Retrospective evaluation and prospective value-add: a review of R&D investment in Australia

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Summary

This paper describes a lead project currently underway through Australia's *Sustainable Built Environment* National Research Centre evaluating investment patterns, diffusion mechanisms and impacts of R&D investment in the Australian built environment. Through a retrospective analysis of R&D investment trends and industry outcomes, and a prospective assessment of industry futures using strategic foresighting, a future-focussed industry R&D roadmap and pursuant policy guidelines will be developed.

This research aims to build new understandings and knowledge relevant to R&D funding strategies, research team formation and management, dissemination of outcomes and industry uptake. Each of these issues are critical due to: the disaggregated nature of the built environment industry; intense competition; limited R&D investment; and new industry challenges (e.g. IT, increased environmental expectations).

This paper details the context within which this project is being undertaken and the research design, and presents findings of the retrospective analysis of past R&D investment in Australia.

Keywords: R&D investment; R&D policy; R&D diffusion; R&D impact; innovation systems; industry roadmapping, built environment

BACKGROUND

The intent of this research is to develop new models of investment and interaction that maximise the value of R&D investment in the built environment and like industries. These models will be based on improved understandings of the nature of future industry trends and research needs, and lessons learned in diffusing research outcomes into public and private industry practice.

This research will provide benefit to both public and private organisations in enhancing their uptake of R&D outcomes for business impact. This will be achieved through the active involvement of public sector infrastructure and building agencies, public sector social and economic infrastructure agencies along with private-sector industry leaders in innovation.

The context for this study is those industries involved in the creation of the Australian built environment as defined by the Australian Expert Group on Industry Studies [1]. This group identifies activity in this arena as a 'product system', as opposed to a cluster, complex or sector. The 2002 Australian Royal Commission into the Building and Construction Industry also adopted this broader definitional perspective, highlighting the degree of complexity and the inter-relatedness of those involved in the building and construction sector.

RESEARCH METHOD

To achieve its aims, this research project will investigate two research questions:

1) What are the success criteria and critical challenges which maximise the diffusion and impact of R&D investment to the Australian building and construction industries?
2) What policy directions and initiatives can be developed from both a retrospective analysis of past investment, and a structured prospective view of the industry?

Researchers will integrate existing construction and management theory, (i.e. open innovation, dynamic capability and absorptive capacity theories) in the context of a strategic foresighting process. Adopting this combination of theory will both facilitate and challenge current conceptual thinking in this field. Through bringing together these theories in the specific context of the built environment, this research will address the tensions which exist in the theory and in industry in order to enhance the uptake of R&D outcomes in this industry.

The retrospective component of the research includes two phases. The first is an audit and analysis of past R&D investment from 1990 to 2008. The second comprises three case studies investigating specific investments. Together these will contribute to an understanding of: (i) explicit and implicit problems being addressed by the research; (ii) criteria for success and critical challenges; (iii) the benefits accruing from this investment; and (iv) pathways for success in the R&D provider/industry relationship.

Researchers will access publically available data relating to R&D investment across Australia in order to (i) map existing research initiatives in this industry; (ii) audit available data on R&D investments; and (iii) undertake a strategic assessment of the above inputs in the context of sector contribution to Australian GDP; research gaps; and to compare investment with that of like sectors. Three case studies will further inform this retrospective analysis, supplementing the audit and analysis through: (i) demonstrating how a selection of R&D monies has been invested; (ii) with what outcomes and impacts; and (iii) identifying success criteria, challenges and lesson learned.

The prospective components of this research are: (i) strategic foresighting using industry roadmapping; and (ii) developing policy guidelines for use by private and public organisations to better leverage future investments.

Strategic foresighting is described as ‘a combination of forecasting with insight’ [2], requiring a deep understanding of the themes being considered. Technology roadmapping will be used along with a review of literature, semi-formal interviews and focus groups to engage effectively with industry experts to achieve valid and defensible outputs. Translating research outcomes (consolidated through each project phase) into policy guidelines to enhance the value of diffusion mechanisms and impacts of R&D outcomes is the ultimate outcome of this research.

IN CONCLUSION

This research is currently underway in Australia and findings of the analysis of retrospective investment will be presented at this conference. In addition the new CIB Task Group 85 – R&D Investment and Outcomes has now been formed with the intent of establishing an international focus on this theme in order to provide: (i) a global snapshot of investment in the built environment, relative to the important contribution that industries in this product system make to community and nation-building; and (ii) to obtain a perspective on probable, possible and preferred futures for building and construction industries globally.

[1] AUSTRALIAN EXPERT GROUP ON INDUSTRY STUDIES (AEGIS), 1999, *Mapping the Building and Construction Product System in Australia,* University of Western Sydney. Sydney.

[2] ROOS G., in press, Appendix B, p.2., compiled from ROOS, G., “Foresight Reflections to 2025”, Key Note Speech, *Forum TECNIO SPAIN*, 16-17 June, 2010, Barcelona, Spain; and ANDERBERG, B. and ROOS, G., “Vorschlag für ein Forschungssystem des ÖBH”, *Report for the Austrian General Staff*, May 2005.

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Summary

This paper describes a lead project currently underway through Australia's *Sustainable Built Environment* National Research Centre evaluating diffusion mechanisms and impacts of R&D investment in the Australian built environment. Through a retrospective analysis of R&D investment trends and industry outcomes, and a prospective assessment of industry futures using strategic foresighting, a future-focussed industry R&D roadmap and pursuant policy guidelines will be developed.

This research aims to build new understandings and knowledge relevant to R&D funding strategies, research team formation and management, dissemination of outcomes and industry uptake. Each of these issues are critical due to: the disaggregated nature of the built environment industry; intense competition; limited R&D investment; and new challenges (e.g. IT, environmental expectations, an imperative for improved safety performance, and the increasing demand for packaged services).

This paper details the context within which this project is being undertaken and the research design. The retrospective analysis includes an audit and analysis of R&D investment in this industry from 1990 to 2008. Researchers will access publically available data relating to R&D investment across Australia in order to (i) map existing research initiatives in this industry; (ii) audit available data on R&D investments; and (iii) undertake a strategic assessment of the above inputs in the context of sector contribution to Australian GDP; research gaps; and to compare investment with that of like sectors. Combined with three detailed case studies of past R&D investments, this retrospective analysis will inform a strategic foresighting process (achieved through industry roadmapping, interviews and focus groups) leading to the development of policy guidelines for the private and public sectors.

Keywords:R&D investment; R&D policy; R&D diffusion; innovation systems; industry roadmapping, built environment

1. Background

The intent of this research is to develop new models of interaction and investment that maximise the value of R&D investment in the built environment and like industries. These models will be based on improved understandings of the nature of future industry trends and research needs, and lessons learned in diffusing research outcomes into public and private industry practice.

This research will provide benefit to both public and private organisations in enhancing their uptake of R&D outcomes for business impact. This will be achieved through the active involvement of public sector infrastructure and building agencies, public sector social and economic infrastructure agencies along with private-sector industry leaders in innovation.

To achieve these aims and intent, four project phases have been designed (Figure 1). Further detail of the research design is provided in Hampson and Kraatz [1].

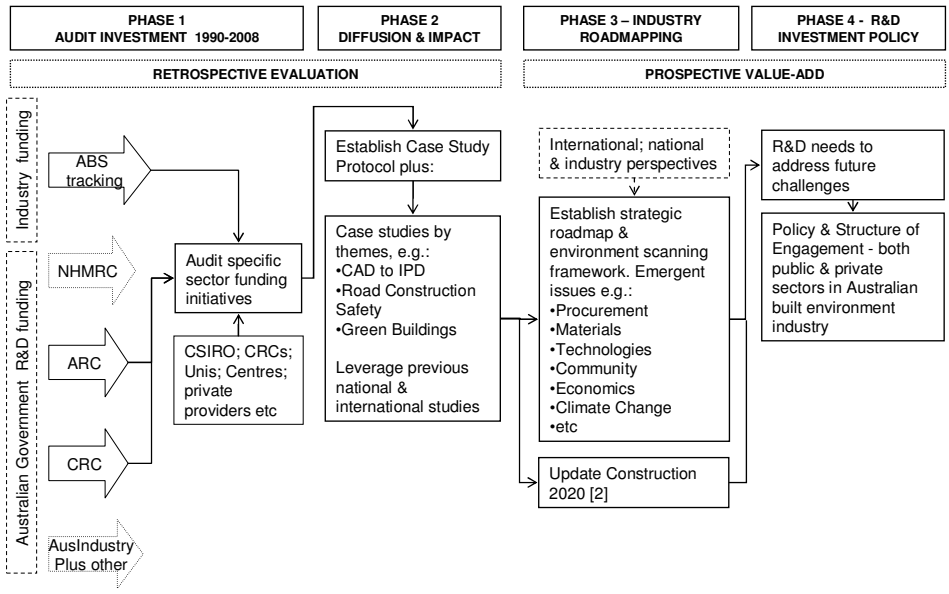


Fig. 1 Research project overview

1.1 Project context

The context for this study is explicitly those industries involved in the creation of the Australian built environment. A relevant definition of this provided by the Australian Expert Group on Industry Studies (AEGIS) [3]. This report appropriately identifies activity in this arena as a 'product system' (as opposed to a cluster, complex or sector), due to: (i) its reach into both services and manufacturing; and (ii) the manner in which innovation in this system impacts across products, processes and services (including elements of goods-producing industries; goods related service industries; knowledge-based services; in-person services and government and defence activities). Figure 2 provides a map of this product system as it informs this research.

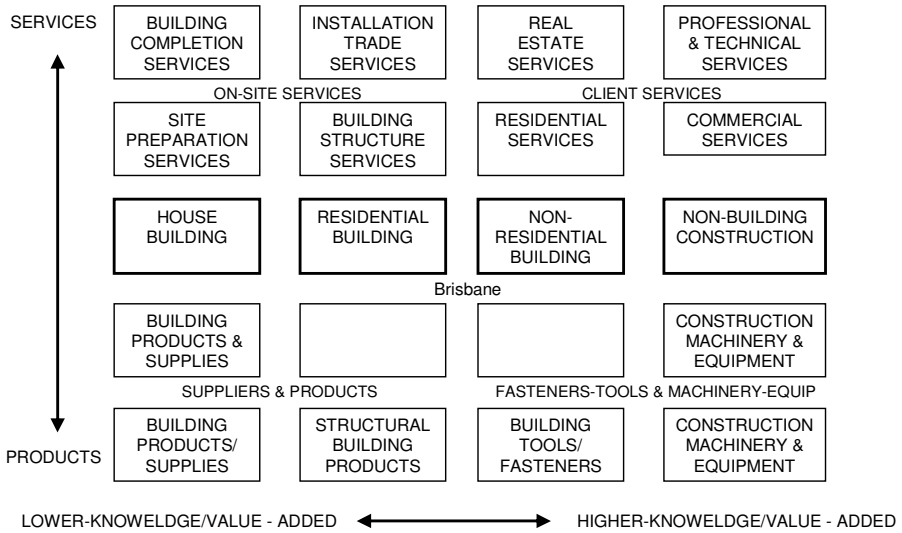


Fig. 2 Map of the creation-production-distribution chain [4]

The Australian Royal Commission into the Building and Construction Industry [5] adopts, and de Valence [6] reinforces the appropriateness and need for this broader definitional perspective. The former highlights the degree of complexity and the inter-relatedness of those involved in the building and construction sector. This report lists the major industry associations involved with over 80 employer and industry associations, organisations and unions named. The latter reviews 'the current data available on industry size and scope and compare differences between the structure-conduct-performance approach and the alternative industry cluster approach' [7] and presents industry related data (to 1997) demonstrating the need for this inclusive approach. Further, de Valence identifies a number of distinct industry sectors within this product system (Table 1).

Table 1 Australian building and construction industry sectors compiled (from de Valence 2010)

Engineering	Road and bridge construction Electrical generation and transmission Water and sewerage Processing plants Miscellaneous - rail, harbours, recreational & pipelines
Non-residential building - Private	Commercial offices Hotels Factories Shops Other – warehouses, terminals, service stations, car parks, telephone exchanges, etc
Non-residential buildings – Public	Educational Health Recreational

Further to this Hampson and Manley [8] detail the key players in the Australian built environment including research institutions; standards and regulatory bodies; training providers; industry associations; and the like. They provide statistics on industry output, contribution to GDP, employment, income, value of work and employment by sector. With specific regard to R&D, these authors provide a breakdown of R&D expenditure by construction sector segments at 1999 (Figure 3), along with innovation programs servicing the sector.

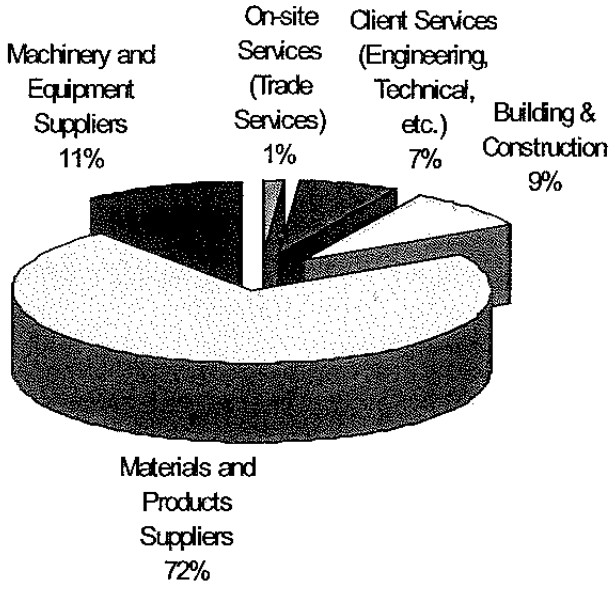


Fig. 3 R&D expenditure by construction sector segments [9]

1.2 Project need

Hampson and Manley [10] further report on the state of construction innovation in Australia in the context of Australian public research investment policy. They provide data on sector income and employment; the value of work done by industry segment; value of work done by industry segment (i.e. residential; non-residential; engineering); R&D expenditure by construction sector segments; and statistics drawn from OECD Main Industrial Indicators (til 1999) including R&D expenditure by contracting firms and R&D as a proportion of value-added. They also highlight that Australian Research Council (ARC) expenditure in building and construction in 1999 was only 0.2% of the total allocated research funds across the sector. They bring into focus the ongoing need for enhanced collaboration between both the private and public sector to achieve better outcomes for R&D investment.

This current research provides an updated analysis of the extent and nature of R&D investment since that study, and its contribution to the Australian economy. This analysis highlights a substantial improvement in this R&D investment in the construction industry since 2001. Barlow [11] recently completed an analysis of investment trends in this industry as a part of this current research project, and highlights some key changes. In the early 1990s, construction was a socio-economic objective for 1% of R&D. By 2008-09 this figure had increased to 6%, with a marked increase since 2001. This has resulted in R&D in this industry in Australia being comparable with that of the motor vehicle industry. Importantly however, whilst overall R&D investment in this industry has experienced growth, investment within Australian universities has declined from 2.3% in the early 1990's to 1.8% in 2008-09. In the 1990's, Australian public institutions were spending 2.9 times more than Australian businesses, whereas by 2008, business spend on construction R&D was 7.9 times that of public research institutions. Further to this Table 2 highlights the overall shift in investment from public-funded R&D to business-funded R&D over that period.

Table 2 National R&D trends in construction (from Barlow 2011)

	Business R&D		**Public R&D**	
	Current $	**As % of Aus. business total**	**Current $**	**As % of Aus. public total**
1992	$27 million	0.9%	$78 million	2.2%
2008	$1.07 billion	6.3%	$136 million	1.2%

Note: (i) Derived from ABS 8112. (ii) Shows R&D expenditures by sector focused on the socio-economic objective 'construction'. (iii) 'Public R&D' counts R&D from the university sector and from state and federal government agencies.

This dramatically changing landscape over the past two decades highlights the current need to establish a current understanding of R&D investment in this industry.

1.3 Research Method

To achieve its aims, this research project will investigate the following research questions:

1) What are the success criteria and critical challenges which maximise investment value and diffusion of R&D investment to the Australian building and construction industries?
2) What policy directions and initiatives can be developed from a retrospective analysis, coupled with a structured prospective view of the industry?

This project's researchers will integrate existing construction and management theory, specifically open innovation, dynamic capability and absorptive capacity theories, in the context of including strategic foresighting and industry roadmapping processes. This is reported in greater detail in Hampson and Kraatz [12]. Adopting this combination of theory will both facilitate and challenge current conceptual thinking in this field. Through bringing together these theories in the specific and critical context of the built environment, this research will address the tensions which exist in the theory and in industry to enhance the investment in and uptake of R&D outcomes in this industry. The four project phases designed to build new knowledge, and develop an industry R&D roadmap and policies are as follows.

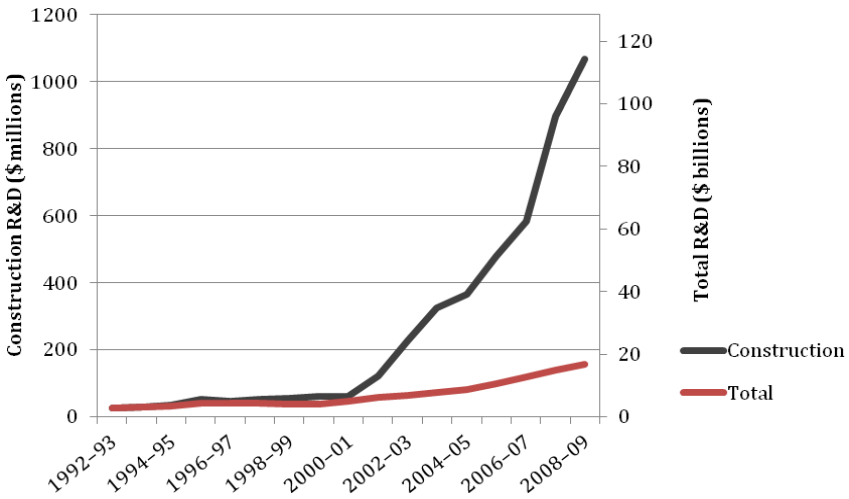
2. Retrospective evaluation

This component of the research encompasses two phases. The first is an audit and analysis of past R&D investment from 1992 to 2008. The second comprises three case studies investigating specific investments across three diverse themes. Together these will contribute to an understanding of: (i) explicit and implicit problems being addressed by the research; (ii) criteria for success and critical challenges; (iii) the benefits accruing from this investment; and (iv) pathways for success in the R&D provider/industry relationship.

2.1 Past R&D investment in the Australian built environment

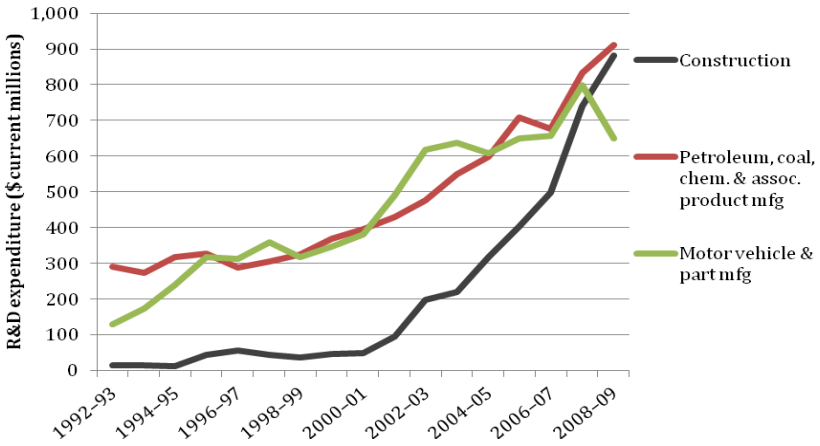
Foundational research for this project has been undertaken in collaboration with Dr. Thomas Barlow with the intent of identifying trends in R&D investment in: (i) the private sector, focussing on the construction, property and real estate services; and (ii) Australian universities and government agencies, focussing on engineering (including civil, environmental, and material), and design (architecture, engineering, urban and building design), and urban and regional planning. In addition, initial input will identify trends in the distribution of investment by source of public sector funds in each of the aforementioned fields has been identified, highlighting the changing balance of funds by source. In Australia these sources include the: (i) Cooperative Research Centres (CRC) Program, which provides 'funding to build critical mass in research ventures between end-users and researchers which tackle clearly-articulated, major challenges for end-users' [13]; (ii) the Australian Research Council (ARC), a statutory authority within the Australian Government Department of Innovation, Industry, Science and Research (DIISR) [14]; and internal university allocations.

Key findings highlighted as an outcome of this analysis include: (i) significant growth in private sector R&D investment within Australia (Figure 4), especially since 2001; (ii) an improvement in performance in comparison with other Australian industry sectors (Figure 5); and (iii) growth in Australian business R&D investment in the Australian construction industry in relation to other OECD nations (Figure 6).



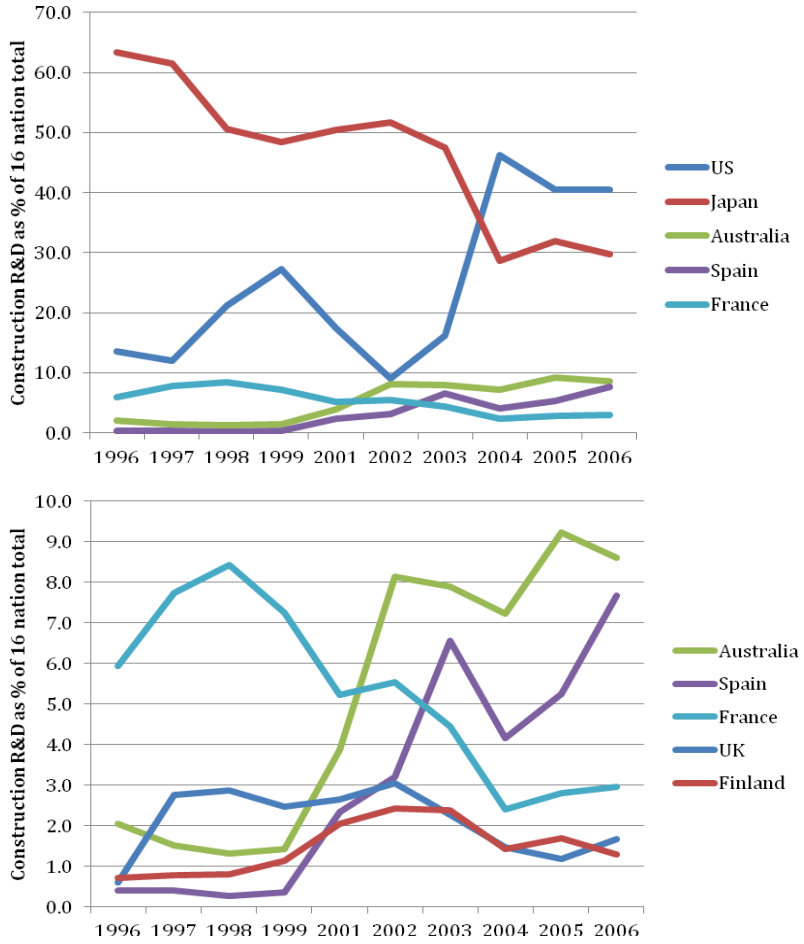
Note: (i) Derived from ABS 8109. (ii) Compares business R&D expenditures focused on the socio-economic objective 'construction' (left axis) with total business R&D expenditures (right axis). (iii) The right axis has been adjusted so that the growth-rates of both curves from 1992 are comparable.

Figure 4 Growth in private-sector R&D on construction relative to total business R&D (from Barlow 2011)



Note: (i) Derived from ABS 8104. (ii) There was a classification change in the definition of industry sectors after 2006-07.

Figure 5 Comparing the Australian construction sector with chemical and motor vehicle manufacturing (from Barlow 2011)



Note: (i) Derived from OECD STAN. (ii) R&D expenditures in the construction sectors are shown as a % of that of 16 OECD nations: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Sweden, Turkey, UK, and the US.

Figure 6 Australian business R&D investment in the construction sector as a share of 16 OECD nations (from Barlow 2011)

In addition, the intensity of R&D investment in the Australian industry has improved relative to its international competitors and it is now in line with other leading nations such as South Korea and Finland, again based upon an analysis of OECD STAN data.

This component of the research thus raises a series of questions for particular attention, in order to better focus future investment [15]. Firstly, it raises the question of 'what occurred in 2001 to cause this increase in investment?' Were there changes to the Australian Government's R&D tax concession arrangements which impacted on both investment and/or reporting? Did the establishment of the Cooperative Research Centre for Construction Innovation in 2001contribute to this upward trend, and if so what were the key contributing factors? Secondly, the shift to this investment occurred within the construction sector (as opposed to construction-related R&D being undertaken in other industry sectors). This may provide valuable policy and practical insights across other sectors of the economy. Thirdly, understanding the significant shift in R&D investment in the past decade from government organisations towards business warrants investigation.

These questions provide additional impetus for the three case studies.

2.2 Case studies

The intent of these case studies is to further inform the retrospective analysis of past R&D investment in the Australian built environment. This supplements the audit and analysis of historical investment through: (i) demonstrating how a selection of R&D fuding has been invested; and with what outcomes and impacts; and (ii) through identifying success criteria, critical challenges and lessons learned that can inform future policy and practice.

Yin [16] identifies at least five different applications for case studies including 'explain(ing) causal links in real life interventions that are too complex for the survey or experimental strategies' and to explain or describe complex phenomena. Further, Dul and Hak [17] discuss the role of practice-based case studies. They consider these appropriate when considering complex situations, as is the investigation of R&D investment and dissemination mechanisms and impact in the built environment.

Drawing on this background, the case studies will be narrow but deep investigations of investment in three specific investment themes which have progressed from need identification to implementation. These themes are: (i) road construction safety; (ii) green buildings; and (iii) from computer aided design and documentation (CADD) to integrated project delivery (IPD). Given the project partnership with lead government client agencies in Queensland and Western Australia, and John Holland Pty Ltd, a leading national construction contractor, the research team has secured valuable access to knowledge and information which facilitates this approach. For example, significant Commonwealth, State and industry funding was invested between 2001 and 2010 (via the CRC for Construction Innovation) in building information modelling (BIM - to inform broader application of CADD), green building initiatives and construction safety research across Australia and in Queensland and Western Australia in particular.

Through these case studies, this research will identify, document, and analyse the context of these investments including: (i) conditions which existed leading up to this investment; (ii) the environment in which the investment was made; (iii) mechanisms and processes through which R&D was delivered and translated into practical outcomes; (iv) success, challenges and lessons learned from the instances of these investments. Specific questions posed in these case studies will draw on the theoretical foundations of dynamic capabilities, absorptive capacity and innovation theory to provide a defensible conceptual basis to inform the subsequent prospective component of this research.

3. Prospective value-add

The two phases of activity in this second prospective component of this research are: (i) strategic foresighting using industry roadmapping, semi-formal interviews and focus groups with industry experts and stakeholders; and (ii) developing policies for use by public and private organisations to

better leverage future investments. The fundamental premise is that every effort must be made to maximise the value of each dollar of R&D funding to the built environment industry. This efficiency perspective is underpinned by anecdotal evidence (to be informed through this research) that built environment industry research is relatively underfunded and does not receive public research funds equivalent to the importance of these industries to the Australian economy. In addition, the Australian Built Environment Industry Innovation Council (BEIIC) recently released a series of recommendations including: (i) the need for increased Australian government support for cooperative built environment research; and (ii) the development of a research roadmap to ensure academic research is undertaken in areas of 'most value to industry' [18].

3.1 Strategic foresighting using industry roadmapping

Roos [19] describes foresighting as 'a combination of forecasting with insight', requiring a deep understanding of the themes being considered. Roos highlights two phases to this approach (as described by Garcia and Bray 1997). The first is the identification of scope and boundaries, and the second the definition of the roadmapping focus, including areas to be studied, technological drivers and alternatives. This aligns with what Voros outlines as the four key activities associated with this process and the form of questioning involved (Figure 4).

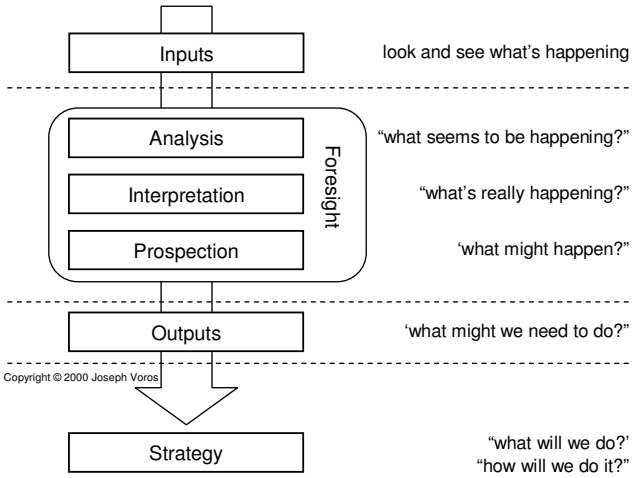


Fig. 4 The foresight framework [20]

Technology roadmapping is one of a number of foresighting methodologies in use globally, and provides a strong practical approach to this endeavour. For this research, this method will be integrated with a review of literature, semi-formal interviews and focus groups to engage effectively with industry experts to achieve valid outputs. Voros [21] describes a morphological analysis technique that will be adapted by the research team to determine possible, probable and preferred futures. 'This approach … is designed to enhance 'the prospects of successful adoption and implementation when policy is made' [22]. Given the collaborative nature of this research and the value of its application to the industry's future, the relevance and practical application of this project's findings is critical.

3.2 Policy development

The final phase of this research is to translate research outcomes into policy in order to enhance the value of investment, diffusion mechanisms and impacts of R&D outcomes. This phase is being informed by 'six functions of foresight for policy-making' provided by Da Costa et al. [23]:

1. *Informing policy: generating insights regarding the dynamics of change, future challenges and options, along with new ideas, and transmitting them to policymakers as an input to policy conceptualisation and design.*

2. *Facilitating policy implementation: enhancing the capacity for change within a given policy field by building a common awareness of the current situation and future challenges as well as new networks and visions among stakeholders.*
3. *Embedding participation in policy-making: facilitating the participation of civil society in the policy-making process, thereby improving its transparency and legitimacy.*
4. *Supporting policy definition: jointly translating outcomes from the collective process into specific options for policy definition and implementation.*
5. *Reconfiguring the policy system: in a way that makes it more apt to address long-term challenges.*
6. *Symbolic function: indicating to the public that policy is based on rational information.*

Each of these functions will be addressed to a varying extent with a primary focus on informing policy guidelines and facilitating their implementation. In addition, the design of this research inherently: (i) embeds industry participation (via the process); (ii) supports the definition of policy (via its outcomes); (iii) provides an example of an innovative method for gaining better insight of past performance and targeting future investment (potentially leading to a reconfigured system for addressing future challenges); and (iv) provides a defensible process on which to base future public and private policy.

4. Conclusion

This paper provides a detailed account of current Australian research designed to deliver a retrospective analysis of R&D investment in Australia from 1992 to 2008, together with a prospective view for investment and engagement for the coming decades. A key outcome is to better inform future investment in this industry.

To provide an international focus on this critical area of research, the new International Council for Building (CIB) *Task Group 85 – R&D Investment and Impact* has been formed in order to provide: (i) a global snapshot of investment in the built environment, relative to the important contribution that industries in this product system make to community and nation-building; and (ii) to obtain a perspective on probable, possible and preferred futures for building and construction industries globally.

In combination this activity will provide valuable guidance to both government and industry policy makers to enhance the investment, diffusion and impact of R&D investment in the construction industry.

5. Acknowledgements

The authors acknowledge the funding and support provided by Australia's *Sustainable Built Environment* National Research Centre (SBEnrc) and its partners. Core Members include Queensland Government, Government of Western Australia, NSW Roads and Traffic Authority, John Holland, Parsons Brinckerhoff, Queensland University of Technology, Swinburne University of Technology, and Curtin University.

6. References

[1] HAMPSON, K.D. and KRAATZ, J.A., "Leveraging R&D Investment for the Australian Built Environment", *6th Nordic Conference on Construction Economics and Organisation*, 13-15 April, 2011, Copenhagen.
[2] HAMPSON, K. D. and BRANDON, P., (eds) 2004, *Construction 2020: A vision for Australia's property and construction industry*, CRC for Construction Innovation, Brisbane.
[3] AUSTRALIAN EXPERT GROUP ON INDUSTRY STUDIES (AEGIS), 1999, *Mapping the Building and Construction Product System in Australia,* University of Western Sydney, Sydney.
[4] AEGIS, op. cit., p.33.
[5] ROYAL COMMISSION INTO THE BUILDING AND CONSTRUCTION INDUSTRY, 2002,

Overview of the Nature and Operation of the Building and Construction Industry, Commonwealth of Australia, Canberra.
[6] DE VALENCE, G., 2010, "Defining an Industry: What is the Size and Scope of the Australian Building and Construction Industry?" *Australasian Journal of Construction Economics and Building,* Vol. 10, No. 1/2, pp.53-65.
[7] DE VALENCE, op. cit., p.53.
[8] HAMPSON, K. D. and MANLEY, K.J., 2001, "Construction Innovation and Public Policy in Australia", *Innovation in Construction: An International Review of Public Policies, in* Manseau A. and Seaden, G., Spon, London, p.34.
[9] HAMPSON and MANLEY, op. cit., p.45.
[10] HAMPSON and MANLEY, op. cit.
[11] HAMPSON and KRAATZ, op. cit., p.6
[12] BARLOW, T., 2011, *The built environment sector in Australia – R&D investment study*.
[13] COMMONWEALTH OF AUSTRALIA, https://www.crc.gov.au/Information/default.aspx.
[14] COMMONWEALTH OF AUSTRALIA, http://www.arc.gov.au/.
[15] BARLOW, op cit., pp.36-37.
[16] YIN, R. K., 2003, *Applications of Case Study Research*, Thousand Oaks, Sage Publications, p.15.
[17] DUL, J. and HAK, T., Eds., 2008, *Case Study Methodology in Business Research*, Amsterdam, Boston, London, Butterworth-Heinemann/Elsevier.
[18] BUILT ENVIRONMENT INDUSTRY INNOVATION COUNCIL (BEIIC), Recommendations Report, October 2010, p.4.
[19] ROOS G., 2011 Appendix B, p.2, compiled from ROOS, G., "Foresight Reflections to 2025", Key Note Speech, *Forum TECNIO SPAIN*, 16-17 June, 2010, Barcelona, Spain; and ANDERBERG, B. and ROOS, G., "Vorschlag für ein Forschungssystem des ÖBH", *Report for the Austrian General Staff*, May 2005.
[20] VOROS, J., 2003, "The Basic Process (GFP): A Generic Foresight Process Framework", *Foresight*, Vol. 5, No. 3, p.14.
[21] VOROS, J., 2009, "Morphological Prospection: Profiling the Shapes of Things to Come", *Foresight,* Vol. 11, No. 6, pp.4-20.
[22] ROOS, op. cit., p.9.
[23] COSTA, O. D., WARNKE, P., CAGNIN C., and SCAPOLO F., 2008, "The impact of foresight on policy-making: insights from the FORLEARN mutual learning process", *Technology Analysis & Strategic Management, Vol.* 20, No. 3, p.369.