the mandate</b> you get from the government especially regarding policies and regulations - if voluntary agencies have a bit more leeway</li> </ul>
Governmental clients with innovative demands	<ul style="list-style-type: none"> <li>– <b>ASBEC membership</b> around 2007- 2008</li> <li>– <b>requested but at times is not provided</b></li> <li>– <b>Some agencies chose to take control</b> of this agenda, not have it imposed e.g. Liveable Neighbourhoods (WA Planning Commission); LandCorp sustainability initiatives; Perth Arena project – government encouraged us to push the boundaries; use of non-potable water Dept. of water; Building Management And Works; Dept. of education</li> <li>– <b>being seen to do the right thing</b></li> <li>– <b>inconsistency in tender documents</b> - emphasised some tender documents and not in others</li> <li>– <b>change in government</b> – can still work on same issues that change the language; reduced funding and lack of staff</li> </ul>
Market pull	<ul style="list-style-type: none"> <li>– <b>industry drivers</b> - proof of concept and case studies from the GBCA and similar overseas organisations; ASBEC</li> <li>– <b>public perception and awareness</b> - being seen to do the right thing</li> <li>– <b>improvement in what is considered best practice</b></li> <li>– <b>generational change</b> and political and social pressure</li> </ul>
Subsidies for innovative applications and materials	<ul style="list-style-type: none"> <li>– <b>Solar cities program</b> (Federal)</li> <li>– <b>AusIndustry</b> administer and R&amp;D tax program (Greensense – schools project)</li> <li>– always pursuing a <b>demonstration of the investment</b> and a change of legislation is a shame (photovoltaics)</li> </ul>
Government guarantee for markets for innovative firms	<ul style="list-style-type: none"> <li>– <b>Federal government initiatives</b> via COAG initiatives; National Strategy For Energy Efficiency; Energy Roundtable</li> <li>– <b>OSCAR obligations</b> - the online system for comprehensive activity reporting</li> <li>– <b>Perth Arena project</b> – government encouraged us to push the boundaries</li> </ul>
<b>Technological capabilities</b>	
Finance the pilot projects	<ul style="list-style-type: none"> <li>– <b>sponsor agency</b> - have the funding, we provide the Project Management services thus can influence project dependent on how the agency respond</li> <li>– <b>GFC</b> - became difficult for industry to invest in initiatives or to trial tools e.g. Hopetown and BHP</li> <li>– <b>demonstration project</b> for carbon and water neutral shopping design by GE</li> <li>– Department of education funded project; Q 12 solar cities</li> </ul>
Product evaluating institutions	<ul style="list-style-type: none"> <li>– <b>GBCA tools</b> - for the first time in the industry understood ratings benchmarks; getting a GBCA rating is a pain but makes design teams deliver on their promise, get results</li> <li>– <b>AGIC</b></li> </ul>
Programs	<ul style="list-style-type: none"> <li>– <b>GBCA and NABERS</b></li> </ul>

Project 2.7 – Green building case study

Driver	Examples
promoting access to technology	
Technology leadership strategy	<ul style="list-style-type: none"> <li>- <b>General Electric and demonstration carbon and water neutral shopping centre</b> – it made no economic sense but from the sustainability point of view (PoV), there was nothing like it</li> </ul>
Knowledge exchange	
Integrated and informal R & D function	<ul style="list-style-type: none"> <li>- <b>mix of formal and informal are applied</b></li> <li>- <b>informal applied research</b> – greywater systems, renewable energy, co-generation</li> <li>- <b>Sustainability Policy Unit research officer position</b></li> <li>- <b>solar cities drove research</b></li> <li>- <b>reliant on outside research</b> – e.g. GBCA, ABGR, NABERS, consultants; look at what others have done and used these results</li> <li>- <b>integration with formal research providers</b> e.g. CRC's and SBEnrc</li> </ul>
Creation of knowledge networks	<ul style="list-style-type: none"> <li>- <b>engagement with SBEnrc, AGIC</b></li> <li>- <b>Green star process</b> has become easier as the market becomes better educated and the tools improve.</li> <li>- <b>sustainability champions</b></li> <li>- <b>support group for previous GBCA state manager</b></li> <li>- <b>agencies set up their own sustainability committees and directorates;</b> use of hierarchy of responsibilities from high-level government support to agency staff</li> </ul>
Stimulation of research	<ul style="list-style-type: none"> <li>- <b>engagement with SBEnrc</b></li> <li>- <b>Building Research and Technical Services Branch</b> - energy benchmarking projects; have a couple of years make projects including GBCA initiatives</li> <li>- <b>LandCorp</b> - Minister at the time required sustainability to be incorporated - board created sustainability unit</li> <li>- <b>6* education building</b></li> <li>- <b>GBCA</b> new community tools</li> <li>- <b>Evidence based design</b> - particularly in health care and education</li> <li>- given sustainability business cases built upon improvement in occupancy indoor air quality is a big hole</li> <li>- <b>policy oriented R&amp;D</b></li> <li>- <b>NABERS</b> rating - government initiated requirement that all government tenants achieved NABERS rating – the initiative almost single-handedly transformed the industry in WA</li> <li>- <b>Dept. of Water</b> and non-potable water example</li> </ul>
Lateral communication structures	<ul style="list-style-type: none"> <li>- <b>externally</b> - APCC; SBEnrc; ratings tools; consultants; ABGR; ASBEC; SEDA; COAG; GBCA; AGIC</li> <li>- <b>lateral inter-agency links</b> between Department of Planning; BMW; and LandCorp</li> <li>- <b>State Sustainability Strategy</b> with input from 42 areas of government</li> </ul>
Training of workers on the site	<ul style="list-style-type: none"> <li>- <b>Involvement in pilot projects</b></li> <li>- <b>disseminating information</b> to bring about behavioural change</li> <li>- <b>implementing changes in regulation</b> – without training, people become suspicious of regulations</li> <li>- <b>sustainability groups and committees</b></li> <li>- need to embed in training on site</li> </ul>
Programs promoting collaboration	<ul style="list-style-type: none"> <li>- <b>GBCA</b> involvement</li> <li>- <b>OSCAR</b> - online system for comprehensive activity reporting on energy use in buildings</li> <li>- <b>ARC grants</b></li> <li>- <b>Departmental initiatives</b> – including non-potable water and department of water, Departments of Health and Water, Building Commission (plumbing regulation)</li> <li>- <b>Solar Cities Schools Project</b></li> </ul>
Effective information gathering	<ul style="list-style-type: none"> <li>- <b>looked at what others have done</b> and used these results;</li> <li>- <b>engagement</b> with SBEnrc, APCC, GBCA, ABGR, NABERS</li> <li>- <b>use of ratings tools</b></li> <li>- <b>Sustainable Policy Unit</b> - 50 Ph.D.s, Masters and undergraduates</li> <li>- <b>solar cities</b> drove research</li> <li>- <b>cultural alignment</b> - ensuring we have a team that was culturally aligned with us in terms of a willingness to investigate sustainability opportunities</li> <li>- <b>sustainability groups and committees</b></li> </ul>



Project 2.7 – Green building case study

Driver	Examples
Broad view of risk	<ul style="list-style-type: none"> <li>- <b>triple bottom line approach</b>, valuing externalities and using these in business cases for green building/sustainability initiatives</li> </ul>
<b>Boundary spanning</b>	
Empowerment and innovation leaders	<ul style="list-style-type: none"> <li>- <b>better budgeting and RFPs</b> to integrate initiatives</li> <li>- <b>companies with 14,001 certification</b> for delivering green star projects</li> <li>- <b>drivers</b> - initiatives were suggested by the people and taken up by people at a higher level; also from executive level to staff members; LandCorp board at the time drove the initiative created sustainability unit</li> <li>- <b>State Sustainability Strategy</b> – input from across 42 areas of government; including agency feedback, rewrites and contributions</li> <li>- <b>agency staff as proactive champions</b></li> </ul>
Explicit coordination of the innovation process	<ul style="list-style-type: none"> <li>- <b>Building Research And Technical Services Branch</b> (previously Built Environment section later Public Works section) - role to contribute to state government's sustainability/green building initiatives e.g. Hopetoun project with BHP Billiton</li> <li>- <b>GBCA</b></li> <li>- See responsibility diagrams</li> <li>- <b>Dept. of Water</b> - leadership of non-potable water</li> <li>- <b>State Sustainability Strategy</b> - requirements on agencies to implement sustainability plans and report against KPI's</li> <li>- <b>Building Management and Works</b> - engage with schools and suppliers</li> </ul>
Empowerment of innovation champions	<ul style="list-style-type: none"> <li>- <b>better budgeting and RFPs to integrate initiatives</b></li> <li>- <b>adoption of Green Star and NABERS</b> (2008)</li> <li>- initiatives were suggested by the people and taken up by people at a higher level</li> <li>- <b>State Sustainability Strategy</b> – input from across 42 areas of government; feedback, rewrites and contributions</li> <li>- <b>Staff</b> inc. agency staff as proactive champions sustainability officer and champions; sustainability steering committee; project leader</li> </ul>
Coordination of participating groups	<ul style="list-style-type: none"> <li>- <b>engagement with consultants via RFPs</b></li> <li>- <b>Minister for Planning</b> - drove sustainability at government level</li> <li>- <b>GBCA</b></li> <li>- <b>collaboration</b> became highly necessary on complex projects</li> <li>- <b>barrier</b> – lack of organisation, value isn't being accessed as well as possible</li> <li>- <b>State Sustainability Strategy</b> – across 42 areas of government</li> <li>- <b>sustainability committee</b> to coordinate efforts</li> </ul>
Strategic alliances in long-term relationships	<ul style="list-style-type: none"> <li>- <b>external engagement</b> incl. SBEnrc; APCC; ratings tools agencies; ABGR</li> <li>- <b>range of R&amp;D activities</b> e.g. CRC CI, Murdoch University, Curtin University, RMIT</li> <li>- <b>inter-agency</b> – e.g. Building Management and Works and Department of education</li> </ul>
Innovations from suppliers	<ul style="list-style-type: none"> <li>- rating tools; greywater systems; feeding power back into the grid; Greensense software</li> </ul>
Involvement of the client	<ul style="list-style-type: none"> <li>- <b>public perception</b> being seen to do the right thing</li> <li>- <b>Project Control Group</b> will make a decision based on available budget - at the end of the day the person paying the bills have the final say</li> <li>- <b>Perth Arena project</b> – we initiated a workshop involving the former Minister and other stakeholders to set up objectives for the building</li> <li>- <b>Department of Education</b> identified schools and funded project</li> <li>- <b>LandCorp</b> and private sector partnerships</li> </ul>
Integration of design and build	<ul style="list-style-type: none"> <li>- <b>Sustainable Infrastructure Decision Model</b></li> <li>- <b>Consultant design teams</b> – e.g. optimisation of facades, and mechanical and electrical systems</li> <li>- <b>opportunities to improve value engineering</b></li> <li>- <b>increased collaboration with contractors</b></li> <li>- <b>training of tradesmen and women required</b></li> </ul>
Mechanisms sharing financial risks and benefits	<ul style="list-style-type: none"> <li>- <b>attendant risks</b> of R&amp;D and green buildings</li> </ul>

**Table 37 - Numbers of interviewees who discussed issues related to drivers for construction innovation**

	Observed
<b>Environmental pressure</b>	
Market pull industry wide	6 of 13
Government guarantee for markets for innovative firms	3 of 13
Governmental clients with innovative demands	9 of 13
Innovation stimulating regulations	9 of 13
Subsidies for innovative applications and materials	3 of 13
<b>Technological capacity</b>	
Product evaluating institutions	4 of 13
Programs promoting access to technology	1 of 13
Finance the pilot projects	4 of 13
Technology fusion	0
Technology leadership strategy	1 of 13
Technology push	0
<b>Knowledge exchange</b>	
Stimulation of research	9 of 13
Creation of knowledge networks	9 of 13
Programs promoting collaboration	7 of 13
Broad view of risk	1 of 13
Integrated and informal R & D function	11 of 13
Effective information gathering	5 of 13
Training of workers on the site	8 of 13
Lateral communication structures	8 of 13
<b>Boundary spanning</b>	
Integration of design and build	4 of 13
Involvement of the client	4 of 13
Mechanisms sharing financial risks and benefits	1 of 13
Coordination of participating groups	7 of 13
Empowerment and innovation leaders	9 of 13
Empowerment of innovation champions	8 of 13
Innovations from suppliers	4 of 13
Explicit coordination of the innovation process	8 of 13
Strategic alliances in long-term relationships	6 of 13

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