

Measuring Up

Innovation and the Value Add of Architecture

A research report prepared by the University of Technology Sydney School of Business and School of Architecture for the NSW Architects Registration Board

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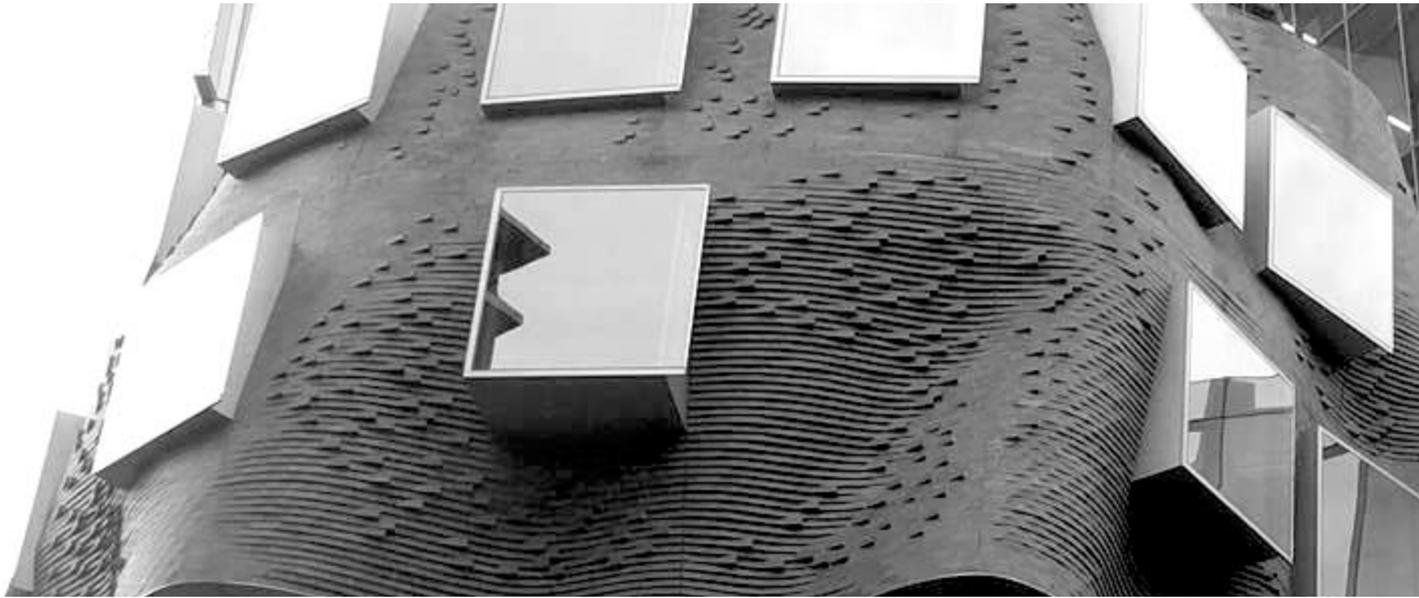
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Executive Summary



The international construction industry is forecast to grow by more than 70% reaching \$15 trillion by 2025. 49% of that activity will happen in the Asian region, positioning Australian 'urban services' broadly understood in an internationally competitively position. However architectural services as they are typically defined are predicted to decline over the same period, falling behind GDP growth.

This report examines the areas where architects add value to the economy beyond typical construction sector analysis and seeks to define where value lies in the work of architects beyond the bricks and mortar value of the construction industry. The report examines two questions;

1. What are the limitations of the architecture profession's relationship, broadly, to current systems of economic measurement in practice and where might other value be found?

2. How does an understanding of new areas of value within architecture reframe the potential for innovation within the industry?

The four key areas of added value examined within this report include; technology development, business development, cultural sector contribution as well as education and research. Case studies are presented for each area demonstrating architects are already contributing to the economy through an expanded definition of practice and architectural services. These four areas outline key areas of opportunity for the architectural services sector to innovate their approach towards business and the services and products architects provide, ultimately growing the potential of the Australian architectural services sector to be a leader in the expanded urban services marketplace in Australia and abroad.



“The international construction industry is forecast to grow by more than 70% reaching \$15 trillion by 2025. 49% of that activity will happen in the Asian region...”

The report finds architectural services are underreported by 15%, and that more than AUD\$1billion (15.43% of industry revenue) is not accounted for in the sector when the areas of technology development, business development, cultural contribution and education are considered.

In terms of innovation, the large majority of the sector is risk adverse, has not changed its approach to business structures or embraced an expanded set of opportunities for its native spatial and creative problem solving skills. The industry has also tended to limit innovation to the design of building projects, ignoring processes, intermediate products and services that are created within a project and have opportunities across multiple projects and a broader definition of industry.

The Architectural Services Sector however is well placed to capitalise on innovation through its native design and problem

solving strengths, its technology skills, and international reach. The authors believe the capacity to creatively problem solve in spatial terms is a core architectural skill that has much potential in other disciplinary contexts.

The report outlines five areas in which architects can look to innovate in their businesses to create new revenue streams. These are identified within innovation literature and include; New to Market products and systems, Intermediary Goods and Services produced within typical project scenarios, new forms of Internationalisation particularly with regard to knowledge and skills transfer, the development of Networks of skills and nurturing niche companies within more traditional business frameworks, and embracing Research and Development as core business.

Introduction



Much work has been undertaken to assess the value of good design in architecture, particularly in the 2000's by the Royal Institute of British Architects (RIBA) and The Commission for Architecture and the Built Environment (CABE), both in the United Kingdom.¹ In most cases, these assessments made important leaps in shedding light on valuing good design, but were limited in quantifying the economic contribution beyond the building cost alone. Where they did venture further in determining broader benefits, these values were measured in terms of urban impact, safety and crime rate reduction, health impacts, maintenance and life-cycle costs.

Yet architecture is a vibrant, projective, forward-oriented discipline, and it is clear that the innovative potential of the industry to create value does not reside in the built outcomes alone but is also generated via business, product, education and services levels of the profession. While past studies have generated important findings with respect to their areas of concern, this report attempts to broaden the scope of discussion beyond the value of the building in construction terms, and begins to assess the benefits of architecture to the wider economy, taking into account the work of architects and architecture in the context of the wider value-chain.

This report - Measuring up; Innovation and the Value add of Architecture - was created for the Architects Registration Board over the 2014-2015 period. The research aims to outline a new strategic understanding of the potential of the architecture profession in Australia, and its capacity to add value to

the Australian economy beyond construction or property industry valuations. As such this study takes a 'whole of industry' perspective, rather than a 'building' perspective, in order to begin to assess the potential forms and scale of added value to the economy not yet reported in current economic data for the architecture industry. Specifically, this report addresses two key questions:

- 1) What are the limitations of the architecture profession's relationship, broadly, to current systems of economic measurement in practice and how might a broader understanding of the economic value of the profession be gained?; and
- 2) How does an awareness of areas of value creation within architecture beyond the built object outcomes reframe the understanding of the industry as an important innovation sector in the economy?

Drawing on available research, case study analysis and industry expertise, this report highlights four key areas of innovation in architecture. While they do not capture all economic outputs from the industry, they have been specifically identified for their potential to add value to the wider economy over and above contributions from conventional construction.

¹ *Comment and list of reports, studies, etc.*

These areas include:

1. **new technology** produced and promoted through innovative architectural design and practice;

2. **new businesses, business models** and **business practices** spurred by innovative thinking in design practice;

3. **cultural products** (both hard and soft) that derive from architectural practices, as well as the follow-on economic benefits gained from events, exhibitions and tourism;

4. **architectural education** as a market sub-sector and the additional benefits (economic and otherwise) of **academic research**. In the broad field that constitutes architectural services, these four domains present previously under-scrutinized areas of architecture's economic contribution. That is, they typically remain unaccounted for in estimations of economic contribution by architects to the broader economy.

By using these four domains to frame a considerable level of economic activity beyond the currently understood contribution to the property industry, the study begins to identify and develop a framework for estimating the current and future potential value of architecture's contributions to Australia's economy. The report aims to expand the frame of reference and identify scope for further research in the innovative potential of architectural services. This reframing in turn, offers a guide for developing more precise values for research and development in the architectural industry while promoting better economic predictions, outcomes and understanding of the economic impact of architecture through the lens of innovation.

Methodology



This report was commissioned in late 2014 by the NSW Architects Registration Board as a joint study by the UTS School of Architecture and the UTS Business School. Source material covered a wide range of formats and topics, including industry reports, innovation literature, past international reports on the economics of good design, as well as specific practice based claims of innovation made through public architectural forums. Case studies were drawn from international and Australian contexts as a means of drawing out clear examples of innovation in current practice that are successful but not yet broadly employed. Equally case studies provided specific information in response to the lack of industry-wide studies in the area of innovation and architecture.

In arriving at value estimates listed throughout the report figures have been developed through a number of sources to arrive at a total estimate of architecture's value add in terms of the four areas of interest. These figures are used with the intent of indicating the scale of the value add of architecture to the economy in broad terms, its potential for future growth and serve as conservative estimates only. More detailed individual and aggregative data would require future studies.

At a high level, values have been calculated using gross numbers provided by the Australian Bureau of Statistics (ABS), industry reports, and information on the industry published publicly by peak bodies such as the Australian Institute of Architects (AIA). Coming from trusted sources and for the purposes of this report, these figures have been taken at face value in assuming the potential of financial value-add of architecture to the economy.

Notes on limitations of methodology

The authors recognise the limitations of this methodology for assessing value based on case studies and secondary sources. These include a reliance on published data and the limits of disaggregation of architecture and the specific sub-sector areas of interest from broadly used economic categories such as construction industry data and education data. Using case studies allows for specific examples in practice to be explored, but is limited by privacy around the financial aspects of each project. With case study analysis care should also be taken when interpreting across cultural contexts.

Ultimately it was not possible to assess values for sections 2.1 and 2.2. as financial data remained private within the case study practices. In section 2.3, in assessing the value of the Chau Chak Wing building, the Benefits Transfer Method (BTM) has been used to arrive at an annual value for the contribution of the building to the local economy. Additional values for cultural events such as biennales have been assumed based on previous events and budgets within the experience of the authors. In section 2.4.1 Education figures were derived from AIA published student numbers and university published fees. Multipliers for international student visits were gained from research by the Go8 on benefits of international students. In section 2.4.2 research ARC published figures for the 2012 ERA collection were used as the latest available values for the 1201 Field of research code. Student fees and ARC reported research incomes are used as a basis to assess the scale of economic activity in these sub-category areas.

More detailed analysis is necessary to adjust and extend these costs beyond the top level information presented here. In particular care should be taken with these figures to recognize the cross over with other sub-category areas such as higher education costs and university funding models and their impact when assessing industry contributions.

Finally developing a total contribution necessarily takes values that are not detailed or complete, but which aim to outline the potential scale of architecture's capacity. While all care has been taken to ensure any figures are verified, it should be noted that no primary research has been undertaken for this report.



Part One

Architecture's economic contribution

1.1 The current context

Australia's Architecture Sector

The Architecture industry is typically defined as part of the construction sector, forming a sub-sector understood as **architectural services**. The focus of this sub-group area is the provision of architectural services leading to the design and construction of buildings, typically calculating fees based on a negotiated percentage of building costs.

The main activities for considering architectural services as they are traditionally understood include:

- architectural consultancy services (excluding construction management);
- drafting services;
- Landscape Architectural Services;
- Town planning /urban design services.

The main products and services being produced include:

- pre-design services;
- architectural drafting services;
- contract administration;
- contract documentation;
- schematic design services;
- other architectural and related services.²

In aligned areas, the architectural activities that typically contribute to the building industry also include; spatial analysis and reporting relating to urban design and strategic urban development planning, the design of new and retrofitted individual buildings and urban spaces, the detailed development of designs for construction and engagement with allied industries such as engineering, surveying, landscape

² Chia, S., *M6921 Architectural Services in Australia*, IBISWorld Industry Report, February 2015, p.2

architecture, project financing and project management, as well as construction supervision and post occupancy evaluation. Architects are central to the development of a quality built environment, and in NSW are required by law for example (SEPP 65) to design, or direct the design of projects over three stories. Similar industries include construction, engineering consulting and environmental services.

Architectural services in Australia in 2014-15 had a revenue of AUD 6.4 billion, and generated AUD 602.7 million of profit. Of the 13,555 architectural businesses, 98 per cent are small enterprises with less than 10 employees. The industry is considered in a mature stage of its lifecycle with company consolidation and economic importance relatively stable. However it is heavily dependent on construction industry investment trends. According to IBIS World, the architectural services industry revenue is “forecast to grow by an annualised 2.2 per cent over the five years through 2019-20, to reach AUD 7.1 billion. Industry expansion will be supported by a recovery in demand from total building construction, which is forecast to grow at an annualised 2.0 per cent over the same period.”³

Architectural services are dependent on the construction sector and as a whole this sector globally is forecast to grow from USD 8.5 trillion to USD 15 trillion in 2025, with steady growth in the advanced economies, and accelerated growth of 5.3 per cent in emerging economies. The share of the global construction industry in the Asia-Pacific is predicted to continue to rise to close to 49 per cent of global activity by 2020.⁴

While traditional architectural firms will benefit from increasing activity in the sector, the industry as a whole is exposed to price based competition, the growth of

multi-disciplinary service providers and outsourcing of services such as drafting. Other pressures include managing fast changing technologies central to the sector as well as competition from international practices in a highly globalized profession⁵ and in turn, the pressure to operate globally to access the construction sector growth much of which will occur outside Australia.

As architectural services is “a knowledge-based industry, which adds value through the use of professional skills and creativity to provide clients with satisfactory design and planning solutions”⁷ any innovation to the industry will have a high labour focus and necessarily include substantial human resource considerations as part of the opportunity and impact of innovation.

Highlighting the need for industry reform and innovation, the overall performance of the architectural services sector as it is currently understood is underperforming. According to IBIS World Industry reports “Over the 10 years through 2019-20, (architectural services) industry value added (a measure of an industry’s contribution to the economy) is forecast to rise by an annualised 0.4 per cent, compared with forecast GDP growth of 2.7 per cent annualised over the same period. This means that the industry is underperforming the economy and reflects the subdued growth in the value of total building construction.”⁸

Despite the maturity of the Architectural services sector, and the predicted growth in construction industry particularly in Asia in the coming decade, new pressures on the sector as outlined above demand attention. Within the industry itself, it is widely held that the architectural industry must innovate to meet the challenges of fast moving change seen in new markets and technologies, by broadening existing conceptions of practice.⁹

³ Chia, S., *M6921 Architectural Services in Australia*, IBISWorld Industry Report, February 2015, p.7

⁴ *Global construction outlook 2020*, <http://marketreportstore.com/global-construction-industry-outlook-2020/>

“To be globally competitive, Australia needs to formulate a comprehensive approach to fostering creativity.”⁶

Australian Firms in the Global Context

Australian firms have a positive history of work in international contexts. In particular Australian Architectural firms are well positioned geographically, technically and culturally to participate in the focus on the global construction section in Asia. This participation in international and particularly Asian contexts is growing, as evidenced by the Australian Prime Ministers recent statement,

“China’s rapid urbanisation has led to 80 Australian architectural studios opening up in china, with a further 220 Australian firms winning work. A good example is Cox Rayner Architects which recently won a competition to design china’s 290m national maritime museum - beating a field of 80 of the worlds leading design firms in Tianjin”

(15 Sept 2015 – Hansard)

⁵ For a summary of the sector, see

⁶ Prime Minister’s Science, Engineering and Innovation Council (PMSEIC), “The Role of Creativity in the Innovation Economy”, Australian Government, *Imagine Australia*, 2005, p5

⁷ Chia, S., *M6921 Architectural Services in Australia*, IBISWorld Industry Report, February 2015, p.23

⁸ Chia, S., *M6921 Architectural Services in Australia*, IBISWorld Industry Report, February 2015, p.10

⁹ *Change. Architecture. Discuss.*, ARB discussion paper 2016, p.38

1.2 An expanded understanding of architecture's economic contribution

This report contends that architecture as a practice is too narrowly defined within the architectural services profile offered by IBIS world and other similar reports, with the implication that the measure of architecture's contribution to the economy is structurally under-reported. Linking the performance of architecture to the construction industry alone is not the experience of the industry on the ground and ignores the substantial contribution of architecture to the economy through a variety of broader services and contributions that are central to the practice of architecture and add value in various ways.

These structural dilemmas referred to above are perhaps inevitable given the uniqueness of architecture as a discipline, located as a fusion of the arts and the sciences. As such, architecture sits within and contributes to a broad ecology of products and services linked not only to the built environment, but a broader context of design, creativity, technology and information which is not strictly captured under a single industry designation. The breadth of these activities is substantial, including connections to information graphics, media, industrial design, manufacturing, hard and soft technology development, human environmental health factors, environmental, cultural and economic sustainability, information architecture, publishing and other forms of cultural production, as well as contributions to the fields of planning, landscape architecture etc.

This broader definition of architectural services demands a transformation in our

understanding of architectural practice; the drivers of innovation in architecture are not likely to come from incremental adjustments to traditional architectural business but from new models and forms of creativity within the broader discipline.

Creativity is understood as a cornerstone of innovation and future business success, linking arts and the business sectors. As noted by the Australian Government in 2011 "Creativity is the key to innovation, and innovation drives growth, sustainability and prosperity. Creative businesses operate where the marketplace and creativity intersect. Many are at the cutting edge of creativity making essential contributions to our national innovation system."¹⁰ Firms that are capable of 'boundary spanning' between one or more of areas of expertise are more likely to have significant impact.

Architectural services have already begun to migrate to new definitions within the professional landscape. Architecture has more recently been considered part of the creative industries, and has benefited from the emergence of "design thinking" which is closely aligned to architecture as a professional field, and which has success in penetrating all levels of business. Architecture is also recognized as a significant factor in developing cultural tourism as architecture captures and enhances the special local characteristics of place through unique design qualities that tourists seek to consume. Architecture also has become the focus of a specific form of cultural tourism linked to biennales,

...the drivers of innovation in architecture are not likely to come from incremental adjustments to traditional architectural business but from new models and forms of creativity within the broader discipline.

exhibitions and events that are specifically about architecture. As such, architects have taken on the roles of exhibition design and curation, publication and promotion associated with these types of activities. These areas of design thinking, creative industries and cultural tourism sit outside the traditional understanding of architectural services and are addressed briefly below.

Traditional Understandings Undervalued

Architecture's value, as traditionally understood, has resided in the production of delightful, safe, healthy, sustainable and comfortable places of human occupation. In 2000, The Royal Institute of British Architects (RIBA) and the Commission for Architecture and the Built Environment (CABE) published reports into the value of good architectural design and its social impact through a range of measures including crime statistics, public sentiment, and positive identity with specific places and so on.¹¹

In 2003, work from the American Institute of Architects followed suit with particular attention to the benefits of good design in public spaces.¹² While these reports have been important, they have stopped short of developing the economic argument for good design and have not challenged traditionally understood dimensions of architectural services.

¹⁰ *Creative Industries, A strategy for 21st Century Australia, Report released 2011, Office of the minister for the Arts, p. 5*

¹¹ *See Eric Loe, 2002, The Value of Architecture, Context and Current Thinking, RIBA Future Studies Series, 2000 and The Value of Good Design; How Buildings and Spaces Create Economic and Social Value, Commission for Architecture and the Built Environment (CABE). <http://webarchive.nationalarchives.gov.uk/20110118095356/http://www.cabe.org.uk/publications/the-value-of-good-design> (accessed 22.09.15)*

¹² *See Cities as a Lab: Designing the Innovation Economy (2013) which explicitly links innovation to architectural design, social value and city making. American Institute of Architect's (AIA) Local Leaders Series.*

Design thinking

Design thinking has emerged over several decades as a field within its own right, but one that has close ties to the creative industries as a whole and the intersection with creativity, business and organizational management. The value of design thinking comes in applying design techniques to non-design contexts that may be regarded as 'wicked problems' - such as business transformation, specific cultures surrounding products and services and workplace cultures. A large number of new degrees in Design Thinking or Creative Intelligence are now offered around the world; often located in business schools. The most notable of these include the D-School at Stanford, the Design Thinking and Innovation course at Harvard, the IDEO U Online design thinking course and the Bachelor of Creative Intelligence and Innovation at the University of Technology Sydney.

Design thinking is aligned to architecture specifically in the ways in which problems are addressed through the creative methods of the architectural design studios and the professionalised creative position of architects in addressing problems that are resistant to solutions because of incomplete or conflicting data. In particular, architectural design methods have value in this context because design is projective in nature and new knowledge is created in the very act of designing. Horst Rittel was the first to use this term in the context of Design Theories and Methods (DTM) in the late 1960's.

The Creative Industries

In 2011, the creative industries, of which architecture is considered by the Australian Government to be a part, was recognised for the first time for the significant contribution to Australia and their "ongoing importance to our economy and culture."¹³ The term "creative industries" describes the generation of creative intellectual property with the potential to be commercialized."¹⁴ Simon Crean, then minister for the Arts in 2011 endorsed the vision of "A competitive creative industries sector (which is) vital to Australia's prosperity, propelling a creative imaginative nation in the 21st Century."¹⁵

Architecture is now considered a creative industry, alongside designers from a range of backgrounds including industrial design; product design, landscape and graphic design. Within the creative Industries framework, in 2011 Architecture accounted for 10% of IGP (Industry Gross Product) and 9% of total employment in the creative industries (47,382)¹⁶ . The creative industries report identifies flow on effects of the creative industries in terms of a multiplier effect. Architecture with advertising had the highest total multiplier effect of 4.02 meaning every dollar in turnover generated by Architecture (i.e. initial revenue stimulus) results in 4.02 times total revenue for all other industries in the Australian economy.¹⁷

"Importantly, industries in the creative sector have higher flow-on contributions to the Australian economy than all other sectors taken as a whole".¹⁸ In this regard, the creative industries begins to recognize the value of architecture to the economy outside of construction industry information, and prioritizes the creative capital produced by architects.

¹³ *Creative Industries, A strategy for 21st Century Australia, Report released 2011, Office of the minister for the Arts, p.4*

¹⁴ *Creative Industries, A strategy for 21st Century Australia, Report released 2011, Office of the minister for the Arts, p.4*

¹⁵ *Creative Industries, A strategy for 21st Century Australia, Report released 2011, Office of the minister for the Arts, p.4*

¹⁶ *Creative Industries Innovation Centre (CIIC), Valuing Australia's Creative Industries, (Sgs Economics and Planning Pty Ltd) 2013 <http://www.sgsep.com.au/news/valuing-australias-creative-industries-report-released/> (last accessed 31.12.15), p57*

¹⁷ *ibid*, p64, note editorial changes for clarity to phrasing in original document.

¹⁸ *ibid* , p64

Cultural tourism and embedded cultural value

Much work has been done to assess the impact of tourism on national and city economies. Increasingly, the assets that support tourism from physical environments to cultural events and attractions are under closer study. Architecture has been recognized in this context for both its contribution of cultural products as well as the creation and enhancement of natural and built physical assets which play a leading role in drawing tourism (Sklair, 2010, Edwards et.al. 2015) (see: Case study 2.3.2). The role of “star architects” in particular has received much attention (Fuerst, et.al., 2010, Pozini 2014). A recent Deloitte report (2013) on the Value of the Sydney Opera House¹⁹ also identified the brand value of places and symbols of which the Sydney Opera House is an international example, as a significant economic contribution over and above the costs of bricks and mortar. These examples begin to outline the intangible contributions of architecture to fields like tourism, city economies and the value of national symbols in the context of trade and investment. Muratovski (2011) notes, “Architecture is in a sense a promotional medium and an identity definer. It is a medium that promotes social relationships and individual enterprises, and can be used as a symbol of territorial identity.”²⁰

In recognizing these new ways in which architecture has begun to be valued over the last decade, this report focuses on the potential of four new areas of value outside of this literature and the traditional aspects of architectural practice linked to building design and delivery.

¹⁹ Deloitte, 2013, *How do you value an Icon; The Sydney Opera House Economic, Cultural and Digital Value*.

²⁰ Muratovski, G., “The role of architecture and integrated design in city branding” in, *Place Branding and Public Diplomacy Vol. 8, 3, (Macmillan Publishers Ltd.) 2012, 1751-8040, p.198*

Defining opportunities for growth and adding value

Architecture as a discipline contributes more broadly to society than buildings and construction services associated with the traditional role of the architect alone. While these services are still considered core to the discipline, architecture's contributions to increased property values, the cultural industry, education, technical and systems development, development of adjacent industries, and tourism should be recognized as broad areas of the national economy that benefit from Architecture.

The four areas of focus identified in this report expand the definition of architectural services towards optimising innovation in the future, and draw a more complex understanding of the cultural work and economic contribution of architecture to Australia.

These areas are:

- technical development of products and new services through design led innovation;
- development of new business models and enterprises from within traditional architectural services;
- cultural contribution through tourism, events and exhibitions;
- education and research.

Real estate value add

Beyond the capital investment of new developments, it should be noted that architecturally designed projects, particularly those engaging contemporary design, bring recognized flow on effects to the property market in areas adjacent to or effected by new development. According to one study (Fuerst et.al, 2010), the use of a "star architect" adds as much as 17 per cent to sale prices of buildings, and between 5-7 per cent to rental rates. A real estate value flow on effect is present in all new projects, however it is appreciably increased when contemporary or innovative design is featured as part of the new development

(Pozini 2014). Case studies of this effect include the development of Millennium Park in Chicago, and an estimated real estate uplift of USD 1.4 billion (Uhlir, 2005), The USD 2 billion development boost of the High Line in NY (McGeehan NYT, 2011), and The Marina Bay development in Singapore as well recognized examples. The most regularly cited case study is the Guggenheim Museum in Bilbao by Gehry Partners, where one building has been emblematic of the revitalization of a whole region (eg Plaza 2007). Claims for the economic benefit of the project vary, however the attention and subsequent tourism and boost to industry is clear. Millennium Park as part of Chicago's urban revitalization project features multiple notable architects involved with large scale public projects which have brought multiple positive effects to the city as a whole.

Technology value add

Technology development with architectural firms and projects is a growing area of interest and one area in which innovation is most directly translated into economic benefit. In particular, new to market innovations such as software applications, digital processes or new devices are particularly potent catalysts for further innovation. Traditionally, this field has not been well recognised or developed in architecture, however the potential to reconnect architectural design to the means of its own production, offers substantial new growth for the sector.

In developing technology, there are substantial flow on effects to industries implicated in the value chain of development, manufacture and delivery, making the impact of new technologies and processes broad across aligned industries. In 2007 the development of the unique plan of Aurora Place in Sydney by Renzo Piano, in response to views to the Opera House and its location adjacent to the Botanical Gardens saw the development of a new glass louvre system (see: 2.1.1. Case study).

“Importantly, industries in the creative sector have higher flow-on contributions to the Australian economy than all other sectors taken as a whole”.¹⁸

This system was custom-designed, and purpose-built for the project, and became a new product line as a result. In the recently completed Dr Chau Chak Wing building, (see: 2.1.2. Case study) at the University of Technology in Sydney by Gehry Partners with local executive architect Daryl Jackson, Robin Dyke, a radical re-design of the brick façade system required to achieve the unique geometry of the building inspired the development of a new brick and sub-frame fixing system, which in turn has effectively become a new product line available for future projects. In these examples, we see innovative architecture acting as the R&D for companies operating across the development value chain.

Business value add

Another overlooked area of innovation in architecture and an area of potentially significant economic contribution to firms is through innovation in the area of new business models. This occurs through new specialist businesses developing from niche aspects of architecture such as technology specialisations or strategic design services. As the industry comprises 98 per cent small to medium enterprises, and start up and technical infrastructure costs are relatively low, there are advantages to developing new businesses and niche business in architecture. These may be cultivated within larger business contexts, developed through external business incubator environments or totally independent start up operations. One such example is the purchase by technology behemoth Trimble in 2015, of Gehry Technologies. Developed as a company strategy to gain greater control of complex geometries of Gehry Partners designs, GT has become a construction pathway solution provider involving information systems for clients, contractors, manufacturers and designers. A case study of the cultivated and spun-off business type, Gehry Technologies, is included below (see: 2.2.1. Case study).

Cultural value add

The contribution to cultural production by a vibrant architectural sector is typically overlooked in estimations of contribution to the economy. However, large and small scale arts and cultural events support a range of positive economic outcomes from tourism to business development across a range of participating sectors. Equally architecture, from specific unique buildings to precincts and neighbourhoods, is increasingly recognised as an attraction. As the number of international Biennale's devoted to Architecture show, architecture and its culture of design has also become a worthy cultural product that attracts a specialist and general international audience. There are currently 221 biennales occurring around the world that cross over art, architecture and design. Of these, 24 are dedicated to architecture

The economic contribution of architecture in this regard has not been well researched, however, internationally recognized festivals and events such as the annual Serpentine Gallery pavilion in London, the Venice Architecture Biennale and the Architectural exhibitions of MoMA (NY), Storefront for Art and Architecture (NY), the Graham Foundation (Chicago), FRAC (France) contribute to local and international culture industries, developing audiences associated with research and academia, education, the broadly defined design industries and the general public. The value of the Venice Biennale as a brand is well known with the event drawing 178,000 visitors to Venice in 2012 alone. Estimating a modest tourist spend of EUR 2000 per visitor contributes EUR 356 million to the Venetian economy every two years, not inclusive of the direct and in-direct flow on effects of the event itself. The Chicago Architecture Biennale is a new event in this mould (see: 2.3.2. Case study) and at the time of writing has generated large international interest. As visitor number and exhibitor contributions become clear the Chicago Biennale will

become a more interesting contemporary case for assessing the cultural and USD 2.1 billion economic contribution to the cities existing arts and cultural sectors.

Architectural tourism is another well-established form of cultural contribution through various types of tourist experiences from general tourist to expert experience types. The tourism industry is largely structured around travel to unique destinations, most of which involve significant or novel buildings which then contributes to the tourism economy through hotel, food and beverage, shopping and transport benefits. In assessing the value-add of cultural contribution and tourism, the Chau Chak Wing building at University of Technology Sydney is considered to add AUD 46 million to the local economy annually. (see: 2.3.1. Case study)

Education and research value add

Architectural education is a high demand area of tertiary education attracting a consistently high demand for local enrolments, as well as international student enrolments on exchange, full degree or partial degree basis. The renewed Australian Government priority on Science, Technology, Engineering and Mathematics (STEM) disciplines and its creative evolution STEAM which includes Arts, is aimed at fostering foundation skills for innovation sectors and replenishing Australia's capacity for basic research. These education priorities position architecture well to deliver in these new "complex problem solving" and innovation environments, integrating technical, creative, and precedent knowledge through studio teaching modes native to architecture.

In addition to the number of students and the demand for places, research in architecture increasingly occurs in both university and industry, and adds valuable flow-on effects for firms and the economy as a whole. The need for research, both basic and applied is

recognized as a necessary and fundamental ingredient for innovation. Architecture is responding to the new research environment through academic and industry-based situations, including championing unique practice-based and project-based PhD research degree's, and developing basic research training as a requirement for all Masters of Architecture (professional exit) degrees as a required component of the Australian Qualifications Framework (AQF) level 9 expectations. Architectural firms also are increasingly appointing research positions and collaborating with academic contexts, as government policy and university demands on research increasingly prioritise industry collaboration. The Australian Institute of Architects has recently updated its research policy as a response to this changing climate noting in its 2009 policy;

"Architecture research contributes to the development of new knowledge in the discipline and results in substantial social, cultural and environmental impacts that are of significant benefit to all Australians." ²¹ Architecture naturally links together fields of endeavour from the technical to the humanities. As such, it is considered to be a natural pathway to interdisciplinary research. The Australian Innovation System reports note the value of skills that link discipline areas (boundary spanning) as integral to the development of innovation.

²¹*Australian Institute of Architects, 2009, see: <http://www.architecture.com.au/docs/default-source/national-policy/research-policy.pdf?sfvrsn=0> (accessed 24.09.15)*

1.3 The innovation framework in Australia

The Australian innovation framework

Innovation is defined as “the implementation of a new or significantly improved product (good or service), process, new marketing method or a new organisational method in business practices, workplace organisation or external relations.”²²

A raft of recent literature has been published on the benefits and need for innovation in the Australian economy as a whole²³ and this has now resulted in a major focus in the form of the Prime Minister’s National Science and innovation Agenda announcement in December 2015. The Australian Innovation System is a key provider of information on innovation and its performance in economic terms with an annual Australian Innovation System Report released each year. Recognising the information on business performance in these reports, the Australian Government has repeatedly signalled its intent to support innovation in Australia. Leaders of industry have also responded in even more direct and urgent terms to the need for innovation within Australian business and the necessity to drive change within our business, education and research contexts specifically as an essential driver of Australia’s post mining future economy.²⁴

This new focus on innovation is overdue when one considers that currently Australia does not perform well in most innovation metrics as determined across the OECD. Australia is not a ‘new to market’ innovator with only 5.7 per cent of Australian businesses introducing new to market innovations in 2012-13 (a declining statistic over the last ten years). Rather Australia is generally an adopter of innovative products and services reflecting Australia’s low investment in research and development in comparison to other OECD countries.

“Despite generally positive business conditions for innovation and evidence of the benefits of innovation to business performance, the report shows that Australian exporters are, on average, not high performers of innovation by OECD standards. Our large businesses account for around 66 per cent of investment in research and development (R&D), 44 per cent of industry value added and around 95 per cent of exports. However, Australian large businesses rank 21st out of 32 OECD countries on the proportion of businesses innovating, and are well below other less developed resource-exporting countries like Brazil and South Africa”.²⁶

On the other hand, while SME’s may form a small part of Australia’s innovation context, as noted above, they are relatively innovative when compared with other countries in OECD rankings, placing 5th out of 29 countries reviewed.²⁷ As the field of architectural services is 98 per cent SME this suggests that there is an underlying innovation capacity that can be nurtured and developed.

Research and development in architectural practice

According to the 2014 Australian Key Innovation Indicators, the construction sector in which Architectural services is located, is the 5th largest sector in terms of spend on R&D.²⁸

In architecture, innovation is usually understood as refinement or invention in the area of building design. In this sense Architectural firms prioritise design as both a market positioning and esteem asset and primary attractor of new clients. However, innovation as defined above includes *processes and products* which are not typically valued as new or offered as services within architecture firms –despite the fact that they are

²²OECD (2005) *Oslo manual: guidelines for collecting and interpreting innovation data, 3rd edition, OECD and European Commission.*

²³See for example, *Venturous Australia; Building Strength in Innovation*, Australian Government Department of Industry Innovation and Science, 2008, <http://www.industry.gov.au/innovation/InnovationPolicy/Pages/ReviewoftheNationalInnovationSystem.aspx> (last accessed 31.12.15)

²⁴See for example Catherine Livingston’s address at the national press club, 29 April, 2015 <http://www.bca.com.au/newsroom/national-press-club-address-by-catherine-livingstone> (accessed 23.09.15)

often instrumental in enabling design innovations. This strong bias towards innovation as meaning design innovation only serves to mask the many other forms of innovation that are represented in the Australian innovation system definition above. Yet object or building design is only a small part of a value chain that includes research and development (design) to implementation, business development distribution and so on. This indicates innovation in practice will require the introduction of new skills beyond traditional fields of architectural design and construction.

A dedicated or strategic approach to research and development within architectural firms is also rare despite the availability of tax concessions to business for these activities. Typically R&D is related to the purchase of new software or technical systems, and growing relations with Australian universities around areas of professional focus. As noted above, architectural firms are beginning to move to embrace research, in 2009, the Australian Institute of Architects released a Research Policy to promote and support collaborative research that links the profession, the construction industry, universities and government. Anecdotally, however investment by firms into R+D is small. As 98% of architectural firms are SME's, capital investment in research is difficult and unique forms of research for modest scaled business revenues must be taken into consideration. More positive examples of research collaborations between architectural firms and universities are needed to demonstrate the value of R&D in the sector.

Innovation is consistently defined as the capacity to take risks in finding alternative solutions that often require disruptive or radical change to bring new products or processes to market. It is our view that architecture must adopt a new appetite for risk if it is to broaden how the sector sees itself, and is seen by others. As indicated above, architectural firms are well positioned to contribute to an innovation-driven economy yet there remain significant internal and external barriers to innovation within historical models

across the sector. Overall, the dependency of the architectural services sector on construction activity suggests that, unless architects derive additional sources of value, the sector will be forever manacled to the boom-bust cycle of development.

The definition of Architectural services within the creative industries, or as a stream within the STEM cluster, may help to frame a different version of value creation in the sector; one that is broad in its application of the native spatial and technical skills of the architect, and one that develops the creativity of architecture towards a new range of strategic building and non-building outcomes.

In compiling this report, several consistent barriers

Barriers to innovation in practice include:

- a focus on design as the only form of innovation;
- a skills shortage within practices necessary to innovate through the entire value chain;
- a predominance of practices as SME's with little revenue to dedicate to R&D;
- a lack of strategic planning around innovation and business development in practices; and
- a strong competitive environment encouraged by design competitions means collaboration between practices is disincentivised.

Assets to innovation in practice include:

- strong cultural understanding and valuing of novelty in design terms;
- broad generalization of skills leading to native 'boundary spanning' capabilities;
- early adopters of technology;
- strong international culture of architecture and workforce;
- strong willingness within practice to innovate; and
- strong creative culture seen as core to innovation.

²⁵During the draft edits of this report, a newly elected Australian Prime Minister Malcom Turnbull took office and subsequently announced a AUD 1 Billion innovation statement on 7th December, 2015.

²⁶ Australian Government, Office of the Chief Economist, Australian Innovation System Report 2014, p2

²⁷OECD (2005) Oslo manual: guidelines for collecting and interpreting innovation data, 3rd edition, OECD and European Commission.

²⁸ <http://www.industry.gov.au/innovation/reportsandstudies/Documents/AustralianKeyInnovationIndicatorsDataCard.pdf> (accessed 24.09.15)



PART 2

New measures for the value add of architecture



Generating a more complete picture of the value add of architecture demands a framework that moves beyond the value of single projects and takes an industry-wide perspective of innovation in the architectural profession. This report highlights four key non-building areas of innovation in architecture - areas identified in innovation literature as essential to a future innovation economy for their potential to add value to the built environment. These areas are:

- **new technology** produced and promoted through innovative architectural design and practice
- **new businesses and business practices** bought about by innovative thinking in design practice
- **cultural products** (both hard and soft) that derive from architectural practices as well as the follow on industries of events, exhibitions and tourism.

- **architectural education** as a sub-market sector and the additional benefits (economic and otherwise) of research

These key areas of innovation are not adequately accounted for in current understandings of the value add of architecture. As outlined below, however, they are vital aspects of a dynamic industry and should be included in assessments in order to develop a more detailed picture of the operation of innovation in practice as well as the value of research and development to the industry and its impacts further afield.

2.1 Technology

.....

Architects are early adopters and advocates for innovative tools and digital technologies. Architectural firms of different sizes are also engaging in their own scales of research and innovation in engineering, materials, planning, urban socioeconomics, transport and movement, as well as sustainable design – which is in turn producing new tools and technologies that have scope within and beyond the sector. As such, architects and peer professionals are both important consumers and producers of new technology, and these exchanges and transfers must be captured in assessments of architecture's economic contribution.

The design and implementation of new technologies – innovative materials and systems – can increase building efficiencies and stimulate growth in intersecting industries, including the manufacturing, construction and real estate industries. Renzo Piano's Aurora Place (see: 2.1.1. Case study), located in Sydney, demonstrates the potential for new chains of value attributable to the design, manufacture and implementation of ground-breaking materials and systems through architectural innovation. A combination of cross ventilation requirements, desirable

views and a contextual treatment facing the botanical gardens opposite the site, led to an innovative spatial organisation in the Australian market, which depended on further innovation in the development of a specific technical solution – a louvre system - which has had ongoing sales success across other projects in the Australian market. Aurora Place ultimately achieved record prices for its residential component while also securing an enviable commercial tenancy profile.²⁹

Even when embracing old materials, innovative architectural design can generate new systems and reinvigorate old industries. The University of Technology, Sydney's new Dr. Chau Chak Wing Building (see: 2.1.2. Case study), design by Gehry Partners, pushed brick design and installation to new technical solutions, producing a range of new brick types to achieve the formal requirements of the building, as well as a new structural tie system to keep the bricks in place. The building has captured the imagination and marketing of Australia's brick industry and highlighted the power of architecture to create new demand for even the most traditional of materials.

²⁹ <http://www.propertyoz.com.au/Article/NewsDetail.aspx?id=&mid=1391>



2.1.1 Case Study

Aurora Place louvre system Renzo Piano

Years: 1996-2000

Location: 88 Phillip Street, Sydney

Developer: East Asia Property Group/
Lend Lease Developments

Project Manager: Bovis Lend Lease

Architect: Renzo Piano Building Work-
shops/Lend Lease Design
Services/Group GSA

Structural Engineer: Lend Lease Design Group

Façade Engineer: Ove Arup & Partners (tower)
and Taylor, Thomson Whit-
ting/Lend Lease Design
Group (Residential)

Renzo Piano Building Workshop is a major international practice whose way of working has influenced two generations of architects. Exploring innovative solutions for often practical or prosaic details has long been Piano's strength. His architecture studios "boast comprehensive workshops where carpenters and other skilled craftsmen work up prototypes of components for new buildings."³⁰

Aurora Place is Renzo Piano's only completed building in Australia. The project contains a mix of speculative office space and residential apartments on a premium site overlooking the Harbour, Bridge and Sydney Opera House. Two buildings are linked by a glass-covered square. The office tower rises 44 levels while the residential building is 17 levels high and faces Sydney's Botanical Gardens. The tower was designed to allow integration between the levels, which was achieved in part by the inclusion of winter gardens and terraces.³¹

The 62 residential units in Macquarie Apartments, including two penthouses, also sold quickly and for record prices. "The penthouses are believed to be the most expensive units ever sold in Australia. One sold for about AUD 7.5 million and the other AUD 6.5 million, while a couple of the larger units went for close to AUD 3 million."³² While multiple factors contributed to these record prices, including the spectacular views from the apartments, the interior quality of spaces and the opportunity to alter the internal environment – both dependant on the unique wintergarden and louvre solution – were obviously a major factor.

Aurora Place "...established new construction and project management trends in Australia, while achieving record prices for its residential component and securing an enviable commercial tenancy profile."³³ Much of this success must be placed at the unique environments Piano was able to create with the help of technological innovation.

³⁰<http://www.theguardian.com/society/2002/mar/29/urbandesign.arts>

³¹<http://www.visitsydneyaustralia.com.au/aurora-place.html>

³²<http://www.propertyoz.com.au/Article/NewsDetail.aspx?id=&mid=1391>

³³<http://www.propertyoz.com.au/Article/NewsDetail.aspx?id=&mid=1391>

Innovation: spatial organisation

The key spatial innovation at the Aurora Place Apartments was the inclusion of wintergardens on the northwest and southeast facades of the tower. Based on a European concept, the winter gardens have been created by enclosing the balconies (officially described as 'transitional spaces') with an operable system of glass louvres to let in and shut out the elements and which are protected by cantilevered aluminium louvered sunshades. Architect Peter Cotton, the National Practice Director of Mirvac Design who worked with Piano on delivering the project, suggested at the time that to his knowledge "this was the first building of this scale in Sydney to adopt wintergardens".³⁴

"The 14 storey louvered glass facade of the (residential) building, which is draped across the balconies of the apartments to create wintergardens, is the largest moving glass wall in the world. This facade shelters the occupants from rain and wind and so extends the periods when the balconies can be used. The east side of the apartments opens in a series of layers to suspend the occupants in their own "botanic garden greenhouse".

Layers of sliding glass, opaque terracotta battens, motorised blinds and low-iron glass with operable louvres, allow the user to engage with or retreat from the view and climate."³⁵ This idea of user engagement was also a new concept in multi-residential architecture in Australia. While architects such as Glenn Murcutt had used this strategy for two decades at a smaller scale in his internationally acclaimed houses, the idea had not been transferred to high rise. The operation of the louvres by tenants in the residential tower gives the development the appearance of a "kinetic sculpture", as described by Renzo Piano, if viewed from the Royal Botanic Gardens.³⁶

Piano's local representative office on the project,

Innovarchi, "cites the building's widespread use of breakout spaces featuring gardens or green elements. While today such spaces are de rigueur, five years ago their worth was far from universally accepted. Piano's plan - which called for two garden spaces on each floor - was considered extravagant. The financial sense to this plan has been proven now, however, according to owner Commonwealth Property Investment Trust, which points to the record prices paid for the apartments and top commercial tenants landed for the office tower. Occupants note that the gardens have become hubs for communication and creativity, and in building surveys they cite the winter gardens as one of the main attractions of the building."³⁷

Innovation: technical solution

To make the wintergardens work, and maintain the oblique view to the iconic Sydney opera house, a new glass louvre system required development that could accommodate both ventilation and shading functions. The solution developed was to support the glass louvres within a glass mullion framework along with the operating mechanism to rotate the louvres. This engineering feat married practical installation and ongoing maintenance while responding to the strong design intent of the architect.

Managed by Scott Turner of the Nysan Asia Pacific, "the challenging job required the engineering team from Hunter Douglas' Nysan solar-control experts to develop custom circular brackets that would fit within Renzo Piano Workshop's design. The shades featured PVC-coated fibreglass fabric in a linen colour and a 5 per cent openness factor."³⁸

The invention of a new louvre system from the ground up involved a wide constellation of international manufacturers, not unlike the design and procurement methods used for aircraft, whose

³⁴ <http://news.domain.com.au/domain/real-estate-news/inside-out-problem-solved-20100429-tu19.html>

³⁵ <http://www.visitsydneyaustralia.com.au/aurora-place.html>

³⁶ <http://www.propertyoz.com.au/Article/NewsDetail.aspx?id=&mid=1391>

³⁷ http://www.hunterdouglascontract.com/referenceprojects/article.jsp?pld=p10502#.Val5y_nzDvA

³⁸ http://www.hunterdouglascontract.com/referenceprojects/article.jsp?pld=p10502#.Val5y_nzDvA

components are sourced internationally and assembled in a specific location. “In the end, the system required collaboration among a group of international partners, with design and extrusion coming from Nysan Asia Pacific, additional design, bracketry and control systems coming from Hunter Douglas’ Nysan unit in Canada, and fabric sourced from Mermet in France.”³⁹

“The control system was likewise custom-created, and considered both aesthetics and usability. Piano wanted the blinds to be motorized, lifting simultaneously in the morning to create the appearance of the building waking up. To allow for more individual control, engineers designed secondary override controls for the fully automatic blinds, allowing the system to be flexible to layout changes on each floor. Perhaps most important, the control system was designed to allow updates, ensuring controls can be changed in response to ever-advancing BMS technology.”⁴⁰

This focus on research and development and rigorous testing, intrinsic to Piano’s working method, was essential to having such a novel solution approved for construction within the Australian market. “To get these approved, we had to prove that they could open and close faultlessly 50,000 times...”⁴¹

For the project to be a success, Piano’s goals needed to be embraced by all the major collaborators: global development firm Bovis Lend Lease, Group GSA (design development and documentation architects for the commercial and residential projects together with HPA Mirvac), and Innovarchi (a Sydney-based architectural firm with principals Ken McBryde and Stephanie Smith). “We were on the same mission,” said McBryde. “We test and test ideas, dump them if they don’t work, or save them. We won’t start until we have the idea right.”⁴²

“Thanks to the ideas built into Aurora Place, tenants and occupants of new buildings around the world rightly expect the opportunity to adjust their own environment as they see

Innovation: ongoing business

“In a few years since Aurora Place opened, these elements --sky gardens, transparent double skins, and fresh air -- have become commonplace elements for new tower schemes.”⁴³

On leasing 10 floors of Renzo Piano’s Aurora Place, Alan McArthur (managing partner) of Minter Ellison stated “An outstanding feature which influenced us is Aurora Place’s recognition of the debilitating effects long, intensive hours and synthetic environments have on those who work within them. Imagine the difference natural sunlight and fresh air will make to our people as we put in long hours getting deals done (www.lendlease.com.au; accessed December 2000).” The idea that happier workers are more productive has thus become management mantra aimed at increasing corporate profitability and employee loyalty (Gratton, 2000). The route to improved worker welfare and morale, stimulation and productivity is seen to be through the design and development of needs-sensitive, functionally and qualitatively flexible office work spaces.”⁴⁵

[INTERVIEW WITH KEN MCBRYDE 29.09.2015]

³⁹http://www.hunterdouglascontract.com/referenceprojects/article.jsp?pld=p10502#.Val5y_nzDvA

⁴⁰http://www.hunterdouglascontract.com/referenceprojects/article.jsp?pld=p10502#.Val5y_nzDvA

⁴¹<http://www.theguardian.com/society/2002/mar/29/urbandesign.arts>

⁴²http://www.hunterdouglascontract.com/referenceprojects/article.jsp?pld=p10502#.Val5y_nzDvA

⁴³ http://www.hunterdouglascontract.com/referenceprojects/article.jsp?pld=p10502#.Val5y_nzDvA

⁴⁴http://www.hunterdouglascontract.com/referenceprojects/article.jsp?pld=p10502#.Val5y_nzDvA

⁴⁵ O’Neill and Mcguirk, “Reconfiguring the CBD,” 1761.



STZ

HOTEL

2.1.2 Case Study

UTS Chau Chak Wing Building Brick and framing system

Location: Omnibus Lane & Ultimo Road, Ultimo NSW, Australia
Design architect: Gehry Partners
Executive architect: Daryl Jackson Robin Dyke
Structural engineer: Arup
Brickwork engineering: AECOM
Builder: Lend Lease Group
Bricklayer: Favetti Bricklaying
Brick Manufacturer: Bowral Bricks
No. of bricks: 320,000
Date of manufacture: June-July 2013

*“...the the dramatic brickwork facade of the new UTS Business School has recently been unveiled. Already it is capturing the imagination of both public and media alike, with some pundits nominating it as an icon of Sydney, alongside the Harbour Bridge and the Opera House.”*⁴⁶

The Project

The Dr Chau Chak Wing Building (CCWB) is part of the ten-year AUD 1 billion UTS City Campus Masterplan, “which is helping transform the southern CBD and will deliver a cutting-edge and connected campus for staff, students and the broader community.”⁴⁷ The building is named for its principal donor, a Chinese-Australian businessman, and is the first Australian commission for Gehry Partners, the Los Angeles-based architectural practice founded by Frank Gehry.”⁴⁸ The practice is among the world’s best-known architects and is renowned for their inventive use of materials and challenging construction requirements.⁴⁹ His milestone projects include the Bilbao Guggenheim Museum and the Los Angeles Walt Disney Concert Hall.

The project is a classic Gehry-designed education building, led by a strong interior organisation which in turn leads to opportunities for complex exterior forms which reflect the programmatic arrangement within. In parallel, Gehry has a series of formal fascinations, one of which is complex folds: “I’ve never really gotten to do a lot of that because when you start doing it the contractors and everyone start telling you, you can’t do it,” adding that “I’ve always wanted to do that with brick.”⁵⁰ And so it is the complex brick façade for which the building is known and for which numerous innovations were required to bring to market.

⁴⁶Bowral Bricks, “Deconstructing Ultimo.”

⁴⁷ <http://www.dezeen.com/2010/12/17/dr-chau-chak-wing-building-by-frank-gehry/>

⁴⁸Bowral Bricks, “Deconstructing Ultimo.”

⁴⁹Bowral Bricks, “Deconstructing Ultimo.”

⁵⁰Bowral Bricks, “Deconstructing Ultimo.”

Innovation: design

Highly anticipated and instantly recognizable, the new Business School by Gehry Partners bolsters UTS's global status. The building's function is primarily postgraduate and executive education, but it serves the university as a whole and is intended to represent the innovative thinking that underpins the teaching, learning and research undertaken by the Business School.⁵¹ The project is a key element of the new conception of a university campus that is central to the UTS master plan, where the role of a university building is understood in the context of online learning and so provides not only classrooms but "goes back to a tradition of university buildings that offers identity and a place for students to gather and be inspired, rather than simply providing accommodation for students gaining degrees through the system."⁵²

Essential to the identity of the building is its unique "twin façade" – one to Harris Street composed of large, angled sheets of glass to fracture and mirror the image of surrounding buildings and one facing Darling Harbour and the city which consists of undulating brick.

"Up close, the plastic, fluid quality of the CCWB creates an encounter and connection that are wholly physical. Its extraordinarily complex construction included five custom-made brick types manufactured specifically for the building. . . and is heavily corbelled and carefully executed to an exacting and highly detailed design. The undulations of the brick facade and the abundance of idiosyncratic visual and tactile detail make "being there" a highly engaging and personal experience."⁵³

Innovation: material

Given the high profile architect and unusual design, its not surprising that brick manufacturers from across Australia and around the world expressed interest in tendering for the project. Brickworks Building Products won the tender after some earlier research which helped prove up the concept:

"Brickworks Building Products' technical, sales and production teams became involved in 2010 when expressions of interest were called to supply bricks for a building unlike any in the long and distinguished history of this iconic building material."⁵⁴

Trials were conducted at Austral Bricks plants around Australia but the final selection was Bowral Bricks, a small regional operation famed for its architectural-quality, dry-pressed bricks that find a ready market in commercial and residential applications. A standard Bowral Bricks colour, Limousin Gold, was also very close to that of the Sydney sandstone colour that Gehry Partners was seeking. Eventually, five buff-coloured brick ranges were selected. Each of the pressed bricks serves a specific function, and differ from standard brick designs.

"All brick faces, for example, were required to be visibly appealing as the curved and corbelled nature of the masonry façade reveals the sides, base, top and front of the bricks to view. The bricks also required individual vertical cuts at the perpend to ensure the mortar space between each brick remains even throughout, allowing for the beautiful, steep curves of the wall."⁵⁵

⁵¹<http://architectureau.com/articles/dr-chau-chak-wing-building/>

⁵²<http://architectureau.com/articles/dr-chau-chak-wing-building/>

⁵³<http://architectureau.com/articles/dr-chau-chak-wing-building/>

⁵⁴Bowral Bricks, "Deconstructing Ultimo."

⁵⁵<http://www.architectureanddesign.com.au/features/features-articles/how-local-s-home-made-invention-keeps-frank-gehry?mid=0c23637e77>

Innovation: processes and technology

The project “challenges construction norms by taking a standard construction method – in this case, brick veneer (a brick skin tied back to a structural frame) – and achieving an incredible fluidity of form and texture that has already raised the profile of the highly skilled bricklayers who laid in the order of 320,000 bricks by hand, following the 3D construction model.”⁵⁶ In this way, the project innovation was a balance between traditional methods that were adjusted to address the new geometries systems. Murray Coleman, Managing Director of Lend Lease’s building business in Australia, summed up this balance very clearly - “the unique Gehry design required the latest computer modelled construction methods combined with the most traditional artisan techniques.”⁵⁷

Specifically, two key innovations were required in regard to brick design and installation – the development of a new type of brick to achieve the formal requirements and to work with the second innovation - a new structural tie system to keep the bricks in place in their unusual configuration where the design demanded that brickwork courses progressively project or recede at up to 26 degrees from the vertical. Brickwork of this complexity has never been attempted before, requiring an innovative engineering solution.

“Standard construction with existing available tie systems proved woefully inadequate – mock-up testing had showed that the brick wall would collapse and become unstable after just four courses with wet mortar applied”.⁵⁸

A new structural tie system was a direct response to key question of how to stop the newly-laid brickwork from toppling or collapsing before the mortar had hardened. An ingenious solution was developed by AECOM’s Building Engineering Group in collaboration with Brickworks and other project partners.

Facts and Figures

No. straight columns:	One
Sharpest angle:	72 degrees
Length of the longest unbroken column:	13.78 m
No. of bricks:	320,000 bricks, laid by hand to create the tessellated facade using five custom-made brick types, manufactured by Austral Bricks in Bowral. Each brick was connected to the infrastructure using a brick-fixing system developed for the project. The bricks were so difficult to lay that master bricklayer Peter Favetti came out of retirement. Because the walls are curved, and many of the bricks stick out at angles, laying the bricks took five times longer than traditional face-finished bricks.
No. of workers:	About 1500 during construction.
No. of students and staff accommodated:	1630
Environmental ratings:	5-Star Green Star rating thanks to features such as the air-conditioning system, which works similar to a sensor light in that it adjusts on and off with people in the room, and Gehry’s innovative lighting specialist who eliminates the need for most exterior lights by making internal lights cast a light outside.

⁵⁶ <http://architectureau.com/articles/dr-chau-chak-wing-building/>

⁵⁷ <http://www.smh.com.au/nsw/frank-gehry-uts-masterpiece-inspires-brickies-on-their-labour-of-love-20131201-2yju1.html>

⁵⁸ <http://www.architectureanddesign.com.au/features/features-articles/how-local-s-home-made-invention-keeps-frank-gehry?mid=0c23637e77>

The solution has a number of components. Firstly, an inner skin, or substrate, of steel was fabricated which defined the curvaceous facade contours. This skin provided a template for the bricklayers to work off in creating the curved geometry without measurement or stringlines, eliminating risks associated with the geometry of the design and leaving the bricklayers to build the walls with standard brick and mortar construction.”

As with conventional brickwork, brick ties were then used to link the brickwork facade to this inner steel substrate:

*“As each course of bricks was laid, a continuous stainless steel wire was placed in the rebates, thus providing lateral support. A special brick tie with two adjustable nuts on a threaded rod was developed. The back of the tie was slotted into a small box attached to the steel substrate panel. The two nuts are then adjusted to lock the tie between the edge of the rebate and the back of the brick. The leading nut also captures the stainless steel wire. The effect is to anchor the bricks, both horizontally and vertically. Once the mortar has hardened (and encapsulated the brick tie and the wire) the brickwork takes on its monolithic strength.”*⁵⁹

In developing a tie system from scratch that had never been used before, the brick wall could be built traditionally with up to 10 courses of wet mortar (the standard for normal masonry construction).⁶⁰ In regard to the mortar, a number of alternatives to conventional sand-cement-water mortars were proposed and trialled with the final solution based on a “conventional mix that was “tweaked” for extra strength while retaining the workability required by the bricklayers.”⁶¹

The second set of innovations is to the brick elements themselves to address both the design requirements of the wall curvature and the

demands of the tie system. Five brick shapes were specifically designed with a rebate or channel in the top face, following the long side, which enables the continuous steel rod to be continuously bedded in the brick wall.

To achieve these geometric requirements, traditional dry pressed bricks were used, as they allowed for the flexibility for the unique shapes to be pressed. This is most evident in the K brick, where Gehry Partners required a special protruding brick that would assist in creating the curved effect and cast a feathered shadow pattern to further animate the facade:

*“The ‘K Brick’ is another development. Shaped to appear as though it has been offset from the standard coursing, it assists in creating the required bends and shadowing. A 1/3 bond pattern was adopted for the wall to suit the curved nature of the wall and avoid the lining up of a strong vertical bond pattern. Laying the bricks by hand on site was essential, and a method favoured over the typical brick curtain wall, which would have detracted from Gehry’s curvilinear designs.”*⁶²

The innovative approach to the façade required extensive testing of the mortar, ties, bricks and full wall height mock-up panels with load and strain gauges which had to be created before full scale construction commenced “since there was no existing Code or Standard that accommodated the extreme geometry and construction system the bricks have been subjected to.”⁶³

“Over 30 different brick façade prototypes were created by Austral Bricks across six of its factories in Australia, before the final product designs were selected. Five custom-made, buff coloured brick ranges will make up the building’s impressive exterior, with each serving a specific function, and differing from standard brick designs.”⁶⁴

⁵⁹Bowral Bricks, “Deconstructing Ultimo.”

⁶⁰<http://www.architectureanddesign.com.au/features/features-articles/how-local-s-home-made-invention-keeps-frank-gehry?mid=0c23637e77>

⁶¹Bowral Bricks, “Deconstructing Ultimo.”

⁶²<http://www.architectureanddesign.com.au/features/features-articles/how-local-s-home-made-invention-keeps-frank-gehry?mid=0c23637e77>

⁶³<http://www.architectureanddesign.com.au/features/features-articles/how-local-s-home-made-invention-keeps-frank-gehry?mid=0c23637e77>

⁶⁴<http://australbricks.com/footers/about-us/press-releases/frank-gehry-uts/>

Daniel Beekwilder, director of Daryl Jackson Robin Dyke, the project's executive architects: "The use of brickwork as a plastic facade material is an amazing idea and Gehry Partners has demonstrated how brick can be used in an unconventional way to create a facade that appears to have a lot of movement. In terms of my ideas on brick design, the building has obviously changed the way I look at the material and it will be interesting to see how other people continue to push those boundaries."⁶⁵

Innovation: flow on economy

The client saw great value in the ability to be recognized both locally and internationally, and thus the building is a key project in the City Campus Master Plan – the University of Technology Sydney's ambitious scheme to overhaul its facilities. It has been estimated that the CCWB will attract 24,000 interstate visitors and 2,000 international visitors each year, adding AUD 36 million to the tourism industry through spending by business event visitors annually:⁶⁶

*"This project raises the profile of architecture for the benefit of all architects, promotes the UTS brand worldwide while also enhancing the local university community, and delivers a richly layered building for the benefit of the people who interact with it as a piece of the city."*⁶⁷

This increase in visitation has also occurred in parallel with an increase in novel brick use, attributed to the impact the building has had on the local design culture:

"Following the successful completion of the iconic Frank Gehry designed Dr Chau Chuk School of Business at the University of Technology Sydney, a continued focus on architectural and specialty bricks has resulted in supply to many multi-residential towers and urban renewal projects. One highlight ... was the supply of bricks in fifteen specially designed shapes and colours for the Australian Embassy project in Bangkok."⁶⁸

⁶⁵Bowral Bricks, "Deconstructing Ultimo."

⁶⁶Independent modelling by Urbis, cited in UTS media release, December 2010. note this report offers a remodeling of this data updating AUD \$36 to AUD \$42million. See case study 2.3.1.)

⁶⁷<http://architectureau.com/articles/dr-chau-chak-wing-building/>

⁶⁸Brickworks, "brickworks news," April 2015, Review of Results.



Image: Chris Hearne 2012, CC, <https://www.flickr.com/photos/60299566@N04/8178007405/in/photolist-ut3Bjv-gcQxrZ-nTTZ8W-awc9o1-9MIH5C-awc9jY-dsEqFF-dqGxM8-kfZo9V-dqGGGJ-gQnQcg-lh3UYz-jEsoP7-A4TcHy-vndNkI-dqGxwP-dqGGYy-dqGxUB-kizcD5-7NTPf>

2.1.3 Approximating a value add for technology

Technical and practice process innovations are fundamental to innovative design but rarely captured as value add to industry. New data is needed to determine the extent of this area of architectural production and confirm the potential of technical innovation to drive value through the supply chain. While recognizing this limitation, there is substantial project based evidence to confirm the potential of design and technical innovation to increase value to clients and the architectural firm, by turning the early adoption of technology toward the development of new purpose-built technology.

Take out message

- Architectural technology has been pre-occupied by issues of industry standardization, which have been promoted by large external technology providers. However, new opportunities are also available to architectural firms willing to research and develop purpose built software and custom, or mass customisable, building elements that have enormous economic potential.

- Technical innovations in practice are occurring at the new intersection of software and material technologies. Practices trained to see these new intersections and risk development will benefit.

- The model of procurement selected and the role of the client prepared to take risks through innovation both play a role in enabling development of new technologies and bringing their proof of concept to market

2.2 Business development – new businesses & business systems

.....

According to the Australian Bureau of Statistics, there were over 13,400 registered businesses operating in the Australian architecture sector in 2013-14. The scope of work undertaken by these business is wide, from a vast range of design services, feasibility work, contract administration, oversight of building works, project management and strategic planning, post-occupancy evaluation and more. According to IBISWorld, typically, a third of work undertaken by architectural businesses extends beyond core pre-design, design and documentation work. With expanded areas of work, and facing increasing competition from new major engineering and project management companies, architectural businesses are adapting to new conditions in the market and built environment sector. They are innovating their business systems and models, engaging with new marketing and media strategies, and developing and spinning-off new businesses and products that address emerging sector areas including technology niches, expert systems management, information handling skills and technologies, archiving and data storage, as well as life-cycle management and systems. New businesses emerging within architectural practice have centred on new tools and technologies developed to ease workflow, increase control and foster a new

ability to design and deliver complex systems and assemblies throughout construction. In addition to the direct benefits to firms, there is a larger commercial imperative that becomes evident when considering the issues of optimisation of construction with the business of construction and development, as well as the employment creation and market value that must be attributed to the businesses themselves. Gehry Technologies (see: 2.2.1 Case Study) has provided an example of business development and innovation in the field. Gehry Technologies (GT) was developed through Gehry Partners in 2002. GT grew from an in-house process of software research, testing and refinement, using and adapting software and techniques from the aerospace and automotive industries, in order to develop bespoke 3D design solutions to help deliver Gehry Partners complex designs. As a spun-off business, GT supplied a consultancy service, a collaborative design platform and building information modelling solutions to the architecture, engineering and construction industries. In 2014, GT spun off another business, Digital Project, while Gehry Technologies - including GTeam and the firm's project delivery services - was acquired for an undisclosed sum by Trimble Navigation, a multi-billion dollar technology firm.

Whereas the Gehry Technology developments grew out of the need to address issues in traditional building design activities, SHoP Architects (see: 2.2.2. Case Study) in New York, have been innovating in their practice structure in even more lateral and projective terms including their form of engagement with finance and real estate and in new construction and delivery techniques. In challenging traditional architectural business practice, SHoP has helped redefine how architecture can be practiced, experimenting with everything from new models for remuneration to how the firm engages, often pre-emptively with the construction and public sectors. In redefining their business model, SHoP has also spun off three companies, the most significant of which is ShoP Construction, which offers services including management of Building and Information Models and the development of Virtual Design and Construction (VDC) packages and construction management. These new approaches to business have helped SHoP become one of fast companies most innovative architectural firms in 2013.⁷⁰ Businesses like SHoP are demonstrating that architectural business are adaptive, creating new business models and practices in the pursuit of innovative solutions.

⁷⁰Source Dezeen, <http://www.archdaily.com/331465/fast-companys-top-10-most-innovative-practices-in-architecture/>



THE COOPER UNION

COOPER ST
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2.2.1 Case Study

Gehry Technologies

Year: 2002-Present

Co-Founder/ Chairman: Frank Gehry

Board of Advisors: Zaha Hadid, Greg Lynn, Laurie Olin, Wolf D. Prix, David Rockwell, Moshe Safdie, Matthias Schuler, Patrik Schumacher, Ben van Berkel, Richard Saul Wurman, David Childs, Massimo Colomlomban

Clients: Diller Scofidio + Renfro
Herzog & de Meuron
Jean Nouvel
Coop Himmelb(l)au
Zaha Hadid

Projects : Beijing National Stadium
City Plaza Hotel
Lincoln Center – Alice Tully Hall
Lou Ruvo Brain Institute
New World Symphony
Museum of Biodiversity in Panama
One Island East
San Li Tun Taikoo Hui Village at Queensridge
Soumaya Museum Los Angeles, Calif.

Practice Pracie

Gehry Partners is one of the world's most eminent architectural practices. Led by founder and creative engine Frank Gehry, the practice rapidly grew from "art house" office to a large scale commercial success on the strength of a range of signature projects delivered since in the early 1990s, the most significant of which was the Guggenheim Museum in Bilbao, Spain.

The Guggenheim Museum drove not only an expansion in the practice in creative terms and industry recognition, it was a key project in the transformation of the way that Gehry Partners designed and procured its buildings.

Innovation: New Techniques

"While working on a monumental fish sculpture for the 1992 Summer Olympics in Barcelona, Frank Gehry's office developed its own software

to manage the complexities of the project and gain greater control of the design and construction process. During the design of the Guggenheim Museum in Bilbao in the late 1990s, they refined this software into what became Digital Project. By 2002, Gehry Technologies (GT) was born. A spin-off from the design office, GT offered architects the software and expertise that came from realizing Gehry Partners' complex buildings."⁷¹

Designed to improve the relationship among architects, contractors, and clients, the first steps in the creation of Gehry Technologies came about when James Glymph, a senior partner at Gehry's firm, was looking for a way to help contractors better understand the demands of Gehry's increasingly complicated designs. He chanced upon an aerospace engineer who recommended the CATIA software which was modified for

⁷¹ http://archrecord.construction.com/news/2014/09/140911-Gehry-Technologies-Spins-Off-Its-Software-and-Services-Businesses.asp?WT.mc_id=rss_archrecord

architectural work. The software can also be used by contractors to produce exact measurements of the steel, wood, and other materials needed in a project. By linking dozens of such suppliers on a single software platform, the construction of complex buildings becomes vastly more efficient.⁷²

Initially, Gehry Technologies just resold CATIA – the software with which they had worked on early projects and offered training and configuration for architects. But they quickly realized that they needed architecture-related features not offered by CATIA, such as support for plumbing and construction scheduling. So they partnered with Dassault Systems, the aerospace manufacturers who made CATIA, to develop an architecture-specific version of the software called Digital Project. Digital Projects works by modelling, in three dimensions, every complex geometry an architect might envision and then letting engineers and architects reconcile the geometry with a building's site, ductwork and other features. It shows how one change to a building's ingredients changes all the others.⁷³

The development of these tools led in turn to the creation of Gehry Technologies, a stand alone business which sells tools and services that relocate the architect in the centre of the work processes around the procurement of buildings. By using Gehry Technologies software, an argument is made that architects regain control by holding the central drawing hub for any project. "I am dedicated to giving architects better control of the process so they can deliver the fruits of their imagination, which is what our clients expect," stated Gehry.⁷⁴

"The stakes in construction are very high. Developers say that the closeness of the match between what an architect draws and what contractors produce can make or break a project. When engineers and contractors misunderstand how parts of a building connect, resulting delays often inflate a construction budget by 5 or 10 per

cent. These days, when banks are loath to risk any money, such contingencies are not available."⁷⁵

Innovation: new business

This link between the software and services of Gehry Technologies and the economic issues present across the various supply and information chains within the construction and property industries led to an awareness of the value of the company outside a project specific service. In a recent interview with *Priceonomics*, Shelden explained Gehry Technology's original intention: "If few can work in this new way, the cost of working with other people is high. By bringing the industry forward, you help your competitors but you also help your partners, ultimately letting you do better work at a lower price."⁷⁶ Shelden has observed that "historically, information was expensive and materials and energy were cheap. Now the cost of information is going down, and the cost of materials and energy is going up." Today, this "cheap" information can save "about 10 per cent the cost of a building's construction," so it's big business.⁷⁷

In 2002, Gehry Partners spun off the software business into a company called Gehry Technologies, which sells Digital Project to other developers and architects and trains project teams to use it. This was a radical model for architectural business and left Gehry in a position where income streams to his business were decoupled from the fee-for-service architectural projects Gehry may have at any one time.

The business transformed when Gehry Technologies expanded from simply being a reseller and started to sell their services to assist in transforming other architects' designs into buildings. GT provides design and project management technology and consulting services to leading owners, developers, architects, engineers, general contractors, fabricators, and other building industry professionals worldwide.⁷⁸

⁷²<http://www.bloomberg.com/bw/stories/2003-10-05/frank-gehrys-high-tech-secret>

⁷³http://www.nytimes.com/2009/02/11/business/11gehry.html?pagewanted=all&_r=0

⁷⁴<http://www.archdaily.com/177424/gehry-technologies-to-transform-the-building-industry-through-technology/>

⁷⁵ http://www.nytimes.com/2009/02/11/business/11gehry.html?pagewanted=all&_r=0

⁷⁶<http://priceonomics.com/the-software-behind-frank-gehrys-geometrically/>

⁷⁷<http://priceonomics.com/the-software-behind-frank-gehrys-geometrically/>

These services helped drive Gehry Technologies' growth--a "25 per cent year over year increase" in both 2010 and 2011--while also informing their software development. They gained insight into how other firms operate, and where technology could make the biggest impact.⁷⁹

"Our service is now in consulting," said Mr. Shelden, the chief technologist for Gehry Technologies. "But we are in discussion with some clients about a shared-savings model," under which the company would be paid a portion of a client's savings in construction overruns.⁸⁰

Interest in the technology led to the formation of two strategic partnerships in 2011:

1) First, the company formed an agreement with Dassault Systemes, a leader in 3D design and PLM (product lifecycle management)_ solutions. The deal integrated GT's Digital Project products into the Dassault Systemes' portfolio, enabling them to be distributed through Dassault Systemes' direct and indirect sales channels. This agreement allows for broader distribution of GT's Digital Project and leads the way for Dassault Systemes' longer term diversification strategy to address this market.⁸¹

2) GT also formed an agreement with Autodesk, Inc., a world leader in 3D design, engineering and entertainment software, to help architecture, engineering and construction (AEC) professionals to more fully realize the benefits of the Building Information Modeling (BIM) process to meet the demands of today's competitive building industry. The partnership enables GT to better serve its customers by expanding its consulting services to firms seeking to transform business and design workflows with Autodesk BIM solutions."⁸²

Then, in September 2014, the 140-person Gehry Technologies first spun off Digital Project, their version of the software CATIA, as a separate company, Digital Project Inc." Digital Project,

though it is no longer part of GT, it will continue to be a core tool in GT's professional services business. Future development, marketing, and sales of the program will continue under Digital Project Inc.⁸³

Finally in September 2014, the new version of Gehry Technologies was acquired by Trimble Navigation Limited for an undisclosed amount.⁸⁴ Trimble is an interesting player in this space, providing GPS, logistics, and asset management technologies to the agriculture, construction, engineering, and transportation sectors, worth over USD 2.6 billion in annual revenue.⁸⁵ The acquisition of Gehry Technologies was part of Trimble's broader strategy to integrate the work flow among the architecture, engineering, and construction industries, a quiet revolution which is yet to fully hit the profession. Trimble has acquired 29 companies that produce software, including CAD, BIM, GIS, and GPS applications including Tekla, a BIM software platform, and SketchUp.⁸⁶

According to Steven Berglund, President and CEO of Trimble, "We're interested in the entire work process," trying to create a company that treats projects as "a continuum of information," according to John Bacus, product management director of Trimble's architecture division. Gehry acknowledges that Trimble was not the first company to approach GT. When asked what motivated the decision to sell, he says, "They have the bandwidth to add (software) developers."⁸⁷

Innovation: wider value

In addition to the software tools that optimise geometry and construction processes, one of the biggest recent innovations of GT has been to develop tools to help architecture and building teams organize themselves and communicate about a project.⁸⁸

"In 2009, while working on the Fondation Louis Vuitton building in Paris, Gehry Technologies began to develop the project-based collaboration

⁷⁸<http://www.archdaily.com/177424/gehry-technologies-to-transform-the-building-industry-through-technology/>

⁷⁹<http://priceonomics.com/the-software-behind-frank-gehrys-geometrically/>

⁸⁰ http://www.nytimes.com/2009/02/11/business/11gehry.html?pagewanted=all&_r=0

⁸¹ <http://www.architectureanddesign.com.au/news/industry-news/gehry-technologies-reports-exponential-growth-than>

⁸² <http://www.architectureanddesign.com.au/news/industry-news/gehry-technologies-reports-exponential-growth-than>

⁸³http://archrecord.construction.com/news/2014/09/140911-Gehry-Technologies-Spins-Off-Its-Software-and-Services-Businesses.asp?WT.mc_id=rss_archrecord

platform called GTeam (now Trimble Connect). They needed a way to support “federated” data, in which databases from different vendors appear to work as one while functioning autonomously. At the same time, they were “excited about social media,” according to Shelden, and about the prospect of fluidly collaborating across firms, time zones, and schedules.”⁸⁹

Like a mix of GitHub, Google Docs, and Facebook, but for design and construction, GTeam allows collaborators to simultaneously edit different models within a project. The implications of each edit automatically propagate throughout, while the software checks for conflicts. Given the financial and legal structures that conventionally discourage architects, engineers, and contractors from sharing information so freely, the software also logs each move for legal record-keeping. Leading architecture firms including Zaha Hadid, Greg Lynn, UNStudio, Moshe Safdie, and Coop Himmelb(l)au have used this platform.⁹⁰

At the same time, the acquisition of Gehry Technologies by Trimble has hinted at new areas where the innovation of the GT products and services may be deployed.

The merger has combined Gehry Technologies’ expertise in design and construction with Trimble’s interests in supply chains, logistics, and facility

management. While the publicly-traded company is tight-lipped about its ambitions, one small sign of things to come arrived in April 2015, when Trimble announced that it was bringing Microsoft’s holographic augmented reality goggles, known as HoloLens, to a market that it tellingly describes as “AEC-O,” or architecture, engineering, construction, and operations.⁹¹

By applying and innovating new technology solutions to old problems such as waste, delay, and miscommunication, this new alliance will lead the process change that the AEC industry needs to confront future challenges. The group represents a new type of professional organization for the 21st century, one which embraces the possibility of technology to empower design.⁹² Architects and developers agree that software to measure a building’s ingredients will gain value as governments tighten rules about buildings’ effects on the environment.⁹³

⁸⁴http://archrecord.construction.com/news/2014/09/140911-Gehry-Technologies-Spins-Off-Its-Software-and-Services-Businesses.asp?WT.mc_id=rss_archrecord

⁸⁵<http://priceonomics.com/the-software-behind-frank-gehrys-geometrically/>

⁸⁶http://archrecord.construction.com/news/2014/09/140911-Gehry-Technologies-Spins-Off-Its-Software-and-Services-Businesses.asp?WT.mc_id=rss_archrecord

⁸⁷http://archrecord.construction.com/news/2014/09/140911-Gehry-Technologies-Spins-Off-Its-Software-and-Services-Businesses.asp?WT.mc_id=rss_archrecord

⁸⁸<http://priceonomics.com/the-software-behind-frank-gehrys-geometrically/>

⁸⁹<http://priceonomics.com/the-software-behind-frank-gehrys-geometrically/>

⁹⁰<http://priceonomics.com/the-software-behind-frank-gehrys-geometrically/>

⁹¹<http://priceonomics.com/the-software-behind-frank-gehrys-geometrically/>

⁹²<http://www.archdaily.com/177424/gehry-technologies-to-transform-the-building-industry-through-technology/>

⁹³http://www.nytimes.com/2009/02/11/business/11gehry.html?pagewanted=all&_r=0





2.2.2 Case Study

SHoP Architects, New York

Founding Year: 1996
Locations:- New York City, USA
Co-founders: Gregg Pasquarelli, Christopher R. Sharples, William W. Sharples, Coren D. Sharples, and Kimberly J. Holden
Principals: Gregg Pasquarelli, Christopher R. Sharples, William W. Sharples, Coren D. Sharples, Kimberly J. Holden, Jonathan Mallie (2007) and Vishaan Chakrabarti (2012)
Staff: 120+ designers, project managers, innovators, and architects

Practice Pracie

From early projects such as Porter House, a focus on materials and manufacturing has propelled SHoP to become one of the leading practices in New York. With more than 100 architects, construction managers and engineers and USD 2.8 billion in projects worldwide, SHoP is among the city's top 10 largest architecture firms. The partnership has averaged 20 per cent growth annually during the past nine years.⁹⁵

An interest in the relationship of building owner, architect and builder has led SHoP to innovate in these three areas, innovating in their own practice structure, their form of engagement with finance and real estate and in new construction and delivery techniques, where a unifying strand is the opportunities available due to new technologies:

“We never limit ourselves to simply designing an image. Part of our initial concept is always about knowing how something is going to be built.”⁹⁴

“The shift is mainly in the relationship of the owner, the architect, and the builder. I think it is a huge mistake to view these three figures as going against each other. The emerging technology allowed more blurring of the boundaries between these groups. If architects don't master the technology and take more responsibilities, they are going to get pushed to the side.”⁹⁶ The practice completed Brooklyn's Barclays Centre, and is currently working on a USD 1.1 billion mixed-income housing complex, an outlet mall in Staten Island with the world's tallest Ferris wheel and a luxury condo tower taller than the Empire State Building.

⁹⁴ <http://www.archnewsnow.com/features/Feature412.htm>

⁹⁵ http://www.crainsnewyork.com/article/20130602/REAL_ESTATE/306029975/shop-architects-gets-tough-projects-built

⁹⁶ <http://www.archnewsnow.com/features/Feature412.htm>

⁹⁷ http://www.crainsnewyork.com/article/20130602/REAL_ESTATE/306029975/shop-architects-gets-tough-projects-built

⁹⁸ http://www.crainsnewyork.com/article/20130602/REAL_ESTATE/306029975/shop-architects-gets-tough-projects-built

⁹⁹ <http://www.fastcompany.com/3025601/shop-architects-the-new-skyline#1>

Innovation: Practice Structures

SHoP's partners talk of breaking free of the tired convention that divides firms into two categories: the hip little ones, which devise adventurous buildings that exist only on paper, and the corporate behemoths, which design soulless glass skyscrapers that actually get built. SHoP's combination of business savvy and slick salesmanship have helped make it one of New York's most prolific firms – appealing not only to the high-minded design community but also the no-nonsense developers.⁹⁷

SHoP's interest in new business models can be attributed to the partners' varied backgrounds. The five founders graduated from Columbia's architecture school within a year of each other, but two studied business as undergrads, another majored in history, and two got art degrees.⁹⁸ Collaborative rather than independent the firm draws on their collective expertise. "This idea of an architect as a solo genius," Chakrabarti says, "is an extraordinarily antiquated concept."⁹⁹ "Our model is the following: architects, who are great creative thinkers, should be generalists and not only specialists. They should start getting involved with their projects on a variety of levels – understand the finance and invest money, get involved in politics, control the construction process, envision ideas for how their buildings will be maintained and used in the future. They can't just be designers. For us to grab back these territories can only be done through the use of the emerging technologies, and that is exactly what is happening. The more engaged and integrated into the building process we get, the more valuable our contribution will be to the built environment overall."

This focus on innovation in a general practice has also led SHoP to consider how traditional practice models act as limiters to their innovation agenda, resulting in a parallel set of innovations in regard to the SHoP business model itself. The partners have started three companies, the most significant of which is SHoP Construction, which offers services in areas such as management of Building

and Information Models including coordination of various systems locations in what is known as clash detection, and the development of Virtual Design and Construction (VDC) packages and construction management. By creating their own solutions, developing and harnessing emerging software, they are demanding a new set of tools to innovate and collaborate, leading rather than following in a realm that has traditionally been slow to change."

Sometimes this company works on a portion of a particular project, sometimes on a whole project, and other times it is commissioned by other architects or contractors to figure out how to build their very high-end designs. A quarter of our staff is now part of SHoP Construction."

Innovation: financial models

"SHoP tries to exert control throughout the development process. "Why not get involved in the politics behind the making of space?" Pasquarelli says. "Why not understand the financial instruments that make buildings happen? And yet our profession kept telling us that was dirty."

SHoP makes the case that innovative design can add tangible value to real estate and thus it follows that the architect's business and fee systems should be tied to this creation of value. Greg Pasquarelli's prior career as an investment banker has been one ingredient in SHoP's deft navigation of the financial environments within which buildings are procured. "I feel like architects should get no fee," he says, "but if their buildings are super successful, they should own a piece going forward." SHoP tested this approach in the seminal Porter House - a condo building in Manhattan's hot Meatpacking District - where SHoP didn't just design the building or the 22 multimillion-dollar apartments inside. The firm also invested some of its own money—both to control the design and to share in the spoils of a project the partners knew would be a success. In other projects the firm has even shirked taking fees in favour of equity in their properties, bridging the gap between architecture and real estate."¹⁰⁷

¹⁰⁰ <http://www.archnewsnow.com/features/Feature412.htm>

¹⁰¹ Olsen and MacNamara, 2014, *Collaborations in Architecture and Engineering*, 52.

¹⁰² <http://www.archnewsnow.com/features/Feature412.htm>

¹⁰³ <http://www.fastcompany.com/3025601/shop-architects-the-new-skyline#1>

Innovation: fabrication techniques

“...starting with the research about 15 years ago, we already knew that the computer does not care if the pieces it needs to fabricate are all different or all the same. So if we can manage the control of such versatile systems by thinking through how everything is going to be built and assembled, you can make anything you can dream of. Now, mass customization (when everything is unique) becomes possible. In the case of the Barclays Center façades, the smaller parts were assembled at the factory, came to the site as bigger panels, and were simply clipped to the building exactly the same way as if they were all the same. I don't think that the complex curvatures that are achieved in this project could have been built even five years ago. The technology was not there yet. Now we can do it.”

“We never limit ourselves to simply designing an image. Part of our initial concept is always about knowing how something is going to be built. For us an idea is not a shape. That's not how we start. We start by saying – let's use copper or let's use glass. Well, how big does the glass come? What are the ways it gets attached? What is the easiest way to put it on the building? Into how many pieces can I break it? How sharp of an angle can I make before it becomes expensive? All that thinking starts on day one. So the building emerges out of the logic, of how it works, and how it is put together. How does that logic work on the inside? How does that logic work within the urban context? How does everything work with the technology that is needed to put everything together?”

In traditional construction, the process of “value engineering” whittles out frills—straightening curved walls, substituting standard cabinets for custom. SHoP claims it can cut costs far more by controlling the process from brainstorming session to final rivet. “It's all about using technology and entrepreneurship to further the art,” says Pasquarelli. “Otherwise, these buildings would be dumbed down into really mediocre stuff.”¹⁰⁸

¹⁰⁴ http://www.crainsnewyork.com/article/20130602/REAL_ESTATE/306029975/shop-architects-gets-tough-projects-built

¹⁰⁵ NY Mag

¹⁰⁶ <http://www.archnewsnow.com/features/Feature412.htm>

¹⁰⁷ <http://www.archnewsnow.com/features/Feature412.htm>

¹⁰⁸ NY Mag

2.2.3 Approximating a value add for business development and systems

Based on the case studies presented here, there is potential for architects to expand their definition of architectural services to include new business models that cross boundaries with other disciplines, from manufacturing to real estate development and project management. Traditional practice structures are typically risk adverse and use the distinction of services under contract to limit liability within the design and construction processes. Taking on more liability within the sub-contractor areas for specific elements within a design that leverage in-house design technology and its links to manufacturing processes is just one way. The added value of this approach is directly applicable to the individual firm both within the constraints of a particular project, but also with ongoing benefits in Intellectual property and unique additional services available to future clients.

As much of this information is commercial in confidence, there is little available data to inform an assumption of this added value to

the sector at this stage. There is substantial evidence however, across a number of world leading firms, to indicate that those practices that are innovating in this space are benefitting enormously from their unique industry positioning, as much as the additional products and services they are developing and able to offer new clients. In the cases studies above, these benefits are substantive and in the multiple millions of dollars.

Using SHoP as an example, their growth over the last decade has been largely attributable to consciously operating beyond the traditional definitions of practice. Equally with Gehry Technologies, their sale to Trimble earlier this year closes a virtuous circle of design driven technological innovation combined with business acumen. The potential for this form of innovation sits directly in line with the Australian Innovation System and recent calls to innovate at the intersection of industries, not just within sectors.

Take out message

- There are significant potential impacts for industry and the economy for entrepreneurialism and innovation within architectural services. Industry will benefit by identifying and directly supporting start-up businesses within existing practices and support those that are emerging in the sector

- New data exchange platforms and digital information tools and processes represent a significant opportunity for architectural practices to innovate and value add to the economy.

- Federal government can play a pivotal role by providing clear incentives for built environment professionals engaged in research in order to drive innovation

2.3 Architecture's cultural contribution - events, exhibitions and tourism

Architecture contributes to cultural production and consumption patterns. Buildings and neighbourhoods act as draw-cards to bring tourists to experience particular settings and see particular buildings. Additionally, architects present new works, ideas, drawings and exhibitions and increasingly create cultural events within the broader design field that also generate economic activity while making a broad cultural contribution. In determining the added value of architecture to the economy, both of these aspects of architectural production are considered for the scale of their economic activity in order to gauge a preliminary value for architecture's added value in this area.

Architecture must be assessed not only in terms of what is built but how these places are used. The built environment can spur socio-cultural activity and generate great economic benefit in return. The tourism industry hinges on the built environment and the quality of touristic places – from heritage buildings and precincts, to iconic modern buildings. This tourism and international activity in turn, can promote a soft power through esteem and identity – raising Australia's profile and agency abroad. The value of built-environment heritage for tourism, one of Australia's fastest-growing sectors, should therefore not be underestimated.

According to Euromonitor International, Sydney is the 57th most visited city in the world - Australia's highest ranking city ahead of Melbourne at 90th- and Australia's built environment assets are world renowned. The Sydney Opera House is exemplary in this regard and is estimated to contribute

“AUD 640 million in yearly expenditure by visitors to Sydney”¹⁰⁹ as it pulls visitors to Sydney, indirectly encouraging overnight stays and visitor spending. Yet, beyond the Sydney Opera House, little data is available to estimate the economic value of iconic architecture to tourism in Australia. The recently completed Dr Chau Chak Wing building by Frank Gehry is complimenting the archi-tourism draw to Sydney and, according to new estimates completed for this report (see case study 2.3.1) is conservatively projected to add AUD 46 million annually to the local economy. This case study can be transferred to other buildings around Australia as a preliminary means through which to assess the scale of economic activity that occurs as a consequence of unique and excellent design in architecture.

In addition to the buildings themselves, cultural events that engage architecture or are focused on architecture are increasing and becoming ever more attractive to tourism. Every second year, the Venice Architecture Biennale brings thousands of tourists to Venice to experience the 4 month exhibition. More than 178,000 people visited the 2012 Venice Architecture Biennale. If we assume a modest EUR 1000 spend per person this equates to a EUR 178 million contribution to the Venice economy. In 2015, Chicago has entered into competition with Venice as a counterpoint to architectural cultural tourism in the United States (see case study 2.3.1). The city is seeking to bolster its existing USD 2.2 billion city arts and culture economy. Both events aim to attract large crowds to visit their host cities for three or more days, to see the exhibitions, hear talks and network amongst industry.

¹⁰⁹ Deloitte, 2013, *How do you value an Icon; The Sydney Opera House Economic, Cultural and Digital Value.*, p. 1)

Chicago Mayor Rahm Emmanuel hopes to “attract cultural tourists and situate the city at the forefront of contemporary architecture and design.”

As a response to the growth in interest in architectural tourism, and in terms of the capacity for cultural tourism to assist in transforming cities, there has been an explosion of biennales around the world (see: 2.3.1. Case study). Currently there are 221 biennales occurring around the world that cross over art, architecture and design. Of these 24 are dedicated specifically to architecture meaning that if a biennale occurs every second year, there is on average a new architecture biennale opening every month somewhere in the world.

Architects produce drawings, models, fly-throughs, movies, publications, prototypes and lectures as part of their work. These are ideal ways to engage broad audiences in the conversation on Architectural design as well as test ideas about the future of our built environment that are of interest to both a professional and public audience. The Sydney Architecture Festival, World Architecture Day, Vivid, professional design awards, and the annual Gold Medal winner lectures are examples of events that are architecture and ideas-centred and capture the interest of a broad public in architecture in Sydney on an annual basis.

As a new Biennale, eyes are on Chicago. With an initial USD 2.5 million seed funding from British Petroleum to ensure the success of the event, and a total supporters drive of USD 4 million, Chicago Mayor Rahm Emmanuel hopes to “attract cultural tourists and situate the city at the forefront of contemporary architecture and design.” Recognizing both the interest in the design of the built environment and the potential value of such an event Sarah Herda, one of the inaugural creative directors of the Chicago Biennale notes, “Architecture is an incredible asset for Chicago, but it’s also an underutilized asset.”



2.3.1 Case Study

The “Bilbao effect”¹¹⁰ – UTS’s Dr. Chau Chak Wing Building and archi-tourism

Location: Omnibus Lane & Ultimo Road,
Design architect: Ultimo NSW, Australia
Executive architect: Gehry Partners
Structural engineer: Daryl Jackson Robin Dyke
**Brickwork engineer-
ing:** Arup
AECOM
Builder: Lend Lease Group
Bricklayer: Favetti Bricklaying
Brick Manufacturer: Bowral Bricks
No. of bricks: 380,000
Date of manufacture: June-July 2013

“The exterior and interior of the Chau Chak Wing Building is creative, innovative, provocative and “a space where creativity is encouraged and all ideas are welcome”

-Lancione & Clegg 2014

The Attraction

Opened in December 2014 the Dr Chau Chak Wing Building (CCWB) has already attracted multitudes of visitors who wander around and through the building, gazing at its unique architectural form and presence. The exterior and interior of the CCWB is creative, innovative, provocative and “a space where creativity is encouraged and all ideas are welcome” (Lancione & Clegg 2014 p.288). Effectively the CCWB has changed the landscape, scale, tempo, visitor activity, and ‘feel’ of the city experience in the Haymarket precinct. The CCWB is emerging as an anchor attraction along with the Sydney Opera House pulling visitors from one end of the city to another demonstrating that spaces, people, activity and architecture all interact to shape the experience of the visitor.

Innovation: Benefits Transfer Method (BTM)- a new value assessment tool for architectural tourism

This report presents a new model for estimating direct tourism expenditure that is likely to accrue from iconic architecture in Australia, using the benefits transfer method (BTM) as a credible model for estimating architectural value. In this case study, a working example of the model is applied to the emerging architectural icon, the CCW. The BTM involves the application of value estimates, functions, data, and/or models from existing studies to estimate economic values for a similar valuation question by transferring available information from studies already completed in another location and/or context. The BTM can be employed when there is limited time, and financial resources to collect primary data. For more on the methodology, see Appendix A.

¹¹⁰The Guggenheim Museum Bilbao, designed by Frank Gehry, was designed and built in the 1990’s as part of a holistic plan to rejuvenate the city. The success of the building benefits to the city delivered unexpected results, “the museum has brought hope to citizens and city officials and has united political parties, trade unions and civic associations...” (Plaza, 2007 p.2). The GMB is viewed as an economic reactivator, creating the phenomenon now known as the “Bilbao effect”.

In the most rigorous application of the BTM, the value function of a study is transfer to another. Specifications of the transferable value functions can be achieved through a theory driven model or can be statistically derived.¹¹¹ Adjustments can be made for differences in characteristics between the original study and the transfer study allowing for more precision in the transfer benefit estimates.

Sydney Opera House (SOH) - The reliability of the BTM is determined by the level of similarity between the study sites. Factors such as quality, location and population characteristics, likeness of environmental change between the two sites, and the robustness of the original valuation study. In this report, the estimate of the value of the CCW building to tourism expenditure, outlined below, is derived from transfer benefit value from methods used to measure the contribution of the SOH to tourism expenditure by Deloitte (2013).¹¹²

The SOH includes performances that include a start time and finish time of which the performance is generally between 2-3.5 hours. The SOH also includes an area in which visitors may observe and enjoy non-use values of the building without entering the building. It can be argued that workshops, seminars and other presentations conducted by academics and audiences in the CCWB are similar to the services provided by the SOH. Additionally, the SOH provides a likeness in population characteristics. As this report seeks to provide a tourism expenditure value and the population is visitors whose primary purpose of travelling is for leisure, the population is identical. In addition the population can be further segmented by the number of domestic day visitors, domestic overnight visitors and international visitors. Finally an existing SOH Deloitte (2013) report provides a high-quality study from which to transfer value. Deloitte (2013) is the most comprehensive study conducted for a single iconic building identified and takes into account economic, audience and social elements, brand strength, and digital footprint.

According to Deloitte (2013) the SOH attracted nearly 1.4 million people to more than 1,800 performances. Two steps to estimating tourism expenditure attributable to the SOH were used. The first was the estimation of tourism expenditure made by visitors whose main reason for travelling to Sydney was for holiday (holiday makers). Holiday makers, in this context were separated by international, domestic overnight visitors and domestic day visitors. The second was estimating the contribution of the SOH to their expenditure. Based on this method the estimated contribution of the SOH to tourism expenditure in Sydney for 2012-2013 was estimated to be AU\$640.1 million, this being 10.55% of the total Sydney holiday expenditure.

Application of the BTM to the Chau Chak Wing Building

A visitor attraction can be defined as a 'named site with a specific human or natural feature which is the focus of visitor and management attention.'¹¹³ The input approach to assigning value in team production makes it difficult to attribute a value to any one tourist attraction. However as tourism activities are an input provided in the delivery of the attraction, the amount paid by visitors to participate in the tourism activity can be used as a proxy for output. According to the 2013 Deloitte report on the Sydney Opera House (SOH), tourism activities related to the SOH can be defined as:

- attending the theatre and other performances;
- visiting heritage buildings, sites, monuments or building of significance;
- sightseeing;
- all other activities.

The Deloitte study used visitor estimations derived from the International Visitor Survey thus the same approach is adopted in this research: the transfer of existing values for a unit to be used to value CCW contributions. The estimate is based on four assumptions.

¹¹¹ *Bateman et al 2011*

¹¹² *See: Deloitte*

¹¹³ *Pearce, 1991, p. 46*

The first assumption is the “return on investment” time period required for the GMB (7years) and TPM (5years) to gain a level of maturity and exposure in the market. The second assumption is that the audience and creative performances of theatre, music and dance are comparable to audiences and academic performances held in the CCW. The third assumption is the average value of performances held at the SOH (AU\$80) is transferrable to academic performances that are expected to be held in the CCW. The final assumption is the team production factors for the SOH and the CCW building will be comparable at approximately 10%. Based on these assumptions the conservative estimated per annum contribution to tourism expenditure expected within 5-10 years from the CCW is AU\$46million. The values and data sources are shown in detail in Appendix A, as well as notes on research limitations.

Innovation: future research

Two key areas can be identified for further study of the value of architectural tourism in Australia. The first area is to conduct a full study on buildings of significant architecture in the country. For the example study the CCWB visitor expenditure were estimated based on their primary purpose of travel: cultural and heritage tourism, and education being the two factors included. However, the ability for the CCWB to attract conferences, business events and multi-day workshops suggests that a different set of variables may be required to more accurately estimate the true value of the CCWB to tourism and tourism expenditure. Therefore it is possible that the tourism expenditure component could be extended to include the direct expenditure method proposed by Edwards, Foley, Schlenker & Hergesell (2014). Extending research to incorporate this method would provide new insights into the different kinds of activities that occur within buildings of significant architecture that attract visitors and the likely impact these various activities have on tourism and tourism expenditure.

The second area for future research concerns the “team contributions” of various significant architecture types and tourist attractions in Australia. The research would provide a better

understanding of the characteristics of different architectural types (such as iconic architecture, landmarks, monuments, historic houses, zoos and other categories of tourist attraction) within the country. For examples, existing studies and cases tend to only include buildings where the primary purpose is arts and culture (museums). A study which addressed the variances in contributions of different types of architecture or tourist attractions would permit architecture and other tourist attractions to be classified into a tiered structure according their built characteristics and their ability to contribute to tourism in general and tourism expenditure specifically.



2.3.2 Case Study

Chicago Biennial

Location:	Chicago Cultural Center and downtown locations, Chicago, USA
Year:	Inaugural event - Oct. 5, 2015-Jan. 3, 2016
Exhibition Curators:	Sarah Herda, Director, Graham Foundation Joseph Grima, fmr. editor-in-chief, Domus
International Advisory Committee:	David Adjaye (London), Elizabeth Diller (New York), Jeanne Gang (Chicago), Frank Gehry (Los Angeles), Stanley Tigerman (Chicago), Sylvia Lavin (Los Angeles), Lord Peter Palumbo (London, Chairman of the Pritzker Prize for Architecture), Hans Ulrich Obrist (London, Co-Director, Exhibitions and Programs, and Director of International Projects at the Serpentine Gallery)

*“the city’s most distinctive cultural asset is its spectacular, ever-evolving architecture and its history as the birthplace of architectural modernism.”*¹¹⁴

The Event “The State of the Art of Architecture”

Aiming to boost tourism and elevate its status as a design and architecture centre, Chicago is about to host a global exhibition of cutting-edge architecture “that will strive to duplicate the cachet and commercial success of a cultural spectacle in Venice, Italy.”¹¹⁵ The project is heavily backed by the Chicago Mayor, Rahm Emmanuel, who hopes it “will attract cultural tourists and situate the city at the forefront of contemporary architecture and design.”¹¹⁶

These sentiments are echoed by Biennale Director Sarah Herda. “Architecture is an incredible asset for Chicago, but it’s also an underutilized asset, ... Chicago is the most important city for architecture in the country and it’s astonishing that such an event hasn’t taken

place yet in North America. It seems like a great opportunity and an important time to convene the world.”¹¹⁷

To run the event, Chicago Architecture Biennial, Inc. has been formed as a non-profit corporation charged with executing the 2015 and subsequent Biennials. The organisation seeks to convene the world’s leading practitioners, theorists and commentators in the field of architecture and urbanism to explore, debate and demonstrate the significance of architecture to contemporary society.¹¹⁸

¹¹⁴<http://www.chicagoreader.com/chicago/architecture-biennial-fifth-star-awards-fire-festival/Content?oid=14394929>

¹¹⁵<http://www.chicagotribune.com/news/columnists/ct-chicago-architecture-biennial-met-0624-20140624-column.html#page=1>

¹¹⁶<http://www.artinamericamagazine.com/news-features/news/chicago-announces-architecture-biennial/>

¹¹⁷<http://www.artinamericamagazine.com/news-features/news/chicago-announces-architecture-biennial/>

¹¹⁸ <http://chicagoarchitecturebiennial.org/about/>

Evolving the biennale model

Starting a new Biennale is a bold project with known risks. “Besides Venice, whose architecture biennial began in 1980, scores of cities — from Sao Paulo to Istanbul to Denver — hold biennial exhibitions of art, design and architecture. Chicago will compete with them for exhibits, attention and tourists’ dollars.”¹¹⁹

Yet the City of Chicago is aware of its special pulling power in the area of architecture and design:

*“Venice is an incredible institution with incredible history and legacy, yet there’s room for such an event in North America. People speak about biennale fatigue, but how could we be tired of them when there’s none here?”*¹²⁰ A key aspect of the Chicago Biennale’s success will be the way in which it manages to distinguish itself from the Venice event. The exhibition will represent all six continents but will reflect the city’s contribution to the architectural discipline.¹²¹

The show – which will be underway when this report is released, is being discussed constantly in binary terms:

*“At worst, it’ll turn out to be a less-than-scintillating three-month exhibit at the Cultural Center, mostly seen by locals. At best, it’ll build on the city’s glory.”*¹²² On the other hand, “David van der Leer, executive director of New York’s Van Alen Institute is certain the Biennale is a great opportunity:

*‘Even though around the world we could safely speak of biennial madness, I welcome all attention we can generate for architecture and design in the U.S.—a country that could see a tremendous increase in well-being and productivity as a result of better-designed cities and buildings...The curators should create a project that truly connects design to society and promote its possibilities among new and surprising audiences in Chicago, around the U.S. and beyond.’*¹²³

An awareness of these issues has openly led to a discussion around the commitment required to hold the event:

Martin C. Pedersen, executive editor of New York-based Metropolis, an architecture and design magazine, has noted that ‘just by being in Chicago alone, even with its amazing cultural heritage around architecture, that in and of itself won’t make it an absolutely must-go. There has to be a real commitment over not just one year, but over three or four years.’¹²⁴

The relationship between architecture and city identity/branding

Co-Director Joseph Grima has clearly articulated the way in which the event and its host city are bound together:

*“For over a century, one of Chicago’s main exports has been bold innovation in architecture. The Chicago Architecture Biennial is an extraordinary opportunity to learn from Chicago and radically reconsider the challenges and opportunities facing contemporary architecture on a global stage. As we design the cities of tomorrow, new platforms of research and reflection are needed, and Chicago’s history is a reminder that we shouldn’t forget to be visionary.”*¹²⁵

The establishment of the Chicago Architecture Biennale has emerged from the longstanding relationship in Chicago between architectural quality and economy. The new biennial is one of the major initiatives of Mayor Rahm Emanuel’s cultural plan - a revision of the 26-year-old *Chicago Cultural Plan*¹²⁶ which is constantly measured for its impact on neighbourhoods throughout the City. The Plan – Chicago’s blueprint to advance the city’s cultural community and creative economy – continues to capture the attention of policymakers around the U.S.¹²⁷

¹¹⁹<http://www.chicagotribune.com/news/columnists/ct-chicago-architecture-biennial-met-0624-20140624-column.html#page=1>

¹²⁰<http://www.artinamericamagazine.com/news-features/news/chicago-announces-architecture-biennial/>

¹²¹<http://www.chicagomag.com/arts-culture/November-2014/What-You-Should-Know-About-the-Chicago-Architecture-Biennial/>

¹²²<http://www.chicagoreader.com/chicago/architecture-biennial-fifth-star-awards-fire-festival/Content?oid=14394929>

¹²³<http://www.artinamericamagazine.com/news-features/news/chicago-announces-architecture-biennial/>

¹²⁴ <http://www.chicagotribune.com/news/columnists/ct-chicago-architecture-biennial-met-0624-20140624-column.html#page=1>

¹²⁵<http://chicagoarchitecturebiennial.org/press/initial/>

The Biennale does sit within a specific, if for a period, forgotten, part of Chicago history. Chicago has a rich architectural and urban heritage, extending from the Columbian exhibition in 1893 (which, in part, inspired the establishment of the Venice Art Biennale), through the modern architecture of Louis Sullivan, Frank Lloyd Wright and Mies van der Rohe, to more contemporary examples like the renovation of Millennium Park and Rem Koolhaas's Campus Center at the Illinois Institute of Technology.¹²⁸

"Architecture defines a city, and no city has been defined by its architecture—or has influenced global architectural design—like Chicago," said Mayor Rahm Emanuel. "The Chicago Architecture Biennial will showcase the city's widely-respected architectural heritage, promote architecture as one of our thriving creative sectors, and deliver a rich cultural experience to our neighbourhoods."¹²⁹

"Architecture is so important to the quality of life in the cities of the 21st century," said Chicago business and civic leader Louis Susman. "As a great global and architectural city, Chicago is the ideal place for a North American biennial of architecture." The new group that Susman is leading, which is in formation, will support, produce, and present ideas and programs that convene the world's leading practitioners, theorists, and commentators to explore, debate, and demonstrate the significance of architecture and related fields to contemporary society."¹³⁰

The exhibition is not a professional building convention but will look at the many dimensions of architecture as a cultural practice, including aesthetic issues, technological issues, environmental issues, socio-economic issues, and political issues.¹³¹ Installations will be

¹²⁶ *Chicago Cultural Plan* – first ordered up by Mayor Harold Washington in the 1980s – designed to make Chicago an enduring icon for arts advocates and city planners nationwide. Daniel Silver of the University of Toronto - *Chicago Cultural Plan* is "incredibly influential" in other cities, including Toronto, where they've produced a new cultural plan every decade since 1973. "But the big pieces—understanding the economic engine that the arts and culture are in the city, and strengthening the Department of Cultural Affairs as a player, as important as, say, Streets and San—those have survived," Dorf says.

¹²⁷ Department of Cultural Affairs and Special Events (DCASE), City Council Budget Hearing – October 22, 2014.

¹²⁸ <http://www.artinamericamagazine.com/news-features/news/chicago-announces-architecture-biennial/>

¹²⁹ <http://chicagoarchitecturebiennial.org/press/initial/>

¹³⁰ <http://chicagoarchitecturebiennial.org/press/initial/>

¹³¹ <http://www.chicagomag.com/arts-culture/November-2014/What-You-Should-Know-About-the-Chicago-Architecture-Biennial/>

created in Millennium Park and other Chicago neighbourhoods to encourage all to explore the city as the canvas for a survey of architecture of the past, present, and future.¹³² It has also been a key part of the planning that the event will make a major contribution to the city's built fabric via plans for legacy projects.¹³³

Mayor Rahm Emanuel boasts that it will “showcase the city's widely respected architectural heritage” while promoting our “thriving creative sectors” and, of course, delivering an experience to the neighbourhoods.¹³⁴ There will also be a program of events “invite(s) the public to engage with and think about architecture in new and unexpected ways, and to take part in a global discussion about the future of the field.”¹³⁵

An organisational structure and business case for architectural events

The Chicago Architecture Biennial will be coordinated by a newly-formed non-profit organization that will be headed by Chicago business and civic leader Louis Susman, former Ambassador to the Court of Saint James.¹³⁶ The Chicago Architecture Biennial will present the event in partnership with the Graham Foundation and the City of Chicago.¹³⁷

Chicago is aware of the value of its arts and cultural sector to the city economy – analysis suggests that it contributes USD 2.2 billion annually, providing 60,000 jobs and USD 1.3 billion in household income every year.¹³⁸

The decision to host a Biennale is therefore is logical progression for a city that understands the benefits this audience brings to the economy. For example, more than 178,000 people attended the 2012 Biennale of Architecture in Venice.¹³⁹ Like Venice, the target audience for the event will be a broad cross section including architects, students, tourists and cultural connoisseurs,¹⁴⁰ for whom city officials see the biennial as a “point of entry” that will introduce visitors to the city's acclaimed line-up of restaurants and museums.¹⁴¹

The promise of the prestige and economy activity resulting from such an event has enticed global giant BP to come on board as inaugural sponsor. Emanuel personally solicited the lead, USD 2.5 million donation for the biennial from BP, which has offices in downtown Chicago and a research and development complex in Naperville. City officials, who said they have other pledges, acknowledged that at least another USD 1.5 million still must be raised from private benefactors. The result will be that unlike the Venice event - which has a two-day ticket price of 30 Euros - there are currently no plans for an admission charge for the Chicago Biennale.

¹³²<http://chicagoarchitecturebiennial.org/press/initial/>

¹³³<http://www.chicagomag.com/arts-culture/November-2014/What-You-Should-Know-About-the-Chicago-Architecture-Biennial/>

¹³⁴<http://www.chicagoreader.com/chicago/architecture-biennial-fifth-star-awards-fire-festival/Content?oid=14394929>

¹³⁵<http://chicagoarchitecturebiennial.org/about/>

¹³⁶<http://chicagoarchitecturebiennial.org/press/initial/>

¹³⁷Department of Cultural Affairs and Special Events (DCASE), *City Council Budget Hearing – October 22, 2014*.

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¹³⁹<http://www.chicagotribune.com/news/columnists/ct-chicago-architecture-biennial-met-0624-20140624-column.html#page=1>

¹⁴⁰<http://www.chicagotribune.com/news/columnists/ct-chicago-architecture-biennial-met-0624-20140624-column.html#page=1>

¹⁴¹<http://www.chicagotribune.com/news/columnists/ct-chicago-architecture-biennial-met-0624-20140624-column.html#page=1>

¹⁴²<http://www.artinamericamagazine.com/news-features/news/chicago-announces-architecture-biennial/>

“Although Chicago enjoys a head start, at least in terms of budget and institutional support, it may struggle to compete with other architecture biennials in Shenzhen, São Paulo, Istanbul and, first and foremost, Venice, which has established a loyal following and international reputation.” ¹⁴²

2.3.3 Approximating a value add for cultural and tourism industries

While generating tourist expenditure is not always an explicit architectural objective, many architects, Lord Mayors and cultural organisations are increasingly aware that architecture may become a visitor attraction in its own right – an externality that requires valuing. Estimating the value of significant architecture enables stakeholders to better understand the economic benefits of design driven development, and the travel and tourism industry to estimate the value of investing further in the development of specific buildings and precincts as well as encouraging collaboration across industry sectors in order to better realise direct and indirect benefits.

Attempts to estimate the tourism contribution of significant buildings is an expensive and time consuming process, yet the information can inform budgets, return on investment, time frames and the contributions governments at all levels are willing to make on the design component of buildings which have the potential to “pull” visitors to an area. The use of the benefits transfer method (BTM) is one way in which estimates can be made drawing on existing cases and data. Above, the Frank Gehry designed CCWB has been used to demonstrate a new method of valuing iconic architecture to tourism. The study estimated the future yearly value of the CCWB to tourism to be in the vicinity of AUD 46 million.

There are limits to current data available in this area, although it has been recognized in various reports that Sydney is a well visited tourist destination and rich in natural and built assets. Sydney enjoys recognised world class architecture in recent new buildings which are attracting significant attention in their own right, as much as providing an attractive ‘bundle’ to draw tourism. Current limits within the field include highly segreg-

ated data on tourism and architecture, and relatively limited methods for assessing the value of more complex relationships between cultural events, built and natural assets and tourism.

If we assume the CCWB is worth AUD 46 million to the economy annually, is it also possible to assume other significant buildings in the same city, as well as other cities create a bundled effect? The Museum of Old and New Art (MONA) has been described as the most important cultural facility in Australian since the opening of the Sydney Opera House. It has achieved international recognition for its architectural presence, for innovating how art is experienced and for generating economic benefits that can create a platform for significant and sustainable urban regeneration and tourism.¹⁴³ Indeed, data from the 2014 Tasmanian Tourism Survey show that 16% of visitors to MONA stated visiting the MONA as their primary reason for travelling to Tasmania. Australia is also home to other modern iconic buildings, beyond the SOH, including One Central Park (NSW), South Australia’s Health and Medical Research Institute (SA) and Federation Square (VIC) which signal the presence of a strong multiplier effect in this area of economic contribution. While clearly recognizing the limits to extrapolate this data further, for the purposes of this report, a multiplier of 3 is used to assume a national figure for architectural tourism in Australia, (ie one CCWB equivalent per most visited states) making architectural cultural tourism in the order of AUD 827million.

Government and institutions can maximize the economic benefits of the built environment such as tourism by making available to the public more architectural assets and working to enhance the “bundling up” of mutually supporting attractors. This suggests

¹⁴³The MONA gallery is headlined as “World Class MONA helps smash Tassie’s Tourism Record” (Martin 2014 p.1).

there is enormous value in well designed precincts, even over individual or isolated 'icons', with implications for city cultural policy and development frameworks. In addition, the flow on effect of economic activity from architecture and its capacity to act as a cultural draw are recognized by the proliferation of biennales, festivals and large scale events globally, and the growth of the architectural tourism market. Annual events such as the National Architecture conference, held by the Australian Institute of Architects, the National Architecture Conference, Vivid, International speaker events and academic conferences as well as specialist exhibitions add to this area. A preliminary assessment of these events in Australia shows a contribution of AUD2.6 million annually before tourism and other flow on effects are included. This highlights a significant opportunity for growth in this area through its proximity to Asia, and to develop international collaboration pathways essential to innovation.

Take out messages:

- Architecture produces cultural products such as exhibitions and events as well as buildings, and is being recognized globally as a leader in city development through tourism.
- Excellent and unique design of the built environment is a draw card for tourism and has a significant and enduring economic impact beyond building costs.
- Individual buildings that operate as draw cards for tourism can be complimented by a 'bundling effect' of buildings and precincts exemplifying design excellence.
- The role of architecture in cultural terms promotes direct and indirect economic activity that is a significant contribution to



2.4 Architectural education and research

Architectural education and research are integral to the discipline of architecture as a whole in a number of respects. In the first instance, the cultural connection and professional investment that many practitioners make to university and continuing education over the span of their careers is unique, as well as the need from universities for casual staff from the profession to deliver their programs. Research has a long informal relationship to practice, but is a growing field within architecture as a whole due to the changing nature of non-traditional services being undertaken by firms as much as the fast moving knowledge landscape aligned to technology, policy, business and so on.

Equally research is now not optional for academic programs working in architecture whose faculty are required to deliver research outcomes through pressures from universities and whose research identities are as important to the success of a program as the work and skills of the graduating students. Both these areas of architecture represent an unaccounted for contribution to the economy well outside of traditional measures of building construction and those located through industry services reports.

Architectural education

Rapid urbanization in developing countries is forecast to fuel investment in urban infrastructure of more than \$9 trillion by 2025.¹⁴⁴ The strong rates of urbanisation in Asia will result in a shift of investment from heavy industry to the building of infrastructure: residential construction, roads and other transport networks, container port capacity, and urban amenities (such as water and electricity distribution)¹⁴⁵. This shift positions the Australian education sector well to service the increased demand for what is increasingly termed *tradeable urban services*¹⁴⁶ comprising architecture, engineering, construction and the like.

The education of a student of architecture is delivered through the tertiary university system, and as such typically falls under the value category of higher education as a whole. Globally, higher education is under enormous pressure to significantly change the way in which it is delivered as much as what the expected skills or graduate attributes of a university degree should signal. New funding models currently under discussion in Australian Federal parliament signal imminent change in the Australian tertiary sector, and with competition from online third party providers moving into education there is internal and external pressure building for education reform. The specific impacts of these larger trends for architectural education signal significant near term changes to the ways in which

¹⁴⁴PWC <https://www.pwc.se/sv/offentlig-sektor/assets/capital-project-and-infrastructure-spending-outlook-to-2025.pdf>

¹⁴⁵http://www.defence.gov.au/whitepaper/2013/docs/australia_in_the_asian_century_white_paper.pdf p66

¹⁴⁶<http://jllblog.com/cities/2014/12/02/the-business-of-cities-the-growth-of-tradable-urban-services-and-solutions/>

architectural education has been delivered.

For more than a decade, architectural education in NSW has been a strong demand degree, with typically > 3 applicants to every 1 commonwealth supported place being offered annually. This demand has in turn driven the ATAR (Australian Tertiary Admissions Rank) for prospective students into the 95 percentile band¹⁴⁷, meaning admissions to architecture in Sydney is theoretically achievable directly from the Higher School Certificate for only the top 5 per cent of students. This demand for architectural education recognises the blend of creative and professional services skills as well as a valuable range of skills including graphic communication, design and problem solving, technical integration, creative practice skills and the broad cultural knowledge of a disciplinary background that make architecture a high 'value-add' degree well aligned to innovation contexts.

An education in architecture in Australia is bound by accreditation standards that recognise the skills central to architectural practice although not explicitly beyond building design and traditional practice standards, which has had flow on effects within school curriculum demands and requirements which is an area of consistent review. Accreditation however is valuable in setting standards not shared universally across the international sector and adding value to the degree's of architects educated and registered in Australia. As there is high demand locally and internationally for the degree and significant scope to increase the number of student places and graduates of architecture, this is an area of significant opportunity to the industry and aligned creative industries as a whole.

Higher education as a whole is under pressure from new online education providers who recognize the value of the sector as part of the education market. There is ongoing debate regarding the benefits for the protection of the professional degree in architecture or its expansion to absorb the demand for the degrees. To calculate this value, student fees paid to education providers serves as an appropriate proxy value.

The value of education

For the purposes of this study, the value of education as a component of the overall value add of architecture to the economy can begin to be calculated as a multiplier of the number of architecture students currently studying architecture in Australia and the average university fees per annum for the first bachelor degree in Architecture and the Masters of architecture degrees across all Australian degrees offering architecture. However, student contribution to the economy is larger than fees alone. The Go8 policy note on *International Students in Higher education and Their Role in the Australian Economy*¹⁴⁸ identifies areas of contribution beyond student fees, which can be considered generally of all students, not just international students.

These include;

- Greater Domestic Participation in Higher Education
- Job Creation
- Magnet for further tourism
- Australia's long term economic growth
- Addressing Skills Shortages
- Improving Australia's research capacity
- Building Australia's network and reputation

Table 1, right, reflects an effort to assess the domestic and international student fee contributions, based on the best available data. Figures on student enrolment – reflecting 2013 enrolments - were available from the Australian Architecture Schools 2015, an annual report compiled by the Australian Institute of Architects, and published by Australian Institute of Architects National Office¹⁴⁹ while annual study fees were taken as averages from fees published on the websites of Australian university providers of architecture, as of September 2015. For the purposes of this study, only the student fees component of the value add has been used in order to calculate a base line for further study, and indicate the scale of the value add of architecture students within the larger higher education sector more generally.

¹⁴⁷ For the three metropolitan schools of architecture, at the University of NSW (UNSW), The University of Sydney (USyd) and the University of Technology Sydney (UTS)

¹⁴⁸ Group of Eight policy note, *International Students in Higher education and Their Role in the Australian Economy*, published March 2014, <https://go8.edu.au/publication/international-students-higher-education-and-their-role-australian-economy> (accessed 21.09.15)

¹⁴⁹ Barton, ACT, 2015 edition, SSN 1320 -1808, p88

Table 1 2015 Architecture student fees income across Australian universities, AUD

Program	DOMESTIC - Australia				INTERNATIONAL				TOTAL
	Student No.	Avg. PA Fee		Fees Income ¹	Student No.	Avg. PA Fee		Fees Income ²	Fees Income
		U'grad	Postgrad			U'grad	Postgrad		
	AUD	AUD	AUD		AUD	AUD	AUD	AUD	
University of Canberra	364	8,768	-	3,191,552	36	26,100	29,880	939,600	4,131,152
University of NSW	297	8,768	-	2,604,096	242	32,000	34,560	7,744,000	10,348,096
University of Newcastle	232	8,768	-	2,034,176	69	-	-	-	2,034,176
University of Sydney	439	8,768	8,768	3,849,152	131	36,000	34,500	4,716,000	8,565,152
University of Technology Sydney	350	8,768	8,768	3,068,800	125	26,208	27,936	3,276,000	6,344,800
Deakin University	570	8,768	24,664	4,997,760	186	25,208	26,680	4,688,688	9,686,448
Monash University	265	8,500	-	2,252,500	48	30,400	-	1,459,200	3,711,700
Royal Melbourne Institute of Technology	331	8,917	31,680	2,951,527	215	-	-	-	2,951,527
University of Melbourne	812	8,917	30,688	7,240,604	543	35,536	35,104	19,296,048	26,536,652
Bond University	45	48,792	34,048	2,195,640	10	48,792	34,048	487,920	2,683,560
Griffith University	231	8,917	23,520	2,059,827	15	28,000	29,500	420,000	2,479,827
Queensland University of Technology	798	8,800	8,800	7,022,400	83	28,000	25,200	2,324,000	9,346,400
Queensland University	375	8,920	8,917	3,345,000	74	34,611	33,280	2,561,214	5,906,214
University of Adelaide	300	8,850	8,925	2,655,000	156	27,500	29,500	4,290,000	6,945,000
University of South Australia	328	8,917	8,917	2,924,776	63	28,000	29,900	1,764,000	4,688,776
Curtin University	402	8,600	8,770	3,457,200	125	31,100	31,600	3,887,500	7,344,700
University of Western Australia	629	8,371	8,371	5,265,359	147	-	-	-	5,265,359
University of Tasmania	272	8,768	8,768	2,384,896	178	23,805	20,004	4,237,290	6,622,186
Charles Darwin University	33	8,768	-	289,344	5	19,344	-	96,720	386,064
Total	7073			63,789,609	2451			62,188,180	125,977,789

1. Calculations based on domestic undergraduate enrolment.
2. Calculations based on international undergraduate enrolment.

Taking the perspective of the overall value add of architectural education to the Australian economy, the good reputation of the programs of architectural education are already significant draw-cards for international students but have the capacity for expansion to grow the sector. In 2011, international students represented a contribution of 0.97 per cent per cent of Australian GDP¹⁵⁰ and are considered Australia's fourth best performing export. International student fees indicate only the amount each student pays to the host institution, but does not factor in living costs, contribution to accommodation, supplies, etc., that international students bring with them. As architectural education is a comparatively long 5 year degree compared to typical 3 year degrees, there is significant potential for future investment and growth in this area with excellent flow on effects to industry skills and internationalisation.

Considering the total annual value-add of architectural education in Australia includes:

- domestic student fees;
- international student fees;
- associated international students costs of living;
- additional international visits for families of international students; and
- course materials and additional course related travel.

Positive factors to be considered in assessing the growth of this area of the architectures value-add include:

- historic pressure on enrolments into architecture degree's and high ATAR's;
- Australia's position as the third largest international student market;
- the international student market as Australia's fourth largest export, estimated at AUD 15 billion in revenue per annum, and contributing over AUD 18.5 billion in revenue in the last 5 years¹⁵¹;
- the excellent reputation of Australian architecture programs;

Negative factors effecting growth in this area are:

- limited program resources and capacity;
- changes in VISA laws;
- instability in the Australian dollar;
- growing international competition; and
- uncertainty due to changing federal education policy.

¹⁵⁰Deloitte Access Economics, *The Economic Contribution of International Students*, report prepared for the Australian Council for Private education and Training, Feb 2013, http://www.acpet.edu.au/uploads/files/Reports_Submissions/2013/Economic-Contribution-Executive-Summary.pdf, (accessed 21.09.2015), p iv

¹⁵¹See Group of Eight policy note, *International Students in Higher education and Their Role in the Australian Economy*, published March 2014, <https://go8.edu.au/publication/international-students-higher-education-and-their-role-australian-economy> (accessed 21.09.15)

Research

Similarly to education, research tied to architecture is valued primarily through Australian Research Council (ARC) granting schemes and the value of research outputs measured by the university sector and is one of the key indicators of innovation in the Australian Innovation System framework. Research occurs throughout the sector across many silo's, from historic and humanities based research to technical and systems development. Within the Australian Innovation System framework therefore, Architecture is generally accounted for within the construction industry sector, although parts of the research landscape would also have it included in professional services and data and IT for example.

The Australian Research Council's Field of Research (FOR) code 1201 Architecture in education and research contexts is used as an indicator of the economic performance of research in Australia currently. The latest available documentation of the Australian research outputs in the FOR 1201, is the 2012 report which collected research outcomes for the period 2008-2010. Table 2, below, breaks out the types of research outputs recorded for that period.

Additionally, Table 3 provides an account of income values for these research outputs under the Australian Research Council's Field of Research (FOR) code 1201 Architecture in education and research contexts. Taken together, these two tables show formal research funding is currently low for 1201 Architecture. However this should be read in the context of a relatively positive research value per FTE (Full Time Equivalent Staff) and a substantial growth in the research area over the last 5 years. While ERA reporting tends to silo outcomes into discreet FOR codes, Architectures impact within other codes of education, design practice and management, sustainability and so on are difficult to determine at this time.

The balance of output types are noteworthy, showing an equality in outputs measured across journal articles, conference papers and original creative works. The value of original creative works is also difficult at this time to measure as these research results might be small exhibition materials or whole buildings. The relative equivalence of curated or exhibited events with books notes the balance in the academic research landscape of architecture towards creative and public outcomes relative to traditional scholarship. In terms of added value to the economy, this points to the readiness of architectural research to engage industry and a broader public.

It should also be noted that the nature of research in architecture is also changing radically as the necessity for research becomes a more frequently cited need within practice itself, distinct from academic research under the ARC programs. This seemingly parallels the drive to expand forms of architectural practice itself and the need to locate new knowledge in a fast changing information context and as a result of new forms of work.

New areas of research in Architecture are intersecting with industry in new ways while addressing areas of national priority in research. Some of these include;

- Robotic and automated advanced construction systems
- New forms of data capture and management and visualisation
- Health and sustainability of human environments
- New forms of energy capture and storage
- Addressing responses to climate change and sustainability
- Urban data gathering and modelling
- Potential of the creative industries and impact of design thinking on business

These research areas intersect architecture with industries such as health, engineering and technology, data and IT, business and climate science.

Table 2 ARC research outputs for CODE 1201 (2008-2010), by type

Type	Quantity	% total ARC Outputs
Book	68.9	0.6
Book Chapter	431.5	
Journal Article	528.1	
Conference Paper	893.8	
Curated or exhibited Event	65.2	
Live performance	0	
Original Creative Work	518.9	
Recorded/rendered work	35.5	
Portfolio	71.3	
TOTAL	2613.2	

Table 3 ARC research incomes for CODE 1201 (2008-2010), AUD

FOR CODE 1201 ERA 2012 (2008-2010 collection)						
Research Category	Outputs No.	Total Value AUD	Med. Income AUD	Avg. Value per output AUD	FTE	Value per FTE AUD
HERDC 1 Australian Competitive Grants Income		8,136,490	240,705			
HERDC 2 Other Public Sector Research Income		5,042,265	138,029			
HERDC 3 Industry and Other income		5,971,934	198,564			
HERDC 3.1 Australian		3,502,400	80,836			
HERDC 3.2 International		345,960	54,049			
HERDC 3.3 Other non-Australian		2,123,574	84,686			
HERDC 4 CRC Research Income		1,017,434	92,542			
Research Commercialisation Income		72				
TOTAL	2,613.2	20,168,195		7,717.82	296.5	68,020.90



2.4.3 Approximating a value add for education and research



Higher Degrees in architecture are in high demand, and are a significant source of potential growth that is not traditionally considered in calculations of architecture's value-add. Equally, while research income in architecture is currently modest it has significant growth potential particularly if the opportunity of intersections with aligned disciplines can be captured.

Take out messages:

- Current domestic and international architecture students contribute AUD 125,977,789 per annum to the education sector in fees alone. This is a strong positive area for future growth and intimately bound to the architectural profession as it is typically valued.

- The flow-on effects of education are core to innovation policy and ambition. Architecture education already well internationalised is well positioned to lead in this space.

- Architectural education is intimately connected to practice in Australia through a single, consistent and agreed National Standard. This positive and strong relationship should continue to be developed and supported as a backbone to innovation in the sector.

- Architectural education is a high demand area with strong international student interest which has a positive economic impact beyond student fees and assists with internationalization and innovation.

- Research funding in Architecture as measured through the ERA 2012 Collection is currently low and has significant potential to increase with the capture of fields of research beyond the FOR 1201 where architecture impacts on research.

- Research in architecture is unique in its balance of traditional and creative outputs. Creative outputs prioritise industry and public engagement and have an economic flow on effect in terms of cultural production.

- Research in architecture is well positioned within the current national research priorities with research outputs and funding trending upwards.

2.5 Totalling up: a new measure



IBIS World valued the architectural services sector in 2015 at AUD 6.4 billion dollars, representing 0.16 per cent of the Australian economy. Including the areas of technology development and innovation, business development, cultural tourism and production, student fees and research investment, under an expanded definition of architectural practice, there is a significant boost in the added value of architecture to the economy. Table 4, below, outlines the basic information used to calculate an approximate 12.86 per cent uplift in industry revenue due to activity in architecture not currently accounted for within the architectural services sector.

If reasonable assumptions based on reports presented here are added to these base figures for national architecture conference delegates spend, international students additional spend and associated family visits, a multiplier of 3 for the building value associated with the CCWB etc. a lift again in this figure to 15.43 per cent becomes evident.

Figures for technology development and business development were not available and have not been included in this report despite the obvious and significant impact these would have on the total figure. Figures for architectural tourism also are considered conservative and more work should be done to ascertain the extent of the 'bundling effect' of multiple notable buildings within precincts across Australia, as well as the draw of neighbourhoods rather than individual buildings, which account for tourism particularly in cities such as Melbourne (laneways) and Hobart (Salamanca Place).

Figures therefore should be considered as both an indicative and conservative estimate of the added value of architecture to the economy as exhaustive analysis is beyond the scope of this study. None-the-less, this initial study reveals a substantial but typically unrecorded impact for architectures contribution to the economy beyond the core services of design and procurement of buildings, and suggests more analysis will reveal additional economic contributions that remain a central component of the work of contemporary architectural practice.

Table 4 Additional architecture sector value above current industry value, AUD

Contribution area	AUD
Technology development	Aggregate values not available
Business development	Aggregate values not available
Cultural tourism	686,162,500
Student fees	125,977,789
Research	10,827,026
Total	822,967,315
Addition to current industry value, %	12.86

Table 5 Overview of architectural value add figures

Contribution area	AUD	Comment
Design-led technology innovation	-	
Subtotal	0.00	
Business development innovation	-	
Subtotal	0.00	
Dr. Chau Chak Wing Building tourism	46,000,000	
Sydney Opera House tourism	640,000,000	
Additional archi-tourism	138,000,000	x3 value of CCWB reflecting total o landmarks with equal draw MONA, Fed Square, Central park, GOMA etc.
International guest public lecture series	112,500	25 per cent schools (4.5) x 10 lectures a year (45) at 2500 per lecture
National conference budget	50,000	assumed
National conference additional spend	600,000	assume half delegates ie 600 with \$1000 pp spend
Venice Architecture Biennale fundraising	800,000	based on 2012 figures
Exhibition and cultural revenue (other)	1,000,000	assumed total value for Hub, Customs House, ADC etc.
Subtotal	826,562,500	
Student fees income	125,977,789	
Student expenses travel and materials	19,048,000	x2000
International Student living and family visit supplement	4,902,000	1 visit for every 2 international students with \$4000 spend pp
Subtotal	149,927,789	
Research Contribution (2012 used as base)	6,722,732	
Research growth 10% pa to 2015	10,827,027	
Subtotal	10,827,027	
Total	987,317,316	
IBIS Industry 2015 contribution value	6,400,000,000	
Value add to industry contribution, %	15.43	
Current share of economy as IBIS, %	0.16	
New share of the economy, %	0.18	



Image: Michael Stewart, CC, 2016

Part Three

Looking ahead

3.1. Architectural innovation- future opportunities

Innovation is defined as “the implementation of a new or significantly improved product (good or service), process, new marketing method or a new organisational method in business practices, workplace organisation or external relations”.¹⁵²

Australia has a well defined innovation framework which monitors business innovation in terms of the national and global competitiveness. In 2014, the annual report showed Australia is lagging in overall innovation in comparison to OECD comparator countries, but that firms that innovate continue to outperform business as usual by substantial margins.

For example those firms that innovate are:

- 31 per cent more likely to increase income and 46 per cent more likely to report increased profitability;
- twice as likely to export and five times more likely to increase the number of export markets targeted;

- twice as likely to increase productivity, employment and training;
- three times more likely to increase investment in information and communications technology; and
- three times more likely to increase the range of goods and services offered.¹⁵³

A recent Deloitte report, *Positioning for prosperity? Catching the next wave, Building the lucky country #3*¹⁵⁴, notes the urgency with which Australia needs to consider new innovative industries at the scale of the mining industry. Within this report, Education and Tourism were two noted areas where there is potential to grow advantage for the future Australian economy. In a similar 2014 report by McKinsey Australia, *Compete to prosper: improving Australia’s global competitiveness*¹⁵⁵, International education and tourism were signalled as leading sectors for growth, while design and engineering services, as well as manufacturing and construction were noted as areas with potential.¹⁵⁶

¹⁵²OECD (2005) *Oslo manual: guidelines for collecting and interpreting innovation data, 3rd edition, OECD and European Commission.*

¹⁵³Australian Government Department of Industry, Office of the Chief Economist, *Australian Innovation System Annual Report 2014, p2* <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf> (accessed 21.09.15)

¹⁵⁴Deloitte (2014) *Positioning for prosperity? Catching the next wave, Building the lucky country #3, Deloitte Touche Tohmatsu*

Further work within the creative industries and STEM cluster is also warranted, particularly with regard to the multiplier effect of architecture being so high (4.02) with regard to other sectors of the economy. More analysis is required to ascertain the precise effects of this multiplier on the terms of this study.¹⁵⁷

The areas outlined in this report are all fundamental to innovation in Australia in the terms of the Australian Innovation System framework. Understanding, valuing and developing the potential of architecture as an expanded practice includes new forms of technology and business development which offer substantial opportunity for new to market innovation. As a significant contributor to culture and tourism and a quality environment capitalising on Australia's current assets, architecture's capacity to add value in cultural and social terms, as well as in the areas of education and research is also substantial and only now starting to be recognised in broader economic terms.

This report sets out new areas through which architecture can be considered to add value to the economy outside of traditional construction industry and architectural services industry data. The areas noted in and of themselves offer substantive potential to increase economic performance in a number of key areas. Architectural firms that can 'boundary span' across these areas are well positioned to drive and capitalise on the new market opportunities.

¹⁵⁵Lydon J, et al. (2014) *Compete to prosper: improving Australia's global competitiveness*, McKinsey Australia

¹⁵⁶Both reports cited in Australian Government Department of Industry, Office of the Chief Economist, *Australian Innovation System Annual Report 2014*, p87 <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Innovation-System/Australian-Innovation-System-Report-2014.pdf> (accessed 21.09.15)

¹⁵⁷Creative Industries Innovation Centre (CIIC), *Valuing Australia's Creative Industries*, (Sgs Economics and Planning Pty Ltd) 2013 <http://www.sgsep.com.au/news/valuing-australias-creative-industries-report-released/> (last accessed 31.12.15), p64

“Yet the gross national product does not allow for the health of our children, the quality of their education or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country, it measures everything in short, except that which makes life worthwhile.”¹⁵⁸

- Robert F. Kennedy, May 1968

Conclusion

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This report was set out to explore the questions;

1. What are the limitations of the architecture profession’s relationship, broadly, to current systems of economic measurement in practice and where is other value found?; and

2. How does an understanding of new areas of value within architecture reframe the potential for innovation within the industry?

The limitations of the architectural profession to systems of economic measurement are recognised as structural within industry standard measures.

The case studies presented here support the case for new areas of value to be recognised within architectural practice that directly support the innovation agenda of the Australian Innovation System. The areas of technology development, business development, cultural contribution and tourism and education and research, all represent substantial prospects for innovation within architectural firms while identifying opportunities for policy support.

¹⁵⁸Robert F Kennedy quoted in, Rogers, S., “Bobby Kennedy on GDP: ‘measures everything except that which is worthwhile’ *The Guardian*, 24.05.2012

<http://www.theguardian.com/news/datablog/2012/may/24/robert-kennedy-gdp> (accessed 23.09.15)

Recommendations



5 Innovation Indicators for Architectural Practice (opening the door to policy)

Intermediary goods

International trade in intermediary goods accounts for 70 per cent of global trade today. Architectural practices that can shift from an “end product” fixation, and innovate through the production of intermediary products or services can access this opportunity in turn increasing international connectivity and opportunity for core business.

International

Practices that innovate are more likely to trade internationally. Connections to international trade drive innovation and competitiveness domestically as well as create further international opportunities. With 49 per cent of the predicted global construction occurring in Asia, architectural firms that can shift their focus and skills internationally will drive innovation.

Network

“Compared to businesses that don’t innovate, innovative Australian businesses that collaborate with research organisations (amongst others) are 242 per cent more likely to report increases in productivity.”

¹⁵⁹ Despite this, architectural firms like most Australian companies are not well

networked and Australia falls behind OECD performance on this issue. Architectural firms should seek out opportunities to collaborate, rather than protect projects as part of a larger innovation strategy for practice.

Research and Development

There is substantial opportunity for firms with a visible commitment to research and development whether in house or as a collaboration, to position themselves as market leaders. This may require new partnering for skills that compliment the traditional skills of the architect in business and manufacturing, marketing and communications.

New to Market

“New-to-market innovation has more impact on the competitive advantage of a business than the adoption of innovations already in the market (new-to-firm innovation).” Even so, “(o)nly 5.7 per cent of Australian businesses introduced new-to-market innovation in 2012–13.” Within the Architectural services sector, there is substantial opportunity for firms who are prepared to bring “new to market” products or services through development. Architectural firms should consider their capacity to develop new to market products and services, beyond those associated with traditional practice.

Bibliography

Appendix A

Calculation of the tourism expenditure contribution of the Dr. Chau Chak Wing Building

In Table 6 below, the expenditure value for tourist attraction activities is taken from the Business Events Sydney 2013 report (Edwards, Foley, Schlenker & Hergesell 2013), with an estimate spend for international visitors of AUD 108, Sydney overnight visitors AUD 20 and Sydney day visitors AUD 15.

The expenditure for performance value is estimated to be AUD 80 per person. This figure is based on the Deloitte 2013 study, where AUD 112 million was generated by 1.4million visitors.

The average per person food and beverage expenditure for international visitors AUD 39, Sydney overnight visitors AUD 38 and Sydney day visitors AUD 15 was taken from the Business Events Sydney 2013 report (Foley, Edwards, Schlenker & Hergesell 2013).

Not all expenditure can be attributed to a single attraction. Visitors visit a bundle of attractions; therefore a team production factor needs to be applied. A factor of 10 per cent is used. This factor is in line with the team based production factor used for the SOH (Deloitte 2013) and the TPM (Carey, Davidson & Sahli 2013) and therefore considered.

Limitations of the BTM

There are four key limitations in this estimation. In 2013 the SOH celebrated its 40 years of operation. The CCW building has been operational for 10 months. Thus the transferred estimates made in this study are not directly comparable on a time scale, but rather a future projection on the potential scale and contributions to tourism. The question, then becomes, what time frame

are these figures likely to accrue. Other cases estimate the time period likely for significant buildings to achieve a positive return on investment as between five and seven years. Therefore the estimates made here are future projected values but limited to 2013 market conditions and data. Expected tourism growth figures are not included in the study despite the estimations representing a projected value.

The team production factor for the SOH was estimated at 10.5%. For simplicity a 10% team production factor was applied to the estimates of the CCW building. However, other factors which may affect team production factors that have not been studied or included in this research. Factors such as location, and primary purpose of the building are two key variances which are likely to have a positive or negative effect on the “ability of the building to contribute to the team”. For example, the SOH is located in an idyllic location on Sydney Harbour, with open space, and views of the Sydney Harbour Bridge. It is also one of the gateway points to the Sydney Botanical Gardens and within easy walking distance to the Art Gallery of New South Wales, the Museum of Contemporary Art and The Rocks historic precinct. The SOH also holds large single events attracting crowds, rather than audiences (for example, Sydney New Years Eve).

The CCW building on the other hand is located in a creative education precinct and is surrounded on three sides by narrow streets, and on one side by the newly opened Goods Line. The Goods Line is open public space and serves as a forecourt to the CCW building and connects people to other attractions such as the Power House Museum and the Sydney Entertainment Centre. The area is undergoing significant

Table 6 Estimated per annum CCWB tourism expenditure contribution, AUD

<i>Activities (visitors '000)^</i>	International	Domestic Overnight	Domestic Day	Total
Average spend on tourist attractions	108	20	15	
Culture and heritage	1,746	1,888	2,270	5,904
Education	18	37	159	214
Activity value	1,764	1,925	2,429	6,118
	190,512,000	38,500,000	35,633,430	264,645,430
Attend performances	80	80	80	
Performance value	1,440,000	2,960,000	12,720,000	17,120,000
				281,765,430
Food and beverage spend	39	38	15	
	68,796,000	73,150,000	36,435,000	178,381,000
				460,146,430
Precinct value			10 per cent team production factor	46,014,643

change and the effects or likely impacts these changes may have on the CCWs contribution to “the team” is difficult to estimate at this time.

The functional attributes of the building were not taken into consideration other than to draw upon similarities of the activities with those of the SOH. Performances held at the SOH were likened to the academic performances held within the CCW building. The similarity between the two was based on the fact that both styles of performances “engage the minds” of their respective audiences. However, this assumption needs to be tested. Other functional aspects such as performance capacity, seating capacity, timing and scheduling of performances, and variances in audience demographics have not been addressed. These functional and operational aspects of the building will have an effect on the the capacity and ability of the CCW to develop, attract and service audiences.