

The Business Value of BIM in Australia and New Zealand:

How Building Information Modeling is Transforming the
Design and Construction Industry



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The Business Value of BIM in Australia and New Zealand: How Building Information Modeling is Transforming the Design and Construction Industry **SmartMarket Report**

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About McGraw Hill Construction

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Introduction

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND

The use of building information modeling (BIM) is spreading rapidly through the global design and construction industry, and architects, engineers, contractors and owners in Australia and New Zealand are no exception. Drawn to the practical efficiencies, integrated processes and compelling visuals that BIM offers, new adopters are coming on board, and existing users are planning aggressive expansions of their BIM programs.

This research study focuses primarily on BIM users in Australia and New Zealand, and it shows that firms in these countries, though relatively new to the use of BIM, recognize its value and are planning to deepen their BIM investments. In fact, 51% of firms are engaged with BIM on more than 30% of their projects today, and this number is expected to increase dramatically in the next two years—**74% report that they will be engaged in BIM on more than 30% of their projects by the end of 2015.**

The research findings suggest that business benefits and returns from BIM are key drivers behind that planned growth.

- **Positive Return on Investment (ROI) for BIM:** Reported by 75% of firms, with 30% citing ROI of 25% or more.
- **Positive View of Potential Benefits from BIM:** 52% of firms report that they can gain more than they already receive, and 39% believe that they are just scratching the surface of what they can gain.

The study also includes a review of companies not yet using BIM in Australia and New Zealand. These non-users are similar to

those in other countries, suggesting that factors that have spurred adoption in other parts of the world could prompt the same shifts in the Australia and New Zealand markets. Some specific notable insights that could drive the conversion of non-users to users include the following:

- **Change the perception of BIM's efficiency for smaller projects,** since 54% of non-users working only in Australia and New Zealand (compared with 38% of those working in and out of Australia and New Zealand) report that it is an important/very important factor delaying their use of BIM.
- **Demand by owners,** including a government mandate, can be a key factor in helping to spur adoption. Significantly more non-users working only on in-country projects believe that their competitors and clients are not using BIM, compared with their peers at global firms. This suggests that education is needed in this market.

Throughout this report, we provide comparisons between the findings in Australia and New Zealand to those in other markets that we have studied since 2007, when notable.

Firms in Australia and New Zealand have the advantage of being able to learn about the benefits that others have experienced and use that knowledge to help make the case for more intensive use of BIM.

We thank our partners who made this study possible, including our premier partners Autodesk and AECOM, as well as our seven other contributing partners: Aconex, A.G. Coombs, AMCA, Consult Australia, CSI Global, Laing O'Rourke and Zuuse.



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Stephen A. Jones, leads McGraw Hill Construction's (MHC) initiatives in BIM and integrated project delivery, as well as developing alliance relationships for technology and content. Active in numerous industry organizations, he frequently speaks at events around the world about the business impact of emerging technologies and trends. Before joining MHC, Jones was a vice president

with Primavera Systems (now Oracle), a leading provider of project management software. Prior to that, he spent 19 years in creative, marketing and management roles with design firms, most recently as a Principal and Board of Directors member with Burt Hill (now Stantec), a large, global architectural and engineering firm. Jones holds an M.B.A. from Wharton and a B.A. from Johns Hopkins.

Harvey M. Bernstein, F.ASCE, LEED AP, has been a leader in the engineering and construction industry for over 30 years. Currently, he has lead responsibility for MHC's market research group as well as MHC's thought leadership initiatives in areas such as green building, BIM, interoperability, innovation and global construction markets. Previously, Bernstein served as the president and CEO of the Civil Engineering Research

Foundation. He currently serves as a member of the Princeton University Civil and Environmental Engineering Advisory Council and as a visiting professor with the University of Reading's School of Construction Management and Engineering in England. Bernstein has an M.B.A. from Loyola College, an M.S. in engineering from Princeton University and a B.S. in civil engineering from the New Jersey Institute of Technology.

TABLE OF CONTENTS

4 **Executive Summary**

- 4 Executive Summary
- 6 Observations and Recommendations

7 **Data**

8 **BIM Use**

- 8 Company Involvement With BIM
- 9 BIM Implementation Levels
- 10 BIM Expertise Levels
- 11 Importance of BIM Capability for Project Team Selection
- 12 Trade Contractor Proficiency in BIM
- 12 Years of Experience Using BIM
- 13 Regional Comparison of BIM Engagement
- 14 **SIDEBAR Engaging Trade Contractors With BIM**
- 15 **SIDEBAR Using BIM to Rebuild Christchurch**

18 **BIM Use and Value—Benefits**

- 18 Experience of Business Value From BIM
- 19 Top BIM Benefits
- 21 Factors That Impact BIM Benefits
- 23 Use of BIM to Enhance Project Sustainability

26 **BIM Use and Value—ROI**

- 26 Perceived ROI for BIM
- 28 Formal Measurement of ROI
- 30 Important Metrics for Formal ROI Measurement
- 31 Top Benefits That Contribute to Improving BIM ROI
- 33 **SIDEBAR BIM in Mining**

36 **BIM Use and Value—Investments**

- 36 Investments in BIM
- 38 **DATA SIDEBAR Global Comparisons for Contractor BIM Use**

43 **BIM Use and Value—Non-Users**

- 43 Non-User Attitudes Toward BIM
- 45 Most Important Reasons for Not Adopting BIM
- 46 Perception of Competitors' and Clients' Uses of BIM
- 47 Top BIM Benefits That Would Convince Non-Users to Consider Adopting BIM
- 48 Importance of BIM in the Next Five Years
- 49 Factors Delaying the Decision to Use BIM
- 50 Most Important Factor Encouraging BIM Adoption
- 51 **SIDEBAR BIM Standards and Guidelines in Australia and New Zealand**



This page:

Left: BIM model for the Royal Hobart Hospital Redevelopment in Tasmania, Australia.

Below: An entryway to the New Royal Adelaide Hospital, a project with a team including more than 65 subcontractors and consultants and more than 200 people working simultaneously on the design.



Front Cover: Designers on the \$1.85 billion New Royal Adelaide Hospital project are using BIM extensively for analysis and visualization. Across the entire team, BIM will be used from the design phases through to operations and maintenance.

52 BIM Utilization

52 Top BIM Activities

54 Tools Used to Make Models Accessible to Field Personnel

55 Use of the Cloud

Case Studies

16 Advancing the State of the Art for Industrial/Infrastructure BIM With Digital Engineering: Cape Lambert Port B, Pilbara Region, Western Australia

24 Enabling Green Design Through BIM on an Australian Tower Project: 1 Bligh Street, Sydney, Australia

34 Executing BIM on a Broad Scale From Design to Operations and Maintenance: New Royal Adelaide Hospital, Adelaide, Australia

56 Multi-Party BIM Execution Planning: Adelaide Oval Redevelopment, Adelaide, Australia

Thought Leader Interviews

58 Mark Tait, General Manager Commercial Developments, Investa Group

59 Michael Haines, CEO, VANZI Ltd.

60 Methodology

61 Resources

Executive Summary

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND

Australia and New Zealand are among the world's leading regions for building information modeling (BIM), with firms planning to deepen their involvement. In order to accelerate this adoption, firms will need to be able to define BIM benefits clearly and help educate owners about its value. The timing is ideal since firms can learn from the successes of users in more experienced countries but still maintain an edge over newer users in other parts of the world.

Adoption and Use of BIM

About half of BIM users indicate that they have been engaged with BIM for more than three years. This compares favorably with other regions, with the U.S. the only major market with notably more experienced users.

BIM Implementation

All users predict a strong increase in implementation (the percentage of their projects that involve BIM).

- **Currently, half (51%) of all users are engaged with BIM on more than 30% of their projects. That will grow to three-quarters (74%) of users by 2015.**
- **Design professionals lead contractors as users, with six out of 10 (61%) currently using BIM on 30% or more of their work, versus only one-third (33%) of contractors.**
- **Contractors will partially close the gap over the next two years, doubling (to 66%) the number implementing at heavy or very heavy levels of use by 2015.**
- **Over half (56%) of the design professionals will be very heavy users (more than 60% of projects) in just two years.**

BIM Expertise

The level of BIM expertise is reported highest among larger architectural/engineering (A/E) firms. The top types of trade contractors by their relative level of BIM expertise include (in order of rank):

- **Mechanical/Sheet Metal/Plumbing Contractors**
- **Steel Fabricators**
- **Civil Contractors**

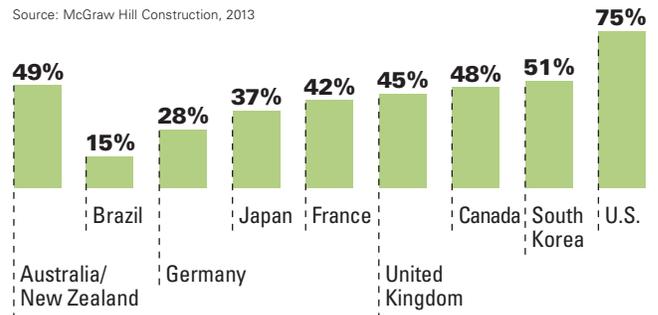
Business Benefits of BIM

The top five benefits of BIM are reducing errors, promoting an industry leader image, reducing rework, improving collaboration and offering new services. Overall, more A/E firms report receiving these benefits at a high level compared with contractors, especially for the entrepreneurial opportunity of offering new services.

Increasing the BIM skill level among staff and having more clearly defined BIM deliverables between parties

Percentage of BIM Users with More than Three Years' Experience (Australia and New Zealand Compared to Other Major Markets)

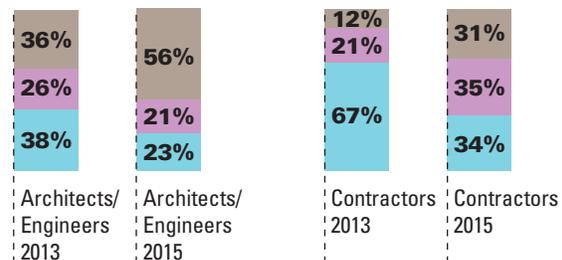
Source: McGraw Hill Construction, 2013



Current and Future BIM Implementation Levels for A/E and Contractor Users

Source: McGraw Hill Construction, 2013

- **Very Heavy Implementation (Over 60% of Projects)**
- **Heavy Implementation (31%–60% of Projects)**
- **Light or Moderate Implementation (Less Than 30% of Projects)**



are seen as the top factors that will increase the ability to receive BIM benefits.

ROI on BIM

Four in 10 users feel that they are achieving an ROI for BIM in the moderately positive range (1%–25%). About a quarter of users feel that their current ROI is still either negative or break-even.

About two-thirds of those surveyed indicate that they have been formally measuring ROI on BIM. Eight in 10 users rate the top three most important metrics for ROI to be the following (in order of importance):

- **Process-related metrics (e.g., fewer RFIs and unplanned changes)**
- **Project schedule metrics (e.g., faster project delivery)**
- **Financial metrics (e.g., reduced cost, higher profitability and productivity).**

A company's level of BIM implementation and the project type it focuses on both have a distinct impact on ROI.

- **Over half (55%) of the companies that focus on infrastructure projects report a very positive ROI (over 25%), versus only 29% of firms that primarily do buildings.**
- **Almost half (46%) of users at a very high BIM implementation level (more than 60% of their projects involve BIM) report a very positive ROI (over 25%) on BIM, versus only 10% of users at a low implementation level (less than 15% of their projects involve BIM).**

Respondents feel that improving project outcomes and better multi-party communications from 3D visuals are the benefits from BIM that will shape ROI in the future.

Investments in BIM Over the Next Two Years

Over the next two years, the greatest number of users will invest in developing internal BIM procedures and custom content libraries. Different subgroups have particular interests.

- **Users at the very high implementation level will focus most on BIM processes with external parties, reflecting a growing need for collaboration skills and processes.**
- **Companies focused on infrastructure/industrial projects will spend more on desktop hardware, mobile hardware, BIM training and customization/interoperability solutions than their buildings-oriented counterparts will.**

Non-Users

Lack of demand from clients/partner firms is cited as the primary reason that non-users have not adopted BIM, although about one third are open to exploring it.

Non-users would be influenced in their decision to adopt BIM if its ability to generate more accurate documents, improve communications and reduce information requests and field coordination problems could be proven. A client requesting BIM for a specific project would also be a significant factor.

Top Five BIM Benefits Received by Architects/Engineers and Contractors (Percentage Receiving the Benefit at a High or Very High Level)

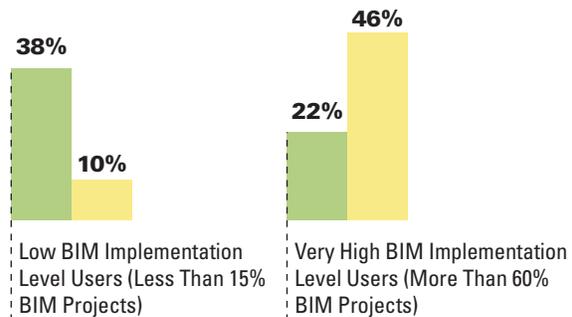
Source: McGraw Hill Construction, 2013

Benefit	Architects/Engineers	Contractors
Reduced Errors and Omissions	50%	38%
Overall Enhancement of Your Firm's Image as an Industry Leader	36%	43%
Reducing Rework	31%	28%
Ability to Work Collaboratively With Owners or Design Firms	27%	24%
Offering New Services	24%	14%

Impact of BIM Implementation Level on ROI

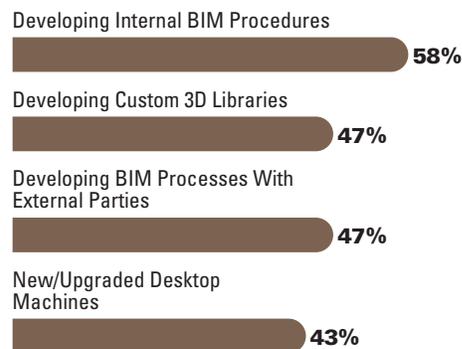
Source: McGraw-Hill Construction, 2013

■ Negative or Break-Even ROI ■ Very Positive ROI (Over 25%)



Top Planned BIM Investments Over Next Two Years by All Users (Among Those Rating It at a High or Very High Level of Importance)

Source: McGraw Hill Construction, 2013



Recommendations

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND

Observations and Recommendations

A/E BIM Users

Two-thirds (66%) of A/E users identified “more 3D building product manufacturer-specific content” as very important to increasing their ability to experience more business benefit from BIM.

- Recommendation:** Rather than wait for the manufacturers that serve Australia and New Zealand to develop BIM content on their own time frames, A/E firms should use their influence to demand content that is searchable and able to be indexed.

Sharing models with contractors is important for the continued advancement of integrated processes between project stakeholders. The table below shows how frequently contractors in several major regions say that they always or often receive models from design professionals. Australia and New Zealand rank last (9%).

- Recommendation:** It would be useful to evaluate the trends in the rest of the world and reevaluate the factors preventing A/E

firms from sharing models with contractors.

Contractor BIM Users

Currently, three times as many A/E users consider themselves to be at the expert BIM skill level (see page 10 for definition) than do contractor users, two-thirds of whom still classify themselves at a beginner or moderate skill level.

- Recommendation:** Contractors should work to increase BIM skills because they correlate directly to greater benefits.

However, contractors from Australia and New Zealand show global leadership in some areas, such as the frequency with which they leverage BIM to visualize design intent and conduct safety planning.

- Recommendation:** Contractors should look to other regions for lessons to help expand the value of BIM. This is especially true for high-value activities, such as multi-trade coordination, model-driven layout in the field and integrating the model

into punch list/snag list and close-out activities—each of which is performed by contractors at a greater frequency in many other regions.

Among the trade contractors, the mechanical/sheet metal/piping, steel and site/civil firms are seen by general contractors as being the most proficient with BIM. This sends a clear message to the electrical, concrete/masonry, curtain wall and drywall/ceilings companies that they need to improve their capabilities.

Contractor and A/E BIM Users

The data show that higher BIM engagement correlates directly to greater enjoyment of benefits and better ROI on BIM.

- Recommendation:** Regardless of a firm’s current BIM Engagement Index (see page 14), there is room for advancement through deeper implementation, greater skills and more experienced staff.

Creating as-built models for owners is a growth

opportunity. Currently, it is a high or very high frequency BIM activity for 59% of BIM users in Australia and New Zealand. However, it rates even more highly among contractors in many other markets, including Germany, Japan, South Korea and the UK.

- Recommendation:** A/E firms and contractors may have an opportunity to provide this service.

Non-Users

BIM is fast becoming a must-have capability. Only 7% of owners surveyed say that BIM expertise has no influence on their selection of team members. Within two years, three-quarters (77%) of the A/E firms and two-thirds (66%) of the contractors currently using BIM in Australia and New Zealand will be doing so at high or very high implementation levels.

In addition to a variety of aspects of improved project performance, these users are enjoying better profitability and success in leveraging their BIM capabilities to market new business, offer new services and maintain repeat clients.

- Recommendations:** Non-users should engage in BIM since the data suggest that the longer it takes for a firm to become engaged with BIM, the more challenging it will be for them to close the gap with their competitors.

Frequency at Which Contractors Report That They Always or Often Receive Models From Design Professionals

Source: McGraw Hill Construction, 2013

Frequency (% Reporting Often or Always)	Canada	Brazil	South Korea	United States	United Kingdom	Australia & New Zealand
Your Company Receives Models From Design Professionals	89%	50%	50%	44%	29%	9%

Data: Introduction

Since McGraw Hill Construction (MHC) first identified the transformation potential of Building Information Modeling (BIM) in 2007, subsequent research in North America, Europe and South Korea has revealed a profound shift to the use of BIM throughout the industry. The global financial recession that has also occurred during that period has highlighted the importance of improving productivity and finding new ways to do business in the industry, and BIM has contributed to that dialogue by supporting efforts to collaborate and use strategies like prefabrication, as well as to reduce the inefficiencies that continue to plague the design and construction industries.

In Australia and New Zealand, awareness of BIM is high, but the commitment to and use of BIM is still relatively early compared with other regions studied by MHC. However, with healthy growth predicted in the Australian market and \$40 billion worth of work in the reconstruction of the Canterbury region in New Zealand over the next 10 years (including Christchurch), insight into how far the industry has gone in the adoption of BIM and how its adoption compares with other areas, like North America and South Korea, provides critical business intelligence that offers a glimpse of the evolution of BIM use and value in Australia and New Zealand.

The study shows that the Australia and New Zealand markets have their own unique drivers and obstacles for the use of BIM. The construction industry, despite the influence of large global players, remains a very local industry driven by small firms and marked by regional differences. The data suggest that for Australia and New Zealand, building owners, both public and private, may emerge as the greatest drivers of BIM, and those seeking greater BIM adoption need to consider owner education and outreach essential.

Overall, the study demonstrates that the construction market in Australia and New Zealand is poised for greater engagement and investment in BIM, similar to the North American market in 2009. All players in this industry need to recognize the potential for an increasing shift to BIM in the next few years and to determine the best way for their companies to capitalize on this sea change.

Note About the Data

The data and analysis in this report are based on an online survey conducted with 435 respondents across the construction industry in Australia and New Zealand, including architects, engineers, contractors, consultants and building owners.

The analysis in this report is largely built on a few key comparisons.

BY FIRM TYPE

- Firms identified as A/E firms in the analysis include architects, engineers and multidisciplinary design firms.
- Firms identified as contractors are grouped into two categories throughout the report—GCs and Trade Contractors. Note, when the term “contractor” is used in the data sections of the report, it is referring to all the respondents from the following two categories:
 - **GCs:** Refers to general contractors, full-service contractors, construction management companies and GC/CM at-Risk firms
 - **Trade Contractors:** Refers to specialty subcontractors, fabricators and installers

BY COUNTRY/REGION

The findings from this study of firms in Australia and New Zealand are compared with findings published in previous *Business Value of BIM SmartMarket Reports*:

- **North America** (research published in 2009 and 2012). Please note that unless otherwise noted, references to North America refer to the 2012 study.
- **South Korea** (research published in 2012)

BY PROJECT TYPE

Throughout the study, there were significant differences for those working primarily on building projects compared with those working primarily on infrastructure/industrial projects. Those differences are noted when significant.

For more information about the firms interviewed or the research conducted, please see the Methodology on page 60.

Company Involvement With BIM

The design and construction industry in Australia and New Zealand is engaging with BIM in a variety of ways and finding many valuable benefits.

Definition of Involvement With BIM

For the purposes of this research, a company does not have to be generating (authoring) models in order to be considered to be engaged with BIM. Engagement can mean that the company is working with models generated by one or more other project team members for valuable activities such as spatial coordination (also known as clash detection), quantity take-offs, project sequencing or constructability evaluation. It can also mean that a company's work is being modeled by other parties but that those models end up benefitting the company and the greater project team.

Once BIM is introduced on a project, many of the companies involved on that project typically will engage in some meaningful way with either the digital version of the design or with models developed by builders, fabricators and installers that guide their processes. The critical distinction for BIM involvement is that the company is not relying exclusively on CAD-generated documents on all of its projects. The non-user analysis in this report reflects those that are exclusively relying on CAD (see pages 41 through 48).

BIM Involvement in Australia and New Zealand

Common trends among all the BIM users surveyed in this research include:

- **Almost two-thirds (64%) are both authoring models and working with models from other parties.**
- **Smaller groups are either only authoring models (19%) or only working with models authored by others (17%).**

Variation by Firm Type

There are varying trends among the disciplines surveyed for this research.

A/E FIRMS

A/E firms represent the largest portion of the users that are only authoring models, as well as the largest portion of those that are both authoring and working with others' models.

CONTRACTORS

Contractors dominate the group that is only working with third-party models, reinforcing that model generation is still primarily concentrated among the design professionals.

- **Among the contractors that are generating models, over half are using internal resources versus outsourcing.**
- **Less than one-third of contractors are either demanding models from trade contractors or receiving models from them without having to demand.**
- **Only about a quarter of construction companies using BIM are doing so because of a demand by an owner, indicating that their BIM growth is being driven primarily by internally generated interest.**

TRADE CONTRACTORS

- **Trade contractors report receiving models from design professionals about half the time.**
- **Twenty-five percent of the trade contractors that develop models report that they are the only trade contractor to do so on their projects.**

Variation by Firm Size

Companies with a high level of BIM involvement, both those that author their own models and those that primarily work with others' models, tend to be larger operations, such as large contractors and medium or large A/E firms.

Conversely, those not engaged with BIM tend to be smaller companies.

BIM Implementation Levels

Companies typically deepen their level of engagement with BIM as their experience and skill levels increase. This engagement is most easily identified by a company's BIM implementation level, meaning the percentage of their projects that involve BIM. This scale for BIM implementation has been used in all of McGraw Hill Construction's BIM research since 2009.

- **Light Implementation Level: Less than 15% of projects using BIM**
- **Medium: 15% to 29% of projects**
- **Heavy: 30% to 59% of projects**
- **Very Heavy: 60% or more of projects**

Highlights of the results from BIM users in Australia and New Zealand about their level of implementation include:

- **Design professionals currently report the deepest implementation of BIM, with 61% reporting a heavy/very heavy level of BIM implementation, compared with only 33% of contractors at that level.**
- **The medium implementation level is currently the most common tier for contractors (39%).**
- **Only 18% of A/E users report being at the light level.**

Future BIM Implementation

Two year forecasts by users show dramatic increases in BIM implementation, indicating an enthusiastic commitment.

- **77% of A/E firms and 66% of contractors believe that they will be at either the heavy or very heavy level in two years.**
- **The heavy implementation level is predicted to be the most common level for contractors (35%).**
- **Only a tiny fraction of A/E and contractor users (1% and 2%, respectively) anticipate remaining at the light level.**

Variation by Country/Region

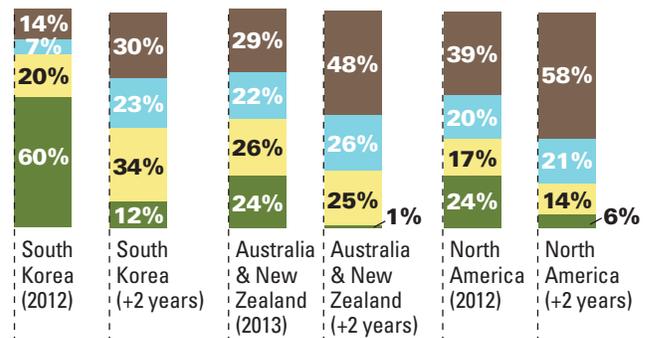
The chart shows BIM implementation in Australia and New Zealand compared with recent research in North America and South Korea. In all cases BIM users were asked to report their current BIM implementation level and also to forecast the level where they believed their company would be two years in the future.

Users at all current levels of implementation in each of the three regions forecast strong increases in their application of BIM.

Current and Forecasted BIM Implementation Levels (According to Country/Region)

Source: McGraw Hill Construction, 2013

- **VERY HEAVY (More Than 60% of Projects)**
- **HEAVY (30%–60% of Projects)**
- **MEDIUM (15%–30% of Projects)**
- **LIGHT (Less Than 15% of Projects)**



- **South Korea, because it is the most recent of the three economies to engage with BIM, currently has the highest percentage of light users (60%), but that is projected to plummet to only 12% by the end of 2014. Also, the number operating at the very heavy implementation level will double from 14% to 30%.**
- **Following suit, only 1% of current BIM users in Australia and New Zealand anticipate being at a light level of implementation in two years (end of 2015), and almost three quarters (74%) believe that they will be in the heavy or very heavy categories.**
- **North America, the most mature BIM market among the three, shows continuing commitment with a forecast that 58% of current BIM users will be at the very heavy level of implementation by the end of 2014, and only 6% will remain light users.**

BIM Expertise Levels

Although there is no globally accepted standard by which to rate BIM expertise, McGraw Hill Construction has asked respondents to classify themselves into one of four skill levels in each of its BIM studies published since 2009: beginner, moderate, advanced or expert. Although subjective, this self-assessment of skill level into a few broad categories provides a useful way to filter results and understand variances in user perceptions and experiences.

Among BIM users in Australia and New Zealand:

- **Almost three times as many A/E respondents (16%) classify themselves as experts compared with contractors (6%).**
- **Conversely, two-thirds (65%) of contractor users consider themselves to have beginner or moderate skill levels, versus less than half of A/E respondents (47%).**

Variation by Country/Region

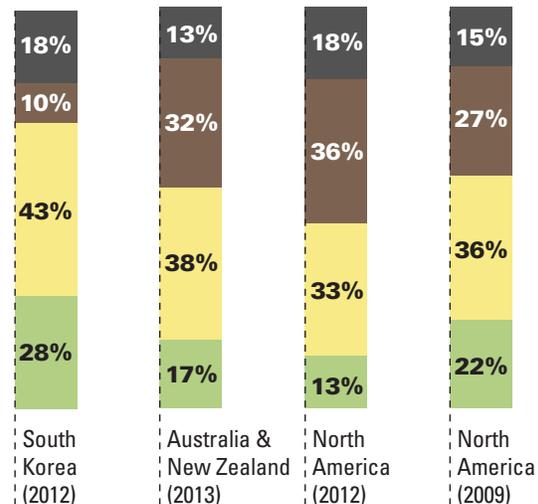
Expertise levels are also a useful way to compare regional BIM activity and engagement. The chart shows the reported levels of BIM expertise in Australia and New Zealand, along with recent (2012) *SmartMarket Report* research on North America and South Korea and, for trending analysis, the results from the 2009 study in North America.

- **The difference between 2009 and 2012 in North America indicates that BIM expertise advances relatively slowly**, with only a small (3%) increase in the expert tier. Meanwhile, the advanced tier grew by one-third, likely reflecting beginner and moderate users moving to the next respective levels while new entrants replaced many of the beginners.
- **As the newest region to embrace BIM, South Korea has 71% of its users in the beginner and moderate ranks.** With the fast growth of their economy and their projected increases in BIM implementation, this should follow the path of North American skill development and show strong growth in the now small (10%) advanced category over the next few years.
- **The expertise breakdown of Australia and New Zealand users appropriately reflects the region's position between the recently engaged South Koreans and the relatively longer history of BIM implementation in North America.** As such, this region should also expect to see a marked rise in advanced users and a steady but more modest increase on experts, as newer users continue to backfill lower tiers.

Regional Variances and Trends in BIM Expertise (According to Country/Region)

Source: McGraw Hill Construction, 2013

- Expert
- Advanced
- Moderate
- Beginner



Importance of BIM Capability for Project Team Selection

As more companies engage with BIM, the value of having other team members with BIM experience becomes increasingly important. However, companies take different approaches to using BIM expertise as a selection criteria for team formation.

- **Twenty-eight percent of BIM users require the companies they select for a project team to have BIM expertise.**
- **Over half report that they encourage BIM expertise but do not require it.**
- **Owners are the most likely group to give weight to BIM expertise in team selection, with only 7% saying that it does not affect their decisions.**

This corresponds almost exactly to the data published in the 2012 *Business Value of BIM in North America SmartMarket Report*, where 28% of BIM users reported that they require BIM expertise, 52% encouraged it but did not require it, and 19% indicated that BIM does not affect their decisions.

The importance of BIM expertise in team selection can be expected to increase in future years as the benefits of integrated processes and more detailed models for fabrication gain wider acceptance.

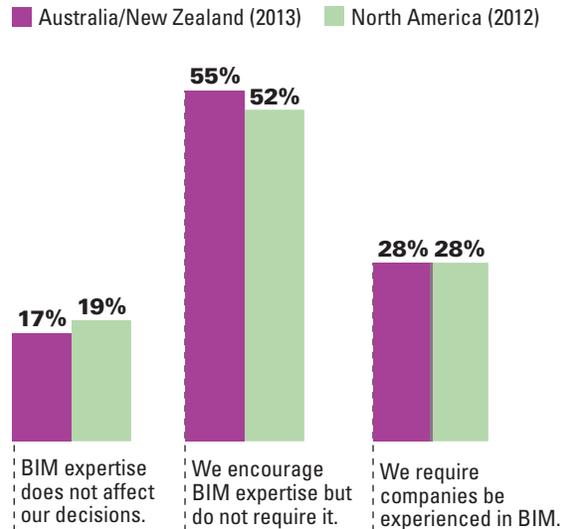
Value Provided by BIM Expertise

Respondents note that BIM expertise conveys several benefits.

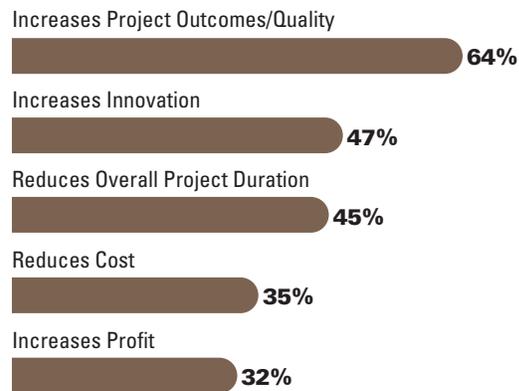
- **Almost two-thirds (64%) believe that working with firms with BIM expertise improves project outcomes and increases quality.**
- **Almost half see that project team members with BIM expertise increase innovation (47%) and reduce overall project duration (45%).**
- **Fewer see direct financial benefits in which having project team members with BIM expertise either reduces cost (35%) or increases the profitability of their organization (32%).**

Importance of BIM Capability

Source: McGraw Hill Construction, 2013



Value Provided by BIM Expertise



Trade Contractor Proficiency in BIM

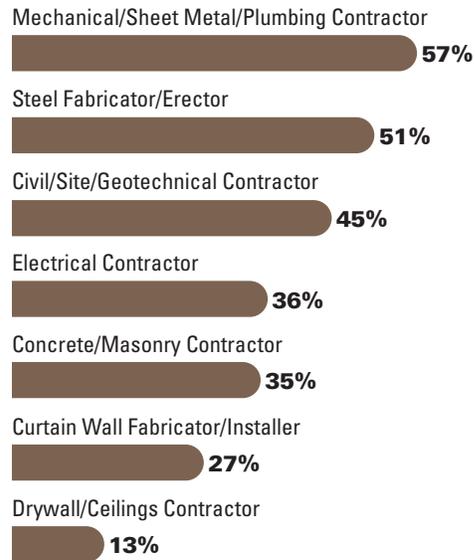
As BIM use expands and project teams engage more fully in activities like spatial coordination, fabrication-level modeling and model-driven prefabrication, BIM proficiency among trade contractors becomes increasingly important.

BIM-using contractors in Australia and New Zealand were asked to generally rate the BIM proficiency of a variety of trades in the markets where they do work.

- **Over half of contractors rated the BIM proficiency of mechanical/sheet metal/plumbing contractors and steel fabricators/erectors as high or very high.**
- **Nearly that many (45%) rated civil/site/geotechnical contractors to be at that skill level, with a particularly strong vote registered from contractors in New Zealand (61%).**
- **Concrete/masonry and electrical contractors garnered high praise from over a third of contractors.**
- **Drywall/ceilings contractors are generally viewed as having the lowest level of proficiency, reflecting the relative immaturity of BIM use for interior construction compared with MEP, structural and civil aspects.**

Trade Contractor Proficiency in BIM

Source: McGraw Hill Construction, 2013



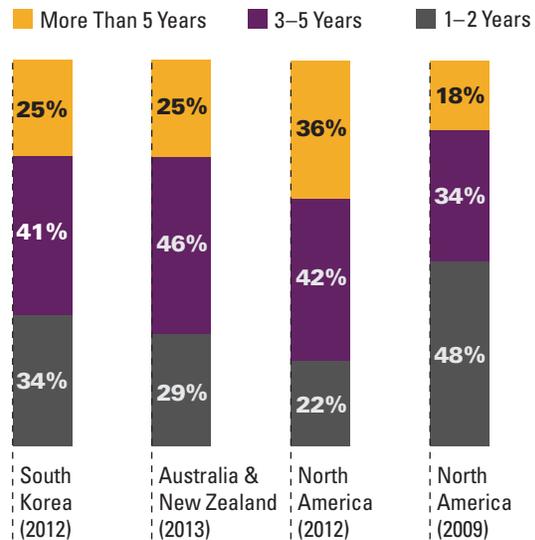
Years of Experience Using BIM

Another useful measure of BIM engagement is the number of years that a user has been involved with BIM. The chart compares BIM users in Australia and New Zealand with those from 2012 research in North America and South Korea, as well as those from the 2009 study in North America, which demonstrates the dramatic growth in experience over the three-year period in that market.

- **North American results reflect the relatively longer time that BIM users have been active, showing that over three-quarters (78%) have three or more years' experience.**
- **Australia and New Zealand have the same percentage of very experienced users (25%) as South Korea, but the latter has more new users, an expected result of its more recent adoption.**

Regional Variances in Years of Experience Using BIM (According to Country/Region)

Source: McGraw Hill Construction, 2013



Regional Comparison of BIM Engagement

Since the 2012 *Business Value of BIM in North America SmartMarket Report*, McGraw Hill Construction has been calculating a BIM Engagement Index that is calculated with weighted scores for a firm’s level of BIM implementation, years of BIM experience and BIM expertise. Among the three factors, the index weighting system (shown in the first table) gives the most significance to higher levels of BIM expertise because McGraw Hill Construction research indicates that skill level typically correlates most strongly with benefits, ROI and ongoing commitment to BIM investments.

Regional BIM Engagement Index

The chart compares the relative overall level of BIM engagement by all users in Australia and New Zealand with that of North America and South Korea. The Regional BIM Engagement Index is calculated by combining individual index scores for experience, expertise and implementation for each region into an overall Regional BIM Engagement Index on a scale from 0 to 100. That scale is broken down into four stages of Regional BIM Engagement from low (where most users have beginner skills, little experience and only a small percentage of BIM projects underway) to very high (where many experienced, expert users are doing most of their work with BIM).

Eventually, as BIM continues to proliferate around the globe, most developed nations are expected to attain a very high Regional BIM Engagement Index. Currently, the North American economy shows the highest relative index (51), but it is just crossing into the third stage of engagement. South Korea trails at 34, but it is moving quickly, driven by robust economic growth and government support of BIM as a productivity enhancement. McGraw Hill Construction will continue to track the dynamics of this global trend and use the Regional BIM Engagement Index as a way to benchmark progress.

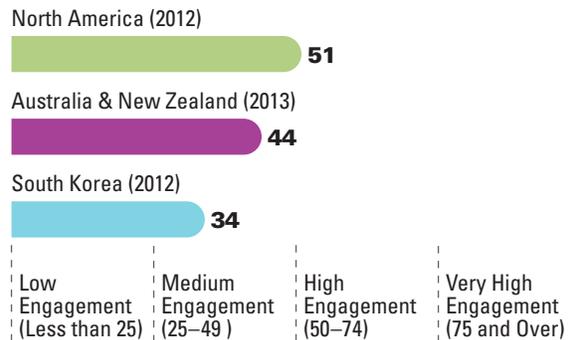
BIM Engagement Index Weighting System

Source: McGraw Hill Construction, 2013

Experience		Expertise		Implementation	
1–2 years	1.5 points	Beginner	1 point	Light	1 point
3–5 years	4 points	Moderate	3 points	Medium	3 points
Over 5 years	9 points	Advanced	6 points	Heavy	5 points
		Expert	10 points	Very Heavy	8 points

Regional BIM Engagement Index Scores (According to Country/Region)

Source: McGraw Hill Construction, 2013



Engaging Trade Contractors With BIM

While BIM is still gaining traction throughout the construction industry in Australia and New Zealand, some industry organizations are showing leadership in helping trade contractors to become engaged and enjoy the business and competitive benefits that are possible to achieve with BIM.

BIM provides the greatest benefit to a project when the largest number of team members is engaged with it. This is especially true for trade (specialty) contractors because they are the companies that implement the modeled work in the field. Although not traditionally seen as aggressive adopters of new technologies, trade contractors around the world are rapidly getting involved with BIM because of the immediate benefits that are relevant to their business success, such as reduced rework, the ability to accurately prefabricate from models and improved labor productivity, safety and site logistics. Also, trade contractors with BIM capabilities report seeing positive impacts on winning new work and offering new services due to their use of BIM. Thus it is not surprising that organizations are focused on engaging trade contractors with BIM.

AMCA BIM-MEP^{AUS} Standard Initiative

BIM-MEP^{AUS} is an important standard being developed by the Air Conditioning and Mechanical Contractors' Association (AMCA) to facilitate the exchange of design models and information. It involves establishing a common and practical set of mechanical, electrical and plumbing (MEP) protocols—standards, specifications, practices, models of components and assemblies and workflow guidelines—that ensure that the data being shared between parties can

be trusted to be accurate and will maintain the integrity of the shared models. The standard has been welcomed by industry, with over \$5 billion of construction projects currently using it, according to AMCA.

Sumit Oberoi, executive director of AMCA, cites several impacts of the BIM-MEP^{AUS} initiative. "BIM is the platform for construction innovation," he states. "Mechanical contractors recognize that it is the e-commerce of the construction industry, where everything from estimating, documenting, fabricating, supply chain management and equipment purchase can be neatly defined through established relationships and translated into a BIM workflow. AMCA members have moved beyond piloting a design-to-fabrication workflow into a constructible model and have adopted the use of robotic site layout and field BIM technology. BIM-MEP^{AUS} is providing direction and clarity to our industry by enabling practical application of standards, solutions, tools and workflows."

Oberoi believes that owners may prove to be an important driver for BIM adoption for trades. He says, "Most new large projects are being specified now for BIM implementation and delivery of an as-built BIM model, progressing from 3D CAD to full BIM." If that becomes commonplace, it will certainly require modeled content from the trades that reflects interaction with suppliers and manufacturers.

Master Builders Association (MBA) of Victoria

Radley de Silva, chief executive officer of the MBA, believes that BIM has the potential for a number of positive transformations for all contractors, among which he cites "improved visualization of the project, increased coordination of subcontractors and construction documentation, estimating and tendering efficiencies, less defects and less costs—just to name a few."

He acknowledges that "adapting to change does not happen quickly in our industry. Perceived costs and related benefits are the key, as well as overcoming their 'comfort' with existing systems in place." Even though "usage of BIM technology is very much in its early stages" among his members, de Silva also perceives that "there is an increasing level of interest among those companies that have not adopted BIM technology." He states, "the Master Builders [Association] is actively watching developments in the BIM space and is playing a role in keeping the industry informed through our events and publications. In addition, we are lobbying government to take the lead in this area."

More information on the AMCA BIM-MEP^{AUS} standard initiative and the MBA's efforts are available at <http://www.bimmepaus.com.au> and <http://www.mbav.com.au>. ■

Using BIM to Rebuild Christchurch

BIM is poised to be an essential part of the estimated \$40 billion rebuilding effort for Christchurch, New Zealand, and the Canterbury region. This massive effort is likely to increase exposure to BIM in the New Zealand construction industry, but the race to get work underway may undermine the use of BIM initially.

Work is just starting on the massive rebuilding effort in the city of Christchurch and the region of Canterbury after the devastating earthquake of February 2011 and its serious aftershocks that wreaked havoc in the area. It is likely that this massive effort, which may take as long as 10 years, will encourage wider BIM use in New Zealand, but currently, in the early stages, it also poses unique challenges.

Improving Productivity at Christchurch

Chris Kane, manager at the Productivity Partnership, sees the potential and the challenges at Christchurch through the lens of the ongoing efforts that his government-run organization has been making to help improve productivity in New Zealand's construction sector since 2010.

Kane describes how his organization is taking two major roles in the rebuilding efforts: "One is around providing information to clients about how they might best manage their investment. We do that by collecting information from all of the major construction clients and putting together a very scary forward projection of workloads. When we share that with the clients, they begin to understand why they are finding it difficult to get contractors to respond to tenders, why prices have gone from \$2,300 per square meters prior to the quake to \$3,800 now.... The other [role] is making sure that

contractors have as much access to skills and technology as they can possibly get."

Opportunities and Immediate Benefits

According to Kane, "Christchurch provides an obvious opportunity to use [BIM] technology in a constrained environment, which is where it could potentially be most beneficial." He regards the very scale of the work to be done in this region as a key driver to improving the productivity of the industry: "We know how much work [clients] want to put in place, but we also know that the sector isn't capable of delivering it as it currently stands."

Kane highlights the benefits of cost savings that BIM can provide as critical: "There is \$40 billion worth of work to be put in, so even if you manage to get to savings of 10%, that is well worth chasing from the perspective of government, so the opportunities are obviously around time saving, greater certainty when it comes to delivery schedules, quality, taking less resources to build a building, less waste, less downtime."

One strategy that the Partnership has undertaken to encourage use of BIM is creating a BIM Handbook to educate the industry, as well as a client's implementation guide for BIM.

Glenn Jowett, senior structural designer at BECA, a design firm engaged in a wide range of projects in the rebuilding efforts, including the \$130 million Burwood Hospital

project, also sees slow adoption of BIM up to this point in the New Zealand market, but that has not prevented his firm from capitalizing on BIM. He says, "We are working with companies that have no BIM experience, but we still see benefit in 'lonely BIM.' There is still benefit in passing 3D information downstream to fabricators and contractors, as well as the ability to quickly schedule materials."

Challenges

Kane also notes a few challenges to wider BIM use. The escalating cost of doing work is driving owners to seek to start their projects as soon as possible. Kane states, "When you are rushing to get things started so that you can beat the tide, you are not likely to take the time required to go outside your traditional approach."

However, Brian Clayton, partner at Chapman Tripp, a major construction law firm in New Zealand, believes that the rush for work is creating a contractors' market, which will lead owners seeking to get large volumes of work underway to consider using an Early Contractor Involvement (ECI) procurement method. He says, "The design is not that far advanced on a number of projects...because of the fast track nature of getting these projects up and running. As a result, [owners] may get the contractors in earlier to help develop a design and develop up-pricing." He believes that this collaborative approach will encourage wider use of BIM. ■

Advancing the State of the Art for Industrial/Infrastructure BIM With Digital Engineering

Cape Lambert Port B

PILBARA REGION, WESTERN AUSTRALIA

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND

With over 20% of the world's iron ore, Western Australia has been experiencing an iron ore mining boom since the early 2000s. Cape Lambert is one of the seaports actively used for exporting iron ore from Rio Tinto's mining operations in the Pilbara region. To support its forecast for continued growth, Rio Tinto has created a new iron ore port facility known as Cape Lambert Port B, located alongside the existing Cape Lambert port.

As one of the largest resource projects ever undertaken in Australia, an important objective was to significantly expand the Cape's iron ore export capacity, from 86 million to 139 million tons per annum. All three Rio Tinto ports in the Pilbara are expected to achieve a base run rate of 290 million tons by mid-2014.

Laing O'Rourke, one of the world's largest privately owned engineering and construction companies, is responsible for supply, fabrication, delivery and installation of the structural, mechanical and piping works needed for the port's mission-critical in-loading and out-loading conveyors and its massive ore transfer towers.

Leveraging BIM to Drive Fabrication

In line with its Design for Manufacture and Assembly (DfMA) initiative, Laing O'Rourke is heavily leveraging BIM in the process of fabricating approximately 3,500 tons of structural steel. Using the client's 3D models, Laing O'Rourke applied its own engineering expertise and virtual coordination skills to drive fabrication of large pre-assemblies by its

partners in Thailand, which included integrated transport and lifting steel for safe and efficient installation when the assemblies reached the site. The 3D model was integral for the coordination of steel placement for clash avoidance of secondary steel members and understanding the safest and most efficient way of removing temporary steel once the module was in place onsite.

Ryan King, structural design engineer on the Laing O'Rourke team, says the powerful visualization enabled through the digital engineering models allowed the team to "adopt an iterative design process with a focus on eradicating many potential fabrication and construction issues before they arose; thus leading to more holistic design solutions."

Innovative Use of BIM for Industrial/Infrastructure Projects

Laing O'Rourke is making many unique and valuable uses of digital engineering models and model-derived data on this large and complex project, significantly advancing the state of the art for industrial/infrastructure BIM. Among these innovations are:

- Laing O'Rourke's site-based team has developed and managed 4D models, integrating the work breakdown structure of the schedule with its corresponding elements of the 3D model, for day-to-day coordination and work planning.
- The firm's piping design team has also assisted in developing smart piping models that have been coordinated and integrated with the structural models, removing the



Use of a tablet computer onsite allows the project team to view the project's 3D model, as well as access work packs (library of 2D, 3D and specification information), construction check sheets, and defects and issues reporting.

Images courtesy of Laing O'Rourke

CONTINUED

Cape Lambert Port B

PILBARA REGION, WESTERN AUSTRALIA

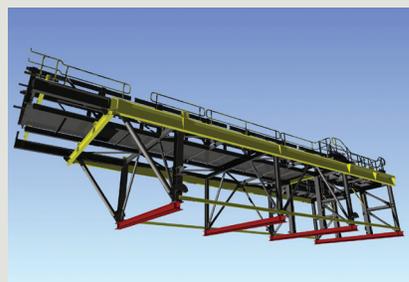
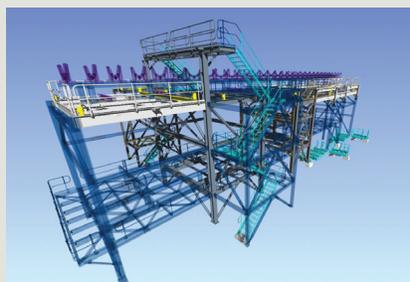
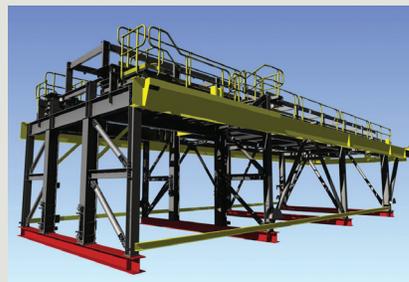
THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND

risk of coordination issues onsite.

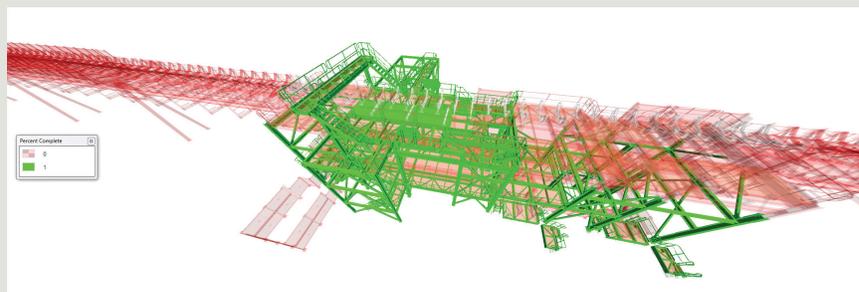
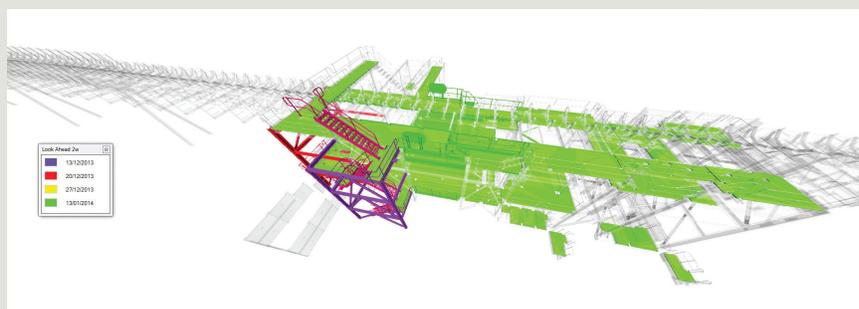
- Tablets onsite allow real-time coordination of 3D digital work packs and detailed 4D sequence installation methodology.
- Laing O'Rourke invested in the output from electronic check sheets so that they replicate the exact appearance of client standard sheets.
- The firm developed a 3D integrated process for materials tracking of steel assemblies through RFID tagging, from the fabrication yard in Thailand to port to delivery onsite.
- Laing O'Rourke has developed customization within existing 3D viewing software so that real-time live data linked to the model can produce heat maps based on set data—for example, critical path in program, overall project status and planned versus actual visualized in the model.
- Center of mass calculations using the model are included in pre-assembly information, enabling safer transportation during shipping and transport over land.
- Models are extensively used by the project team for Safety in Design reviews (Australian legislation) to ensure safety during erection and transportation.
- The workforce is actively being engaged through training in a variety of software applications and new efficient processes, such as tablet-based QA solutions.

Liam Cummins, director of the Western Region at Laing O'Rourke, notes the valuable contributions from digital engineering to the firm's work at Cape Lambert: "It allows us to build projects twice—first in a

digital environment and then onsite, creating efficiencies in project delivery and operational performance. It also provides our clients greater levels of assurance by demonstrating our understanding of the complexity of the construction process, risks, logistics and program, as well as maximizing the safe delivery of a project on time and to cost." ■



These images show models for a transfer station (above left) and part of a conveyor (above and top right) with temporary lifting steelwork in yellow and transport steelwork in red, which help prevent damage when in transit from overseas and while the module is being lifted into place.



The heat maps shown above visually link project management activities to the model with color codes. In these examples, future tasks and percentage completed are displayed.

Data: BIM Use and Value— Benefits

Experience of Business Value From BIM

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND DATA

Each user engages BIM in a way particular to their role on a project, company objectives and personal view of its potential for process improvement and innovation. The chart shows how much value users find that they are receiving from BIM.

- **The majority (52%) feel that there is much more to be gained, which demonstrates that users see great potential for BIM.**
- **Only 2% believe that they are receiving no meaningful value from BIM, reinforcing the positive position of the majority.**

Variation by Firm Type

Consistent with findings from other McGraw Hill Construction BIM research, A/E firms generally are more advanced in their use of BIM than contractors are because, in most cases, A/E firms started using it earlier. As a result, although the individual disciplines responding to the question of how much value they receive from BIM were generally aligned in their views, a few exceptions emerged between A/E and contractor respondents.

- **Over half (58%) of contractors feel that they are only just scratching the surface of BIM, versus a third (36%) of A/E respondents.**
- **Conversely, 55% of A/E users feel that they are already well under way in getting a lot of value from BIM, versus only 42% of contractors expressing that view.**

Variation by Type of Projects Undertaken by Firms

The type of projects that a company is primarily involved with also has an influence on their perception of value from BIM. The vast majority (84%) of firms working primarily on infrastructure projects feel that they are either getting a lot or getting all the possible value available from BIM. However, only half (51%) of companies focused on buildings report experiencing the same level of value from BIM as the infrastructure firms.

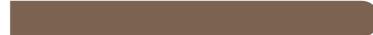
Experience of Business Value from BIM

Source: McGraw Hill Construction, 2013

We're getting everything out of BIM that we believe it can provide for us.

 **7%**

We're getting a lot of value from BIM but feel there is more to be gained.

 **52%**

We're just scratching the surface of how much value BIM can provide for us.

 **39%**

We're getting no meaningful value from BIM.

 **2%**

Top BIM Benefits

McGraw Hill Construction’s BIM research consistently focuses on the business benefits being received by users, both internally (where they provide value directly to the company involved with BIM) and externally (where they contribute to improving the overall process of designing, building and operating a project).

When analyzing BIM benefits, McGraw Hill Construction differentiates between:

- **Short-term benefits** of BIM that a company can begin to enjoy on its first BIM projects
- **Long-term benefits** of BIM that require completion of a number of projects before they become reliably apparent

The two charts show the percentage of BIM users in Australia and New Zealand who reported that they are experiencing the specific short- and long-term benefits at a significant (either high or very high) level.

Short-Term BIM Benefits

While none of these benefits are being experienced by more than half of all BIM users, several of them are making significant contributions.

- **Almost half (45%) of BIM users experience fewer errors and omissions because of BIM.**
- **More than a quarter see a reduction in rework and appreciate the ability to work collaboratively with other team members.**
- **Two benefits related to business development—offering new services and marketing new business—are enjoyed by about one fifth of users.**

Long-Term BIM Benefits

Because long-term benefits of BIM require the completion of numerous projects to identify reliable trends, they naturally score lower among users in Australia and New Zealand, which is still in a medium phase of BIM engagement. Research results in North America from 2009 and 2012 indicate how long-term benefits can grow substantially over a relatively short period.

- **Maintaining Repeat Business and Reduced Project Duration each increased by 37%.**
- **Increased Profits rose by 71%.**

Factors Influencing Benefits

In general, twice as many infrastructure companies highly rate BIM benefits related to increasing the speed of their projects than companies that are focused on buildings. Those benefits include faster regulatory and client approval cycles, reduced cycle time for workflows and

Short-Term BIM Benefits (By Percentage of Users Experiencing Benefit at a High/Very High Level)

Source: McGraw Hill Construction, 2013



Long-Term BIM Benefits (By Percentage of Users Experiencing Benefit at a High/Very High Level)

Source: McGraw Hill Construction, 2013



reducing the overall project duration.

For benefits that generate business development opportunities, more buildings-related companies report that they are finding BIM helps them with marketing new business and offering new services, while infrastructure companies are having greater success leveraging BIM to maintain repeat business. This may reflect the nature of the infrastructure market, with relatively fewer large clients that provide continuing opportunities for repeat work.

Company size also appears to have an impact.

- **More large A/E users report receiving more value from BIM's ability to enable them to offer new services than midsize or small firms.** This may be a result of the level of available resources that large firms can devote to this type of initiative, as well as the new service opportunities presented by bigger, more complex projects. However, as a trend it indicates that larger companies are better leveraging the innovative potential of BIM for business growth, and that may shift market power in their direction.
- **Among contractors, greater numbers of small companies report increased profits, better cost control/predictability and reduced rework than their midsize and large counterparts.** They also find greater success using BIM to market new business and offer new services. This may be because smaller companies can be more nimble and tend to have shorter projects, affording them the opportunity to build skills and generate success metrics more quickly.

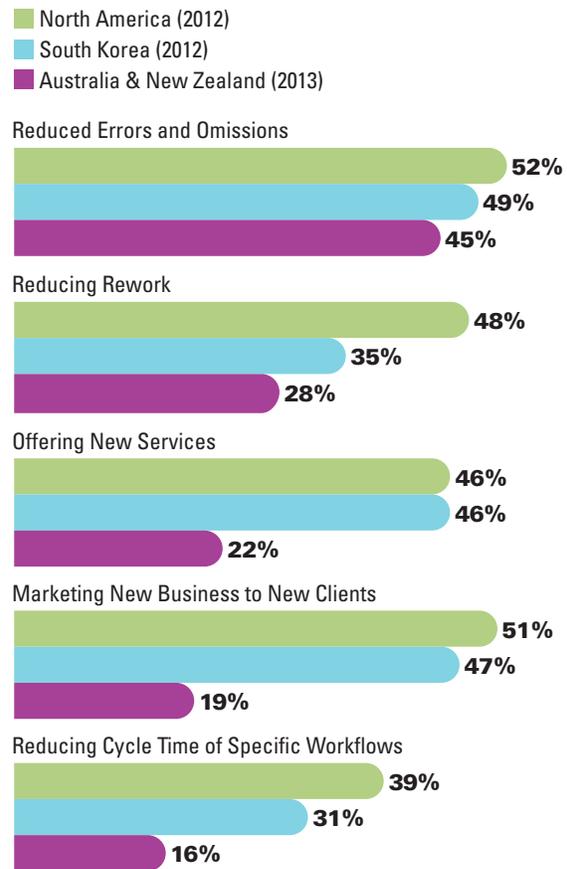
Variation by Country/Region

Although Australia and New Zealand are demonstrating a good enjoyment of BIM benefits, it is useful to compare those results with other economies for benchmarking purposes. The chart shows the degree to which the top five BIM benefits from McGraw Hill Construction's research in North America (2012) are being enjoyed by users in Australia and New Zealand (2013) and in South Korea (2012).

- **The top benefit for all three regions is reduced errors and omissions.**
- **Reducing rework scores only about half as high in Australia and New Zealand as it does in North America,** perhaps reflecting the relatively fewer projects that have been modeled for design and then tracked throughout construction.
- **Significantly fewer users in Australia and New Zealand rate the top two business development benefits than users in North America and South Korea.**

Comparisons of Top Five BIM Benefits Among Regions (By Percentage of Users Experiencing Benefit at a High or Very High Level)

Source: McGraw Hill Construction, 2013



- **Increasing BIM use has successfully driven greater integration among project team members in North America, probably resulting in more than twice as many users citing reduced cycle times for project workflows than users from Australia and New Zealand.**
- **In general, South Korean users fall between North America and Australia and New Zealand, perhaps indicating the aggressive adoption and implementation path that the South Korean economy is on in spite of its relatively recent start with BIM.**

Based on the relatively wide enjoyment of BIM benefits in North America and South Korea, it is likely that the users in Australia and New Zealand have exciting opportunities for increasing benefits ahead of them.

Factors That Impact BIM Benefits

BIM users in Australia and New Zealand rated a variety of factors for how each would enhance their benefit of BIM. The chart shows how many users said that a factor would have either a high or very high influence. In general, contractors feel more strongly about the influence of these factors than A/E respondents, and the differences between their responses to specific factors shed light on the nature of their respective uses of BIM.

Variation by Firm Type

CONTRACTORS

Not surprisingly, contractors focus on factors that will increase the value of BIM for the build team, such as integration of BIM data with mobile devices (100%) and contracts that are more supportive of BIM and collaboration so that they can further integrate digitally with trades, fabricators and suppliers (86%). Other trends include:

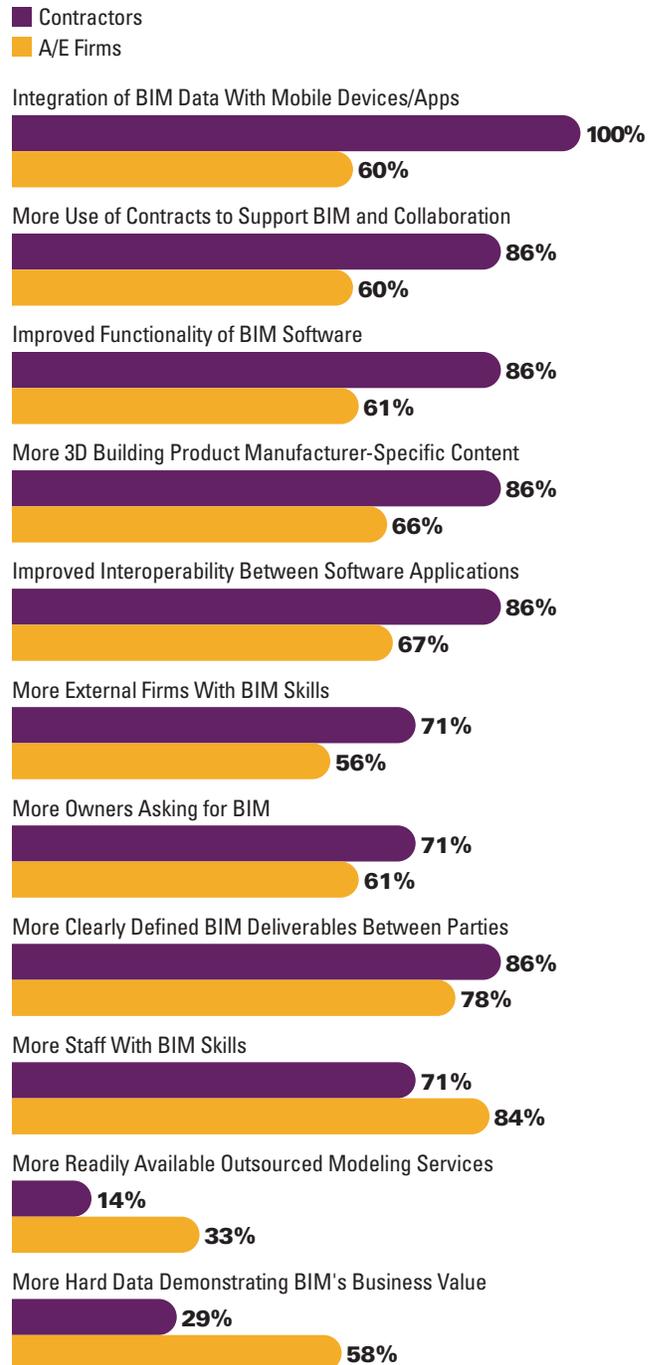
- **Eighty-six percent of contractors call for improved BIM functionality, versus only 61% of A/E users**, perhaps giving voice to a perception that BIM software is currently focused on supporting the design process.
- **Contractors also more strongly cite the need for improved interoperability between software applications than A/E respondents (86% and 67%, respectively)**. This likely results from their need to manage modeled content from multiple design professionals and trades, fabricators and installers.
- **Contractors (86%) voice the loudest call for more manufacturer-specific 3D building product content**, which is not surprising since they need to procure specific products. Only 66% of A/E users feel as strongly.
- **At 86%, contractors also lead the way in calling for more clearly defined BIM deliverables between parties**, an issue that directly affects their work because of the need for accurate, complete and consistently formatted project information to distribute among the build team for execution. Since 78% of A/E users also vote strongly for this factor, it is clearly a universal need.

A/E FIRMS

- **The top factor identified by A/E users (84%) is more staff with BIM skills** because model authoring is a critical capability for them. Seventy-one percent of contractors agree, making an industry-wide statement that the demand is strong for skilled personnel.
- **Very keen are 58% of A/E users for more hard data** that demonstrate the business value of BIM. Interestingly, only 29% of contractors feel that need, perhaps

Factors Most Likely to Increase BIM Benefits for Users (According to Type of Firm)

Source: McGraw Hill Construction, 2013



reflecting the tangible benefits that contractors are increasingly receiving from BIM.

- **Further reinforcing the importance of model authoring for design professionals, 33% of A/E users want more readily available outsourced modeling services,** compared with only 14% of contractors.

Variation by Type of Projects Undertaken by Firms

Almost all (94%) of the companies primarily working on infrastructure projects believe more staff with BIM skills is a critical factor to increasing BIM benefits, compared with 74% of firms focused on building projects. One factor that may contribute to this finding is that firms working on infrastructure projects tend to be more internally self-sufficient and work less often with large integrated teams.

Conversely, 71% and 75% of firms working on building projects are looking for more BIM-skilled companies in the industry and better contracts to support BIM and collaboration, compared with only 44% and 56%, respectively, of those working on infrastructure projects. This may reflect the relatively larger and more integrated teams on building projects.

Three-quarters of firms working on buildings projects want more owners to ask for BIM, a need expressed by 49% of those working in infrastructure, probably due to concentration of fewer large clients in the infrastructure market.

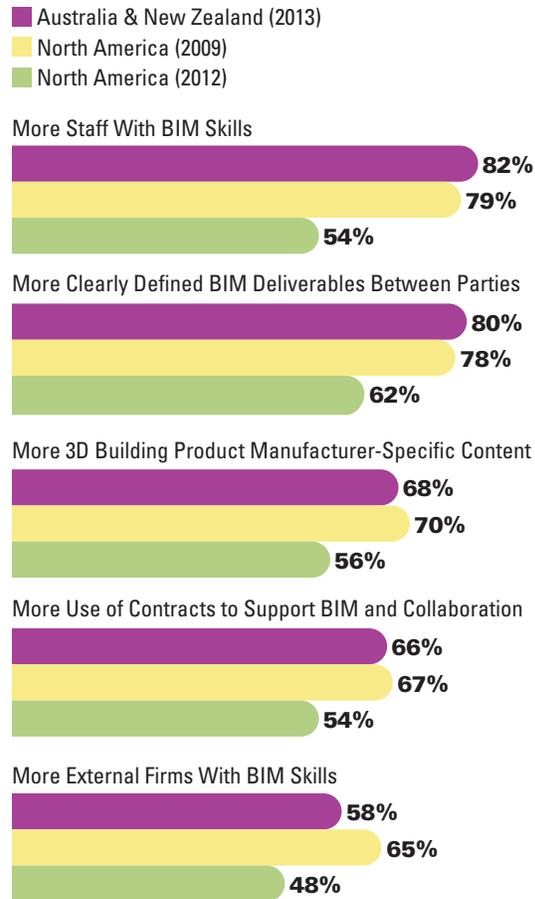
Variation by Country/Region

McGraw Hill Construction's BIM research in North America between 2009 and 2012 shows a decrease over that period in the number of respondents placing high priority on factors that may increase their BIM benefits. Perhaps this is because BIM has been more widely used there for a longer time, BIM engagement is relatively high, and the benefits are more well-established compared with Australia and New Zealand where BIM is still maturing and more users are looking to enhance BIM value.

The chart shows the five factors from the Australia and New Zealand results that differ most markedly from the 2012 North American findings. Added between these two benchmarks in the chart for each factor is the response from the 2009 survey in North America. Remarkably, there is very close alignment between the current desires of users in Australia and New Zealand and the 2009 results from North America, suggesting that the lower 2012 North American results may represent a reasonable

Top Five Factors With Greatest Differences Between Australia & New Zealand and North America

Source: McGraw Hill Construction, 2013



expectation for users in Australia and New Zealand in just a few years.

MORE SKILLED STAFF

The steep drop in users who assign a high priority to finding more staff with BIM skills in North America (from 79% in 2009 to only 54% in 2012) may reflect both the temporary effect of the global financial crisis on design and construction there and a longer-term trend of more skilled BIM practitioners available in that market. The continued growth of BIM in Australia and New Zealand will certainly generate more skilled users to meet the needs of A/E firms and contractors.

MORE BIM DELIVERABLES

The desire for more clearly defined BIM deliverables among parties in Australia and New Zealand also aligns

BIM Use and Value—Benefits

Factors That Impact BIM Benefits CONTINUED

closely with North America in 2009. In the interim, more owners have developed BIM execution programs, the BIMForum has advanced the LOD (Level of Development) standard, and many firms have settled on reliable routines for exchange of BIM information during projects.

MORE BIM CONTRACTS

Industry organizations in North America, such as the American Institute of Architects (AIA) and the Associated General Contractors of America (AGC), as well as numerous owners, have developed agreements specifically tailored to supporting BIM processes. In addition, Penn State University and several public owners have created BIM execution guides that are widely available for project teams to adapt to their needs. Organizations in Australia and New Zealand are working on a number of initiatives and standards programs that will make it easier for project teams to take more advantage of integrated BIM processes and reduce this demand for BIM contracts. (See page 51 for more information.)

MORE FIRMS WITH BIM USERS

The natural evolution of BIM in Australia and New Zealand will create more opportunities for current non-user companies to get engaged with BIM projects. Comparatively, in 2009, architects were the dominant users of BIM in North America. However, based on the adoption trends identified in McGraw Hill Construction's BIM research that year, 2010 was predicted to be the "Year of the Contractor" in BIM. Indeed, although architects continued to come on board, aggressive adoption by both general and trade contractors swelled their numbers dramatically, ultimately resulting in contractors exceeding the adoption level of architects in the next (2012) study, reaching 74%.

A similar expansion of BIM capabilities is likely in Australia and New Zealand. As BIM projects proliferate, trade organizations, such as AMCA and Consult Australia, provide BIM guidance and encouragement to their members, and consulting firms, such as CSI Global Services, support training and continued development within the companies that have adopted BIM.

Use of BIM to Enhance Project Sustainability

Green building and BIM are two powerful construction industry trends that are increasingly aligned as both continue to gain traction globally. BIM users in Australia and New Zealand are helping to drive that synergy by demonstrating innovation and commitment to using BIM for sustainable design and construction practices. (See case study on page 24 for an example of BIM use on a green project.)

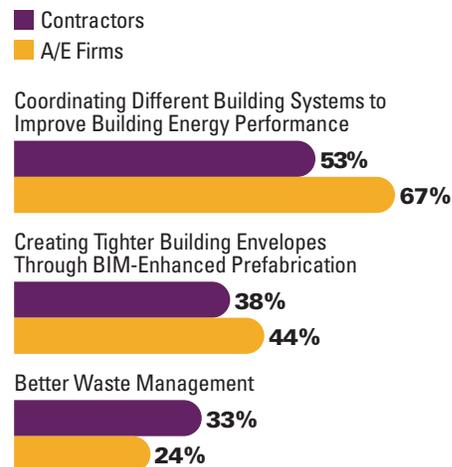
The chart shows what percentage of BIM users report engaging in these green BIM activities at either a high or very high frequency. Some of the benefits are intertwined. For example, use of prefabrication also contributes to better waste management.

There were some variations by firm size.

- **Using BIM for coordinating different building systems to improve energy performance is particularly prevalent among large A/E firms, reported by 80% of them.**
- **The coordination and prefabrication practices occur with greater frequency among large companies (67% for contractors and 52% for A/E firms) than among small ones (45% for contractors and 32% for A/E firms).**

Use of BIM to Enhance Project Sustainability (By Firm Type)

Source: McGraw Hill Construction, 2013



Enabling Green Design Through BIM on an Australian Tower Project

1 Bligh Street
SYDNEY, AUSTRALIA

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND

1 Bligh Street is a stunning 28-story high-rise in Sydney, Australia, that has won numerous awards for its architectural design and achieved Australia's highest green building rating: six stars in the Green Star ratings program of the Green Building Council of Australia (the equivalent of LEED Platinum in the U.S.). What is not as well known about the project is how an integrated project team used BIM and 3D design to achieve its audacious design and sustainability goals.

"The elegance of the design solution was a very hard taskmaster: There was no opportunity to change the building geometry if the performance goals were not being met," says Rodd Perey, a principal in the Sydney office of Architectus, which designed the

tower along with the firm ingenhoven of Düsseldorf, Germany. "It was essential that the performance of the building be simulated and verified at a very early stage."

BIM in Action

The building has complex cantilevers, a split and offset core with thin slab connections and a full-height atrium void. This required extensive analysis to develop and optimize the design. The high Green Star rating was largely dependent on the intrinsic performance of building elements, such as the double-skin façade and the atrium. To ensure that 1 Bligh Street met the performance requirements for the rating, the performance of the building was extensively simulated and analyzed. Separate BIM models were created



1 Bligh Street is a modern office tower in the heart of Sydney's business district.



Thanks to a comprehensive BIM program and buy-in from all disciplines, 1 Bligh Street's double-skin façade design changed remarkably little from design to construction.

for architectural design, structural and MEP design and coordinated for construction. Ansys AirPAK was used to plan the building's airflow and fluid dynamics.

"BIM benefited almost every aspect of the project," Perey says. "Elements such as the double-skin façade could be optimized for best performance and minimal materials through CFD analysis. Similarly, the structural design was refined for maximum structural efficiency through rigorous iterative analysis of the model."

Plant room design in the complex and difficult-to-visualize plant spaces under the building's helical basement ramps was refined through clash detection to allow for

CONTINUED

1 Bligh Street SYDNEY, AUSTRALIA

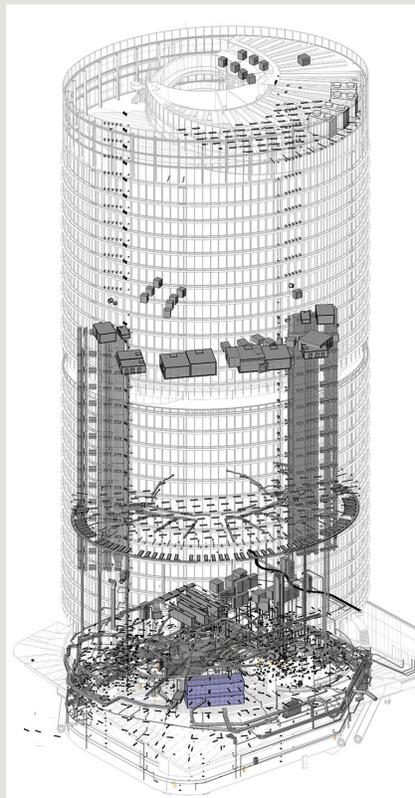
THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND

a tighter placement of equipment. This resulted in smaller plant rooms and less excavation of the sandstone beneath the building.

Sprinkler pipework was coordinated so that, in the basements, it could run in sleeves through the beams—resulting in a much cleaner appearance and eliminating hundreds of elbows and pipe cuts. Washrooms were assembled from prefabricated modules that were manufactured offsite. From the commencement of construction through to completion, more than 10,000 clashes were resolved through clash-detection and coordination processes.

The building's floor plans are oval, with the long axis running southwest to northeast. This orientation places the office spaces on the northwest and gives the upper floors spectacular views of Sydney Harbor. The building changed remarkably little from its conceptual design to its completion in 2011. A multitude of considerations—including sustainability, urban design, those views, the commercial positioning of the office tower and tenant requirements—produced a design of Da Vinci-like simplicity.

"It is the strength of the initial design in resolving these factors that has allowed the design to evolve and continue to be refined without moving far from the schematic proposal," Perey says. "One of the values of BIM has been to allow us to understand the complexity of the geometry in 3D, resolve the junctions of elements and constructability issues and communicate that to the teams assembling the building. So the vision didn't change, but BIM allowed us to resolve the details."



Architectus + ingenhoven's design for 1 Bligh Street allowed fully daylit office spaces, cyclical airflow and MEP equipment concentrated mainly on the lower floors of the structure.

Developer Commitment

Developer DEXUS Property Group, Sydney, was committed to the six-star Green Star rating as well as the premium positioning of the tower in the Sydney commercial office market. Perey says that while having the integrated team working together in a BIM process was the enabling factor, the project would have never been able to achieve its ambitious design and sustainability goals without such a committed client.

"They had a genuine desire to future-proof the building as far as possible, and BIM was part of that

for its ability to verify the sustainability and performance aspects of the building, to improve the construction process and to provide a platform for the management of the facility," Perey says. "I have checked with various members of the design team, and they cannot think of a single instance of a compromise to the original design intent that was made on the project. In at least one case, it actually went the other way: Atrium glass walls and balustrades that were initially designed as faceted were changed to curved during construction, when the curved glass was found to offer better strength at a given thickness." ■

Project Facts and Figures

Owner/Partnership

DEXUS Property Group, DEXUS Wholesale Property Fund and Cbus Property

Architects

Architectus + ingenhoven architects

Contractor

Grocon

Type of Project

High-rise office building

Size

42,700 sq. metres over 28 stories

Completed

July 2011

Green Designations

- 6 Star Green Star Office Design v2 Certified Rating
- 6 Star Green Star Office As-Built v2 Certified Rating
- Designed to achieve 5-Star NABERS (National Australian Built Environment Rating System) Energy Rating

stats

Data: BIM Use and Value—ROI

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND DATA

Perceived ROI for BIM

Although there is no single widely accepted method for calculating a company's return on its investments (ROI) in BIM, most users have a perception of the degree to which they are receiving value for the time, money and effort that they have expended. Since 2009 McGraw Hill Construction has been asking survey respondents in its BIM research to estimate their ROI on BIM as being in one of seven ranges, which are grouped into three tiers:

- Negative or Break-Even
- Moderately Positive (up to 25% ROI)
- Very Positive (Over 25% ROI)

Perceived ROI for BIM in Australia and New Zealand

A/E and contractor users are about equally divided across the three tiers, with contractors having slightly more presence in the moderately positive group and A/E users in the very positive ROI group. This is likely due to the longer period of time that design professionals have been engaged with BIM, thereby having amortized more of the initial costs and found the efficiencies that generate the payback.

However, a dramatic difference in ROI appears among companies that are primarily focused on infrastructure and industrial work as opposed to those in the buildings sector.

- **Almost half (55%) of infrastructure companies report a very positive ROI versus only 30% of buildings firms.**
- **About a third (30%) of buildings firms are in the negative or break-even tier, compared to only 6% of those that focus on infrastructure.**

Impact of BIM Implementation Level on ROI in Australia and New Zealand

The degree to which a company implements BIM across its portfolio of projects has a direct relationship to its perception of the ROI it is receiving on its investment in BIM. The third chart at right shows the difference between the three major tiers of ROI reported by companies with low BIM implementation (less than 15% of their projects) versus those with very high implementation (more than 60% of their projects).

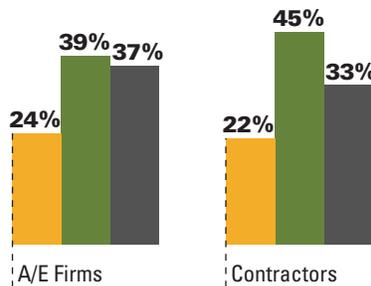
- **Almost half (46%) of the very high implementers are also in the very positive ROI tier,** clearly enjoying powerful benefits of BIM across the wide array of projects where they are deploying it. Although 22% are in the negative or break-even tier, only 4% of those are actually reporting a negative ROI, with the remaining 18% showing break-even status.

Perceived ROI for BIM

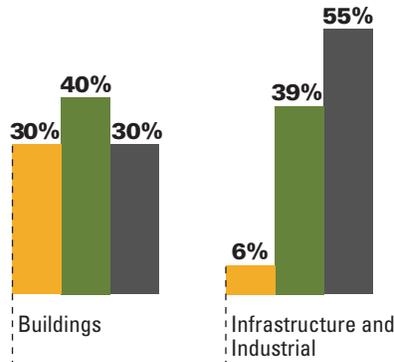
Source: McGraw Hill Construction, 2013

- Negative or Break-Even ROI
- Moderately Positive ROI
- Very Positive ROI

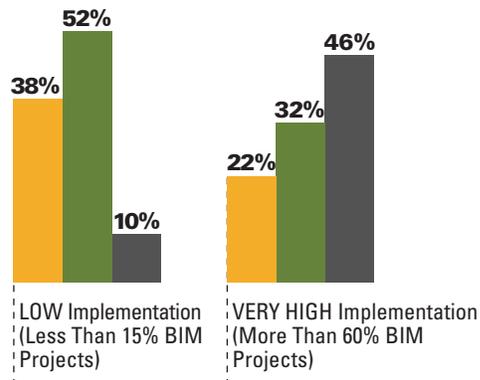
Perceived ROI for BIM by A/E and Contractor Users in Australia and New Zealand



Impact of Project Types on Perception of ROI



Impact of BIM Implementation Level on Perception of ROI



- Only 10% of low implementation users have a very positive ROI, and well over one-third (38%) are in the negative or break-even tier, split evenly between negative (18%) and break-even (20%).

Comparing the Perceived ROI in Australia and New Zealand With Other Regions

The differences in perceived ROI among regions and different types of companies provide insights into the dynamics of BIM use and where various parties receive value. In general, BIM users in Australia and New Zealand report receiving a higher ROI than North American respondents.

- Australia and New Zealand significantly outpace North America in the positive ROI categories, especially the 51%–100% range (15% versus 9%).
- Less than half as many users in Australia and New Zealand (8%) perceive themselves to be at negative ROI than in North America (18%), and fewer also believe that they are at break-even (17% and 20%, respectively).

Variance between company types drives regional ROI differences, as each grapples with unique challenges in deriving ROI from BIM. The charts at right shows the variances among three company types in Australia and New Zealand, South Korea and North America, divided into the three major ROI tiers.

CONTRACTORS

A majority of contractors in all three regions report receiving a moderately positive ROI on BIM and within a very close range of each other. Marked differences appear in the other two tiers, however.

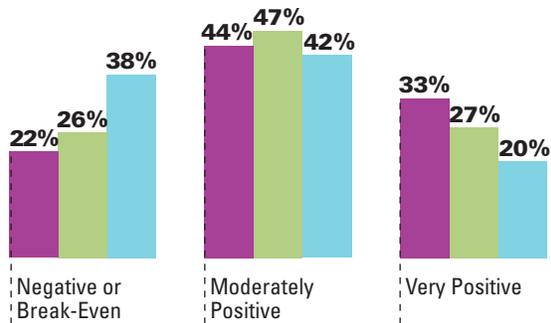
- Thirty-eight percent of South Korean contractors are in the lowest ROI tier. Due to their more recent wave of adoption, many are still coming up to speed, negatively impacting their ROI. The more established use of BIM in Australia and New Zealand and in North America gives rise to their lower counts in this tier.
- Contractors from Australia and New Zealand are top among those reporting very positive ROI. This may be because those users have been able to take advantage of practices and processes developed by their peers, both locally and elsewhere in the world, and are leveraging those learnings to achieve better ROI more quickly than has been typical in North America.

Perception of ROI by Contractors, Architects and Engineers in Three Regions

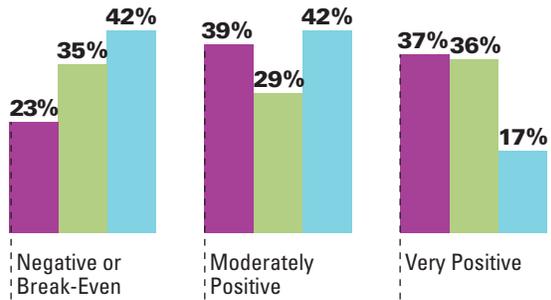
Source: McGraw Hill Construction, 2013

- Australia & New Zealand (2013)
- North America (2012)
- South Korea (2012)

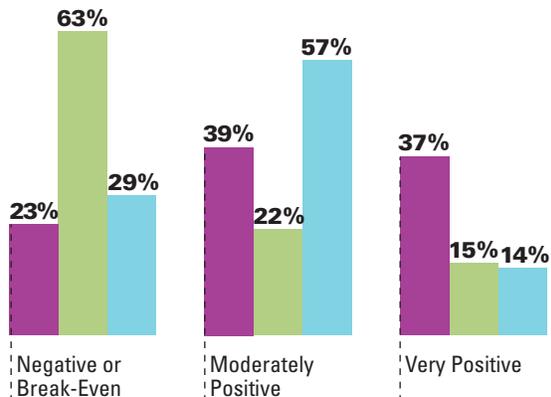
Contractors



Architects



Engineers



ARCHITECTS

The ROI results from architects show a different distribution pattern than contractors.

- **The negative or break-even tier displays a similar pattern to that of the contractors**, although the percentages are larger across the board. This highlights the ongoing challenge faced by architects to justify continuing investments required for BIM. The call by architects and engineers for more hard data demonstrating the value of BIM in their ratings of factors that will increase BIM value (see page 21) underscores this point.
- **Though still capturing the majority of users, the moderately positive ROI tier is not the dominant category as it is with contractors.** This is especially true among North American firms where larger companies that have been using BIM for a longer time are generating greater value, and smaller firms and newer entrants are more challenged to defray and amortize the ongoing investment.
- **South Korean architects express concern that their fees are not in line with the work required by BIM**, especially early in the project process. This is reflected in the large number that are in the lowest tier (42%) and the small number in the very positive group (17%).

Architect users in Australia and New Zealand and in North America, however, still outnumber contractors for very positive ROI.

ENGINEERS

Engineers show yet another distinct pattern representing the challenges and opportunities they are engaged with.

- **In North America, the perceived ROI for engineers declined between 2009 and 2012, with 63% of these firms now in the negative or break-even tier.** Challenges of supporting multiple architects with different BIM platforms, working with relatively less mature BIM functionality and content, needing to provide more fully developed design solutions earlier in the process and frequently being engaged in detailed virtual coordination all combine to suppress their ROI.
- **Engineers from Australia and New Zealand and from South Korea both express a more positive perception of their ROI**, although their numbers in the very positive tier are the lowest among all company types.

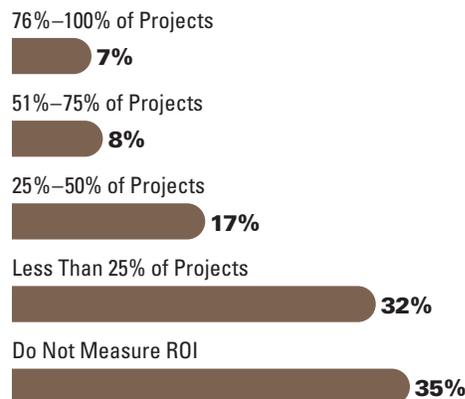
Formal Measurement of ROI

Many firms regularly measure ROI of BIM at a project level. Among the BIM users surveyed for this research:

- **Two-thirds (65%) of users in Australia and New Zealand measure ROI on their BIM projects.** This compares favorably to North America, where only 56% formally measure ROI, and very favorably to South Korea, where just a third (33%) do it.
- **Only 15% in Australia and New Zealand measure ROI on over half of their projects.** In North America, 43% of all users measure more than half their projects, yet in South Korea only 7% measure with that frequency.
- **Thirty-eight percent of A/E users and 22% of contractor users in Australia and New Zealand report that they are not currently measuring ROI.**

How Frequently BIM Users Formally Measure ROI on Projects

Source: McGraw Hill Construction, 2013



Companies that measure ROI are about equally split among those doing it less than a year, those doing it for one to two years and those that have been doing it for more than two years. Among these companies:

- **One-third (33%) of A/E firms that measure ROI have been doing so for two years or more**, and 39% for one or two years. This compares to only 14% of contractors in each of those categories.
- **Most contractors (71%) that measure ROI have only been doing so for less than a year.**

Variation by Type of Projects Undertaken by Firms

Firms focused primarily on infrastructure and industrial projects engage far more frequently in formal measurement of ROI, compared with those working primarily on building projects (see methodology on page 60 for more information).

- **Almost all (94%) firms working primarily on infrastructure and industrial projects are measuring ROI of BIM, as opposed to less than half (47%) of firms focused on building projects.**
- **Two-thirds (66%) measure ROI on at least a quarter of their projects, versus only 25% of those working on building projects.**
- **Almost one in five (19%) are measuring ROI on over three-quarters of their projects, compared with only 4% of buildings companies.**

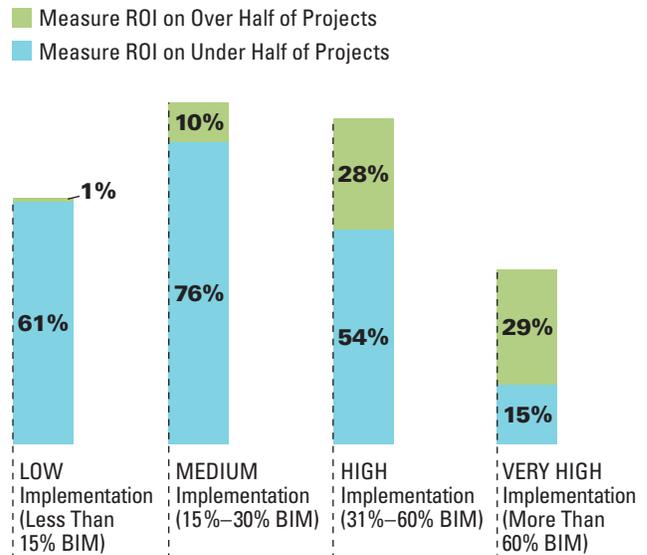
Variation by BIM Implementation Level

A company's level of BIM implementation directly correlates to their measurement of ROI.

- **Although 62% of companies at low BIM implementation level measure ROI, only 1% do so on more than half of their projects.**
- **A higher percentage (86%) of medium implementation users measure ROI, but still only 10% do so more than half the time.**
- **Most (82%) high implementation level users also measure, and a third of them do so on more than half of their work.**
- **While only 44% of very high implementation level users measure ROI, two-thirds of them are doing so on over half of their projects.**

Formal Measurement of ROI by BIM Implementation Level

Source: McGraw Hill Construction, 2013



An interesting trend appears in this data that is consistent across all the BIM research conducted by McGraw Hill Construction: **The tendency to measure ROI increases from low to medium implementation, begins to taper off among high implementation users, then drops dramatically with users at the very high implementation level.**

The likely explanation is that in the earlier stages of BIM adoption and implementation, it is important to monitor the ROI in order to justify the needs for continuing investment required to launch and sustain a BIM program. However, once an organization has reached very high implementation, BIM has established its value, and early investments have been amortized over many projects, so the need to continue measuring its ROI diminishes.

Important Metrics for Formal ROI Measurement

BIM users deploy a variety of metrics to track ROI. Five of the leading metrics used by A/E users and contractors in Australia and New Zealand are shown in the chart, indicating the percentage of each company type that gives them either a high or very high importance rating for determining ROI.

- **Financial Metrics:** Such as reduced cost, higher profitability and higher productivity
- **Schedule Metrics:** Related to faster project delivery
- **Safety Metrics:** Ways in which BIM contributes to improved site safety
- **Project Process Metrics:** Such as reduced RFIs, fewer unplanned changes, greater customer satisfaction and less overall disruption in the project process
- **Internal Benefits:** Non-project benefits, such as enhanced marketing, offering new services or staff recruitment/retention

Variation by Type of Firm

It is natural that the metrics related to project process and outcomes (financial, schedule, safety and process) are rated more highly by contractors than A/E users because of the contractors' responsibility for project execution.

Within that group, small contractors (annual revenue of less than \$5 million) show much higher-than-average interest in all five metrics types.

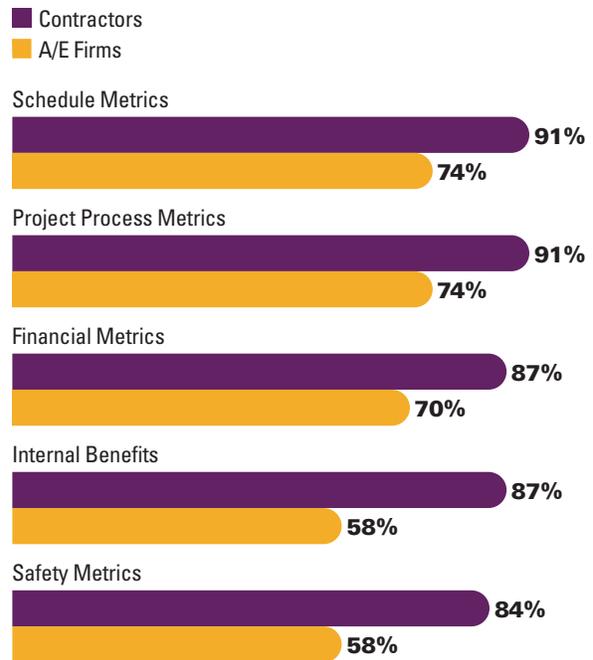
In addition, **87% of all contractors are heavily focused on internal benefits, compared with only 58% of A/E users.** This finding is surprising in that these benefits are equally available to both company types. Further research is called for to determine the metrics favored by A/E firms, which are probably centered more on enhanced design solutions and documentation efficiencies.

Variation by Types of Projects Undertaken by Firms

There are also significant differences for those users that work primarily in infrastructure and industrial projects versus those working on buildings. They show a 10-percentage-point higher-than-average reliance on safety metrics (76% versus average of 69%), which relates to the extremely keen focus on safety for those types of projects.

Important Metrics for Formal ROI Measurement (By Company Type)

Source: McGraw Hill Construction, 2013



Importance of Metrics

(According to All Users and Small Contractors)

Source: McGraw Hill Construction, 2013

Type of ROI Metric	Average (All Users)	Small Contractors
Schedule	80%	95%
Project Process	81%	95%
Financial	78%	87%
Internal Benefits	70%	95%
Safety	69%	92%

Top Benefits That Contribute to Improving BIM ROI

Users have varying opinions about the degree to which improvements in specific benefits would positively impact their ROI. **Increasing BIM’s ability to improve project processes and multi-party communication/ understanding would both have significant positive impact on ROI according to the top benefits reported as having a high or very high impact** (see chart at right).

- **A/E users** are more interested in personnel productivity.
- **Contractors** focus on improved safety, reduced cycle times and project delivery and better sustainability.
- **Both company types** believe that enhanced ability to prefabricate will boost ROI.

Variation by BIM Expertise and Implementation Levels

Users with high levels of BIM expertise (see page 10) and those with very high implementation levels (see page 9) express stronger-than-average feelings about the value of particular benefits.

- **Improved Project Processes:** Seventy-one percent of BIM experts and 80% of users at very high implementation levels rated this as critical.
- **Increased Ability to Prefabricate:** Forty-two percent of BIM experts rated this as a top driver of increased ROI.
- **Reduced Cycle Time:** At 39%, significantly more BIM experts weighed in more heavily for this benefit.

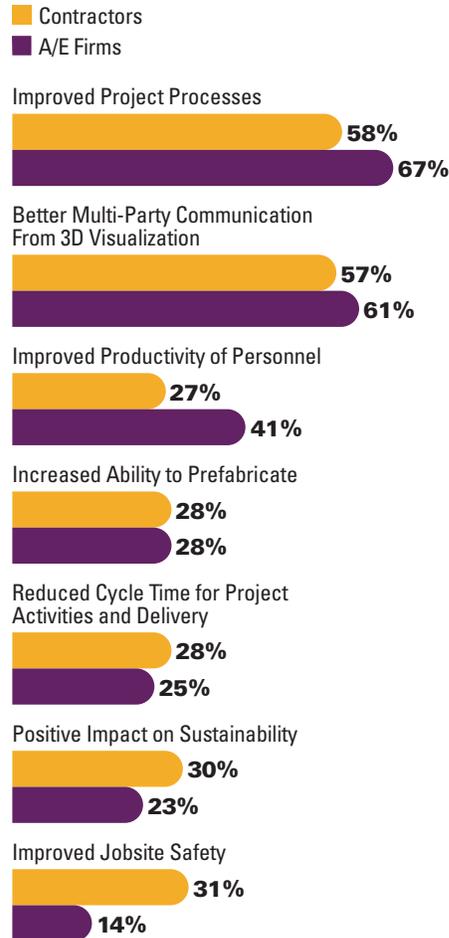
The benefits of lower project cost and faster plan approval and permits had the lowest average scores across all users, with BIM experts and very high implementers actually coming in below average, reinforcing their low potential to drive improved ROI.

Variation by Types of Projects Undertaken by Firms

- **Increased Ability to Prefabricate:** Almost half (47%) of users working primarily on infrastructure/industrial projects are demanding more prefabrication, indicating the emerging importance of BIM-driven fabrication in these markets.
- **Reduced Cycle Time:** Thirty-eight percent of those working on infrastructure/industrial projects rate this as very important, revealing an intense focus on reducing project duration for these projects.

Top Benefits That Would Contribute to Improving BIM ROI (According to Type of Firm)

Source: McGraw Hill Construction, 2013



Variation by Country/Region

Although there is agreement on which top benefits have high or very high potential for increasing ROI, a higher percentage of North American users gave top ratings than did those in Australia and New Zealand. This is probably a function of the longer time that North American companies have been engaged with BIM and tracking the metrics that may improve it. Thus it is very likely to increase in Australia and New Zealand as more companies measure ROI on a greater number of their projects.

- **Improved Personnel Productivity:** Averaging 77% across all users, this is the top potential ROI enhancer in North America, especially among contractors (85%).
- **Improved Project Processes:** Australia and New Zealand's top ROI enhancer is second in North America, with an average of 74%. Again, contractors lead with 81%.
- **Increased Ability to Prefabricate:** Resonates with 81% of North American contractors. This probably reflects the aggressive recent growth of model-driven prefabrication in North America and will certainly show the same in Australia and New Zealand.

BIM in Mining

Architects and engineers in Australia are finding that building information modeling (BIM) is offering significant benefits for mining projects—helping to identify more efficient and safer solutions and proving its value to clients.

Within Australia's technologically advanced mining industry, the adoption of BIM by engineering and construction firms is starting to make inroads.

The 3D aspects of modeling have been in use at mines for more than a decade. Western Australia-based PDC, for example, used 3D modeling on a mining project for BHP Billiton in North Queensland in 2002. However, in recent years, firms have started to push the "information" aspect of modeling, in an effort to leverage 4D, 5D and 6D capabilities.

The Big Picture

Warwick Biggs, the materials handling service line leader at GHD, says that, while a few specific elements of a mine might have been modeled in the past, all elements of a mine can be modeled today, from geotechnical aspects to physical infrastructure, like conveyors, piping and buildings.

Biggs says that by combining all elements of a mining project, the team can do more through analysis that takes into account how each affects the other. In some cases, this could be clash detection. In others, it could help find more efficient or safer solutions. Biggs notes that this can be particularly helpful when expanding an existing plant. On one expansion project, GHD was able to show a 4D animation of the effects that construction would have on existing operations.

"Because it was a brownfield site,

you could see on the model where you'd have to shut some [of the facilities] down," he says. "On one part, we had to build over top of a building for the materials handling system. That was very useful to explain the plan to the clients."

Operations and Maintenance

While modeling the information, GHD is also able to provide 6D information that could be used during future operations and maintenance. "[Clients] tend to want a lot of information on the process system, like tons per hour and flow rates," Biggs says. "Plus, they can click on a component, and it will provide the information they need for maintenance."

Biggs sees multiple benefits for owners. Although additional time is dedicated up front for additional modeling, he says that designers save time in the end. "Most [clients] want you to do a review at 20% design, 50% and 70%," he says. "In the past, you used to stop and produce hundreds of 2D drawings for a couple of weeks before each design review. After the review, we would take a few weeks to input all of the changes. Now our models are live, so we can take that into a meeting and capture the comments right there."

He estimates that the design team saves roughly 10% on the schedule with BIM and that the construction team saves up to 20% on the schedule due to reduction in errors and rework.

"As it goes forward, there will

be even further savings because contractors will get more accurate information and can offer a cheaper price," Biggs adds.

Value for Owners

Mark Long, senior project manager in mining at AECOM, says proving BIM's value to clients is key to future adoption. "It will take engineering companies showing miners that they can save time and rework by using a particular set of tools," he says.

One strategy that AECOM is developing is the ability to create standardized and modularized elements using BIM on projects for owners with multiple assets.

"You could standardize all of the conveyors, the process buildings and other elements," Long says. "Then as these develop, you have a library of information that you can use for the next mine. If you then tie that into a manufacturing facility, they would already have that information in their machine shop, and they just push the button to produce it. It would mean that all you'd have to do is adjust for geotechnical factors. The speed of the design and development could be 60% to 150% quicker."

Long adds that by standardizing elements of a mine, an owner could optimize its workforce by creating familiarity in one mine to the next. This could improve productivity as well as safety. ■

Executing BIM on a Broad Scale From Design to Operations and Maintenance

New Royal Adelaide Hospital

ADELAIDE, AUSTRALIA

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND

The largest test of building information modeling (BIM) capabilities in Australia is underway at the \$1.85 billion new Royal Adelaide Hospital (nRAH). To deliver the 260,000-sq-ft, 800-bed replacement facility in 2016, the team employed a broad-ranging BIM execution plan that spans from the design phases through to operations and maintenance.

The plan was born out of both necessity and altruism, says Chris Penn, BIM manager with HYLIC, a joint venture of Hansen Yuncken and Leighton Contractors. The project's BIM requirements will introduce numerous Australian firms to the emerging capabilities of BIM—with several firms using BIM for the first time. The team implemented the new Australian and New Zealand Revit Standards on the project, which aims to create a common framework for users and establish common families that can be used on projects through the country (see related article on page 51). "This will drive the use of BIM by the industry in South Australia," Penn says.

Furthermore, Penn says that the project's tight program—which calls for two years of design and two years of installation—would not be possible without BIM.

"It was decided that we needed to embrace BIM to bring a faster, smarter and better way of working," Penn says. "If we didn't have BIM, we would have needed twice as many resources on the documentation side."

Contractors and Coordination

The HYLIC joint-venture team includes more than 65 subcontractors and consultants, with more than 200 people working simultaneously on the design. The project is split into 19 sectors with each sector acting "as a project of its own," Penn says. All models are brought together into a federated model to provide a project-wide view. Under this plan, the models offer both trade-specific and team-wide advantages. Each consultant and contractor can model its own scope, carrying out any necessary

analysis and documentation to meet specific needs. By bringing the models together, larger issues can be explored, such as 3D clash coordination of trade contractors.

Nicholas Hagop of CDC Plumbing, which is providing hydraulic services, says that his team started using BIM for the first time on the nRAH project and quickly saw the benefits. "We've already encountered that, had it not been for an accurate model, one [contractor's installed work] would run into another pretty quickly," he says. "That enabled us to find [clashes] before they happened in real life."

Using a third party to model its work, CDC Plumbing is able to identify its work to the level of plumbing fixtures and fittings. The firm also required its suppliers to provide the families that would be needed to populate its models. "The suppliers will benefit from this, and we benefit from this," Hagop says. "Once they create a family, they can then provide that to other people who come to them [for materials]."

Prefabrication and Modularization

Through modeling, some contractors are also executing prefabrication and modularization on the project. BSA Limited has taken the lead in incorporating multiple trade packages for prefabricated work and modules. These services could include mechanical, electrical, hydraulic, fire, pneumatic tube, medical and laboratory gas. Specific portions of the building lend themselves to modular design, such as the corridors. BSA estimates that it will deliver approximately 650 4.5-metre modules.



For construction of the \$1.85 billion new Royal Adelaide Hospital, the team instituted a broad-ranging BIM execution plan that spans from the design phases through to operations and maintenance.

Image courtesy of HYLIC, a joint venture of Hansen Yuncken and Leighton Contractors

CONTINUED

New Royal Adelaide Hospital

ADELAIDE, AUSTRALIA

Modules can be built offsite in a warehouse, providing a safer and more controlled environment. Although the prefabrication process can be more expensive and labor intensive, BSA expects to recoup any added costs through time savings and improved productivity.

Offsite fabrication also helps the team address site storage issues. Modules can be built and stored at the warehouse and delivered just in time. Penn says that BSA is also testing RFID tagging of the modules for improved tracking.

Cost, Scheduling and Quality Management

For part of its overall management strategy, the team developed the Single Point of Truth nRAH Information Centre (SPOTNIC) system. The system incorporates 3D BIM models with QA management, document management and reporting. BIM models can also be accessed via field tablets, which the team claims is the first use of such a method in Australia. This system can be used by team members in the field during design, construction and commissioning.

The project team is also testing 4D and 5D BIM capabilities on the job. Although 4D and 5D were excluded from the original execution plan, it was added in a revised plan. The team is now using BIM-related software for model-based scheduling exercises. Some use of 5D for cost estimating is running in conjunction with the traditional approach. Penn says that because so many team members needed to get up to speed on BIM early in the process, much of the cost-estimating work was completed before BIM was implemented.



The 24,000-square-meter, 800-bed replacement facility is scheduled to open in 2016. The fast-track schedule would not have been possible without the use of BIM, according to the project team.

"We haven't pushed 5D as much on this project, but what we've learned here will help in subsequent projects," Penn says.

Operations and Maintenance

The team is also developing 6D models for operations and maintenance. Hagop notes that the BIM families provided by its suppliers include pertinent information for facilities management, such as part numbers and warranty information.

Penn says that design-construction teams and facilities managers are both investigating how BIM information can be used to support operations and maintenance functions. He notes that most facilities managers currently use systems that don't accept BIM data, but as owners begin to recognize the value, they will come to expect that capability from management software.

In the case of the nRAH, Penn says that he is looking at the big-picture potential. The project is being built under a public-private partnership with a long-term interest in future operations. He says, "[Facilities services firm] Spotless will be operating this hospital for 30 years, and we want to help them do that." ■

Project Facts and Figures

Joint Venture

Hansen Yuncken and Leighton Contractors

Type of Project

Hospital

Project Budget

\$1.85 billion

Size

24,000 square meters over nine levels

Anticipated Completion

2016

BIM Usage

BIM and related tools will be leveraged to aid in:

- Visualization
- Coordination and clash detection
- Prefabrication and modularization
- Scheduling
- Cost estimating
- Quality management
- Operations and maintenance

stats

Data: BIM Use and Value— Investments

Investments in BIM

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND DATA

BIM programs require ongoing investments in hardware, software, training and processes in order to realize the potential value. McGraw Hill Construction research has been tracking the categories of BIM users' investment across several regions since 2007.

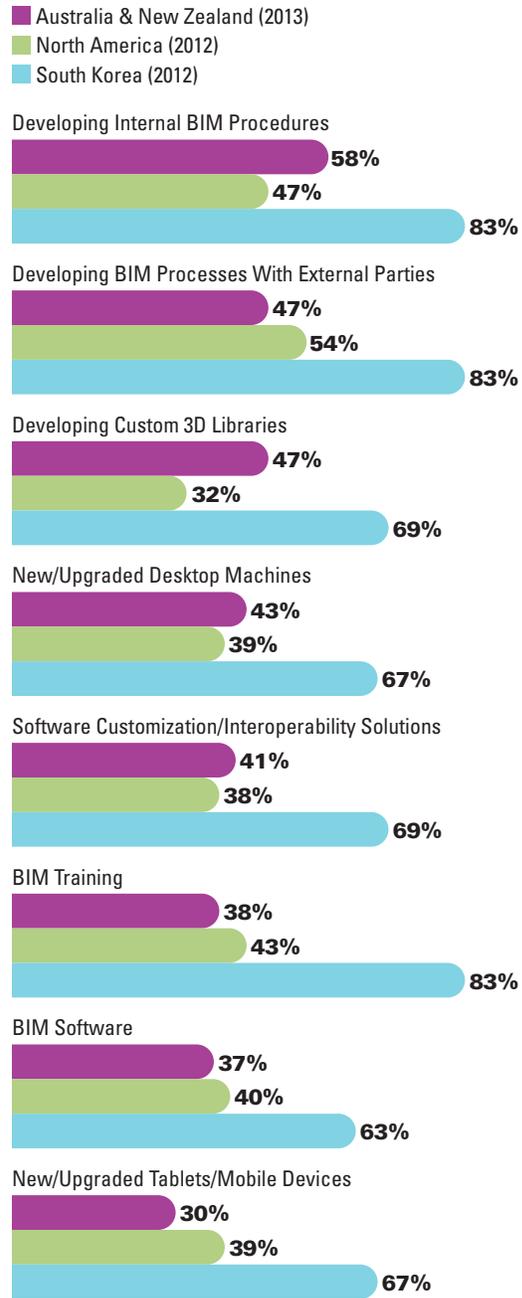
Variation by Country/Region

Users were asked what level of investment that they are planning to make in each of eight categories over the next two years. The chart shows the percentage of users rating each one either high or very high.

- Investment Plans in South Korea:** The large number of South Korean users expressing high or very high intent to make these investments reflects both the relatively early stage of BIM engagement there and the aggressive growth path that users are on.
- BIM Processes:** All regions place a high priority on internal and external BIM processes. The preference shown in North America for external over internal processes (54% to 47%) reflects the growing focus on integrated practices throughout the project team. In fact, this category jumped to its highest level (from 33% to 54%) in the most recent North American research. This trend is likely to repeat in Australia and New Zealand as users standardize internal procedures and shift focus to optimizing team use of models.
- 3D Libraries:** The need for custom 3D libraries is felt much more strongly in Australia and New Zealand and in South Korea, another reflection of the developing stage of BIM in those regions.
- Hardware:** Hardware investments and upgrades are likely to be a permanent element in BIM budgets, but the faster processing and mobile access that they enable contribute directly to efficiency and ROI.
- Software:** Investment in software by existing BIM users has been trending down in North America from a high of 48% in 2009 to the 40% forecast level shown in the chart. The opposite trend is true, though, for software customization and interoperability solutions, which jumped from a 2009 level of 25% to the 38% forecast shown here. This countertrend will probably take hold in Australia and New Zealand, and also in South Korea, once the initial first investment wave has completed.

BIM Investments Planned by Users (According to Country/Region)

Source: McGraw Hill Construction, 2013



Variation by Firm Type

Contractor users express a significantly greater interest in investing in BIM training, new desktop hardware and BIM processes with external parties than do A/E users, which makes sense because of contractors’ growing role in orchestrating distributed BIM use throughout the team.

On the other hand, A/E users prefer focusing investments on internal BIM processes and 3D libraries, both appropriate to their lead role in authoring models.

Variation by Level of BIM Implementation and Expertise

Very high BIM implementation level users (see page 9) place a much higher-than-average focus on external BIM processes (60% versus the average of 47%), certainly reflecting active engagement on a relatively large number of BIM projects.

Expert BIM users (see page 10) show an above-average focus on software customization/interoperability solutions and custom content libraries, both of which reflect their BIM technical skills.

Variation by Types of Projects Undertaken by Firms

Firms working primarily on infrastructure and industrial projects are targeting a spending level well above firms working on building projects for investments in desktop hardware, mobile hardware, BIM training and customization/interoperability solutions.

Planned BIM Investments by Project Type
(Percentage of Users Rating High or Very High Importance Levels)

Source: McGraw Hill Construction, 2013

	Buildings	Infrastructure/ Industrial
Desktop Hardware	36%	58%
Mobile Hardware	28%	42%
BIM Training	33%	50%
Customization/Interoperability	36%	44%

Data: Global Comparisons

Global Comparisons for Contractor BIM Use

Construction companies around the world are aggressively adopting and implementing BIM. This section provides comparisons between contractor BIM activity in Australia and New Zealand (ANZ) and those in eight other countries: Brazil, Canada, France, Germany, Japan, South Korea, the UK and the U.S. The data are drawn from McGraw Hill Construction's 2014 study on the use of BIM by construction companies in these major regions.

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND DATA

Length of Time Using BIM

Australia and New Zealand (ANZ) fall in the middle of the pack in terms of the duration of BIM experience reported by their users. Key comparison points with other regions:

- The activity in ANZ contrasts sharply with **Brazil**, which has begun to adopt BIM much more recently.
- The length of BIM use in **Japan and South Korea** show the hallmarks of markets that began their rapid adoption a few years ago, because while approximately a quarter of users are still in the early stage (1–2 years), 63% have moved to the moderate level.
- The length of contractor use of BIM in **Western Europe and North America** is the longest—with significantly more having used BIM for more than 10 years. This reveals markets that are more mature in BIM use.

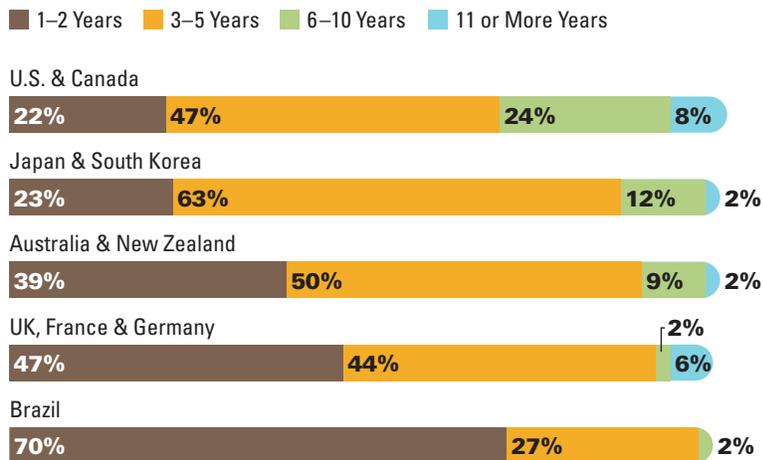
BIM Expertise Level

Contractors rated their own perception of BIM skills by one of four categories. Although there is no universally accepted standard for BIM expertise, this self-description is still useful as a way to broadly assess relative capability differences between regions.

Similar to their years of experience with BIM, contractors in ANZ are about in the middle of the range

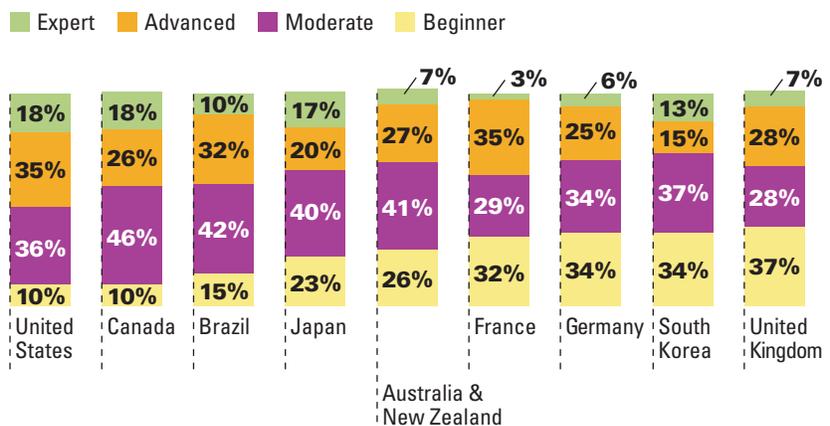
Number of Years Contractors Have Been Using BIM

Source: McGraw Hill Construction, 2013



Contractors' BIM Expertise Level by Region

Source: McGraw Hill Construction, 2013



of skills assessment globally. Key comparison points on other markets:

- With its recently announced government mandate for BIM on public projects, the **UK** shows the highest number of beginner users, likely because of the surge of users realizing that they need to sharpen their skills in order to comply with requirements.
- The **U.S. and Canada** show the most expertise, likely correlated with their longer use of BIM.

BIM Implementation

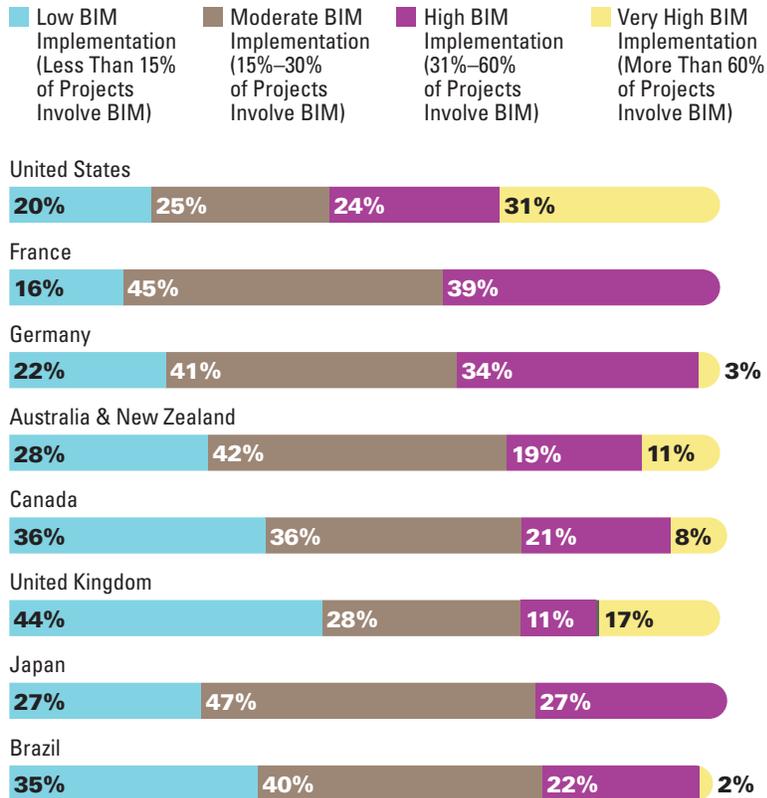
Once companies become engaged with BIM, an interesting trend to track over time is the increasing percentage of their projects that involve BIM, also known as a company's level of BIM implementation. McGraw Hill Construction developed four tiers of BIM implementation and has used these tiers in its BIM research around the world since 2009.

ANZ ranks fourth among regions for users at high and very high implementation levels (i.e., engaging with BIM on more than 30% of their projects). Key comparisons to other regions:

- Because BIM started in Western Europe, it is not surprising that **France and Germany** rank relatively strongly.
- The **UK** has a high percentage on both ends of the spectrum, which may reflect the recent influx of companies responding to government mandates for BIM use; many of these firms are still in the early stages of rolling out BIM.
- **South Korea** shows the highest percentage of low implementation, likely due to the recent fast adoption growth there, with many firms still doing only a few projects.

Contractors' BIM Implementation by Region (In Order of Percentage of Users at High and Very High Implementation Levels)

Source: McGraw Hill Construction, 2013



BIM Engagement Index

To assess the overall level of BIM engagement by users in a region, McGraw Hill Construction developed a BIM Engagement Index (see page 13 for the calculation methodology), which reflects the scope of a user's level of engagement with BIM.

The relative number of users in a given region that populate the various tiers is a useful way to compare regions in terms of overall level of BIM engagement.

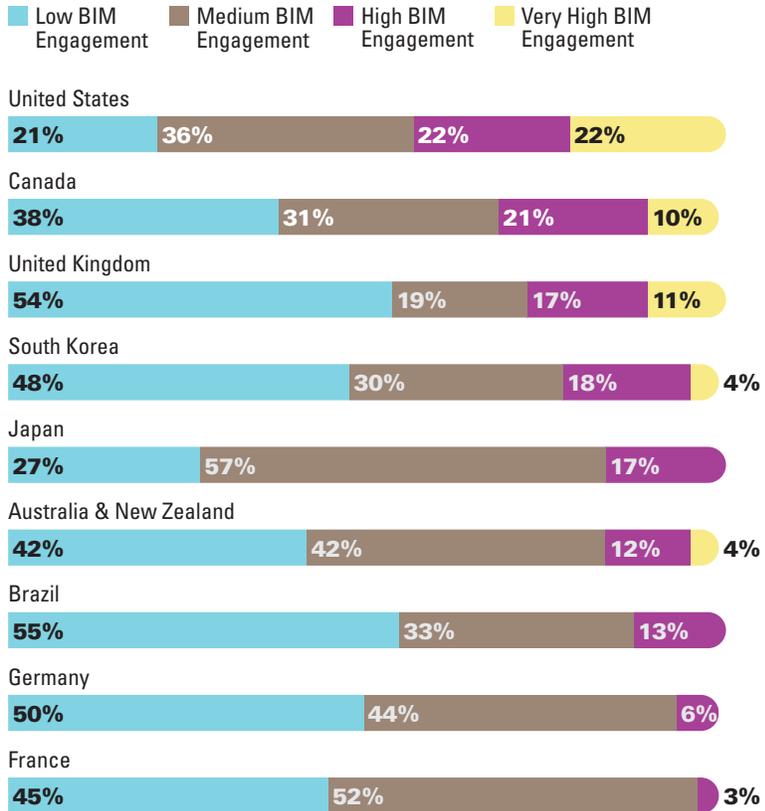
ANZ falls below the midline in terms of overall BIM engagement level when the regions are ranked by the percentage of users at high or very high levels. Comparisons with other regions:

- The **UK** scores high in spite of its large percentage of low-engagement users due to the 28% of users at high and very high levels.
- The **U.S.** has both the fewest low-level users and the largest numbers at high and very high levels, likely due to both the length of time that BIM has been actively deployed there and the rapid pace of its growth.

Contractors' BIM Engagement Level by Region

(In Order of Percentage of High and Very High Engagement Users)

Source: McGraw Hill Construction, 2013



BIM Benefits

The business value of BIM is expressed most clearly in the benefits received by users. In the chart, the regions that rated each benefit at the lowest and highest levels are compared with ANZ contractors to show the range of opinion for each benefit, in order to understand where the results from ANZ fall in the range of experiences of contractors from other parts of the world.

- ANZ is tied with Brazil in having the greatest number of contractors who express the strong belief that **BIM capability enhances their industry leadership image**.
- ANZ contractors report seeing **reduced errors and omissions** at a high or very high level on BIM projects. This result falls in the middle range for this very popular benefit.
- ANZ is well above the median for experiencing **reduced rework on BIM projects, improved safety and reduced cycle time of specific workflows**.
- The ANZ region falls at or below the median for all other BIM benefits.

Percentage of Contractors From ANZ That Report Receiving Specific BIM Benefits at High or Very High Levels Compared to Lowest and Highest Percent From Other Regions (In Order of Highest Benefits to Australia and New Zealand Contractors)

Source: McGraw Hill Construction, 2013

	Lowest	ANZ	Highest
Overall Enhancement of Your Organization's Image as an Industry Leader	13% Japan	41%	41% Brazil
Reduced Errors and Omissions	19% Germany	39%	63% South Korea
Ability to Work Collaboratively With Owners or Design Firms	20% Japan	26%	45% U.S.
Reducing Rework	3% Germany	26%	40% U.S.
Better Cost Control/Predictability	11% South Korea	23%	44% Germany
Reduced Construction Cost	13% Japan	21%	46% Brazil
Reducing Overall Project Duration	10% South Korea	20%	38% Germany
Increased Profits	7% South Korea	16%	39% France
Improved Safety	3% Brazil	16%	22% Germany
Marketing New Business to New Clients	0% France	14%	31% South Korea
Maintaining Repeat Business With Past Clients	4% South Korea	14%	32% France
Offering New Services	7% UK	12%	26% South Korea
Faster Regulatory Approval Cycles	1% U.S.	12%	22% Germany
Reducing Cycle Time of Specific Workflows	2% UK	12%	18% Canada
Faster Client Approval Cycles	6% U.S.	7%	20% Japan

Perceived ROI on BIM

Although there is no single widely accepted method for calculating a company's return on its investments in BIM, most users have a perception of the degree to which they are receiving value for the time, money and effort that they have expended. At right, the chart reveals the differences between perceived ROI on BIM in different regions.

BIM Investments

For an individual user, evaluating planned investment in BIM is a useful means of assessing the intensity of commitment to a BIM initiative; for an entire region, aggregating predictions from all its users can assess a region's commitment to BIM.

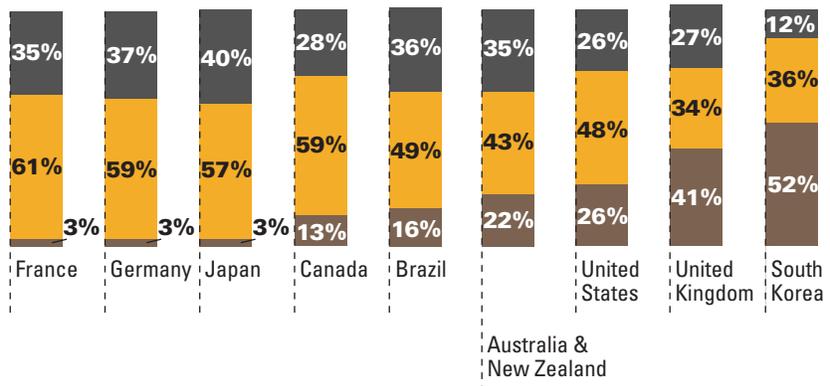
Australia and New Zealand fall slightly above the average among the nine regions for a high or very high level of importance placed by its contractors on the aggregated combination of all BIM investment categories. Some comparisons in specific BIM investments include:

- Contractors in Australia and New Zealand lead in their plans to invest in new/upgraded desktop computers, with half (50%) expressing high or very high importance compared with only one-third (33%) as the average among all other regions.
- Half (50%) of the ANZ contractors also plan to invest in developing collaborative BIM processes (a sign of BIM maturity that recognizes the importance of integrated processes), outpacing the average (40%) of the other regions.
- Contractors from Australia and New Zealand either tie or fall in a close range with the average for all other BIM investments surveyed.

Contractors' Perceived ROI on BIM by Region

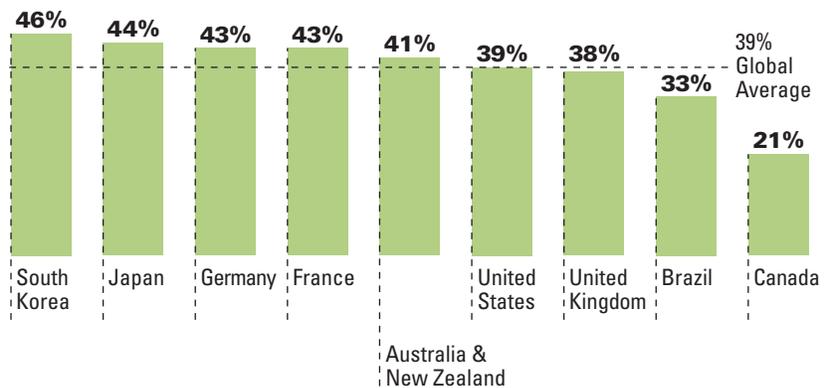
Source: McGraw Hill Construction, 2013

- Very Positive ROI (Over 25%)
- Moderately Positive ROI (Up to 25%)
- Negative or Break-Even ROI



Percentage of Contractors Assigning High or Very High Importance to All BIM Investment Categories by Region

Source: McGraw Hill Construction, 2013



More detail on BIM activity by contractors in ANZ and other regions can be found in the 2014 *Business Value of BIM for Construction in Major Global Markets SMR*. ■

Data: BIM Use and Value— Non-Users

Non-User Attitudes Toward BIM

Despite the growing adoption of BIM around the world, there are still many companies in every region that have not adopted BIM for a wide variety of reasons. Since 2009 McGraw Hill Construction has been surveying non-users as an integral part of BIM research to identify and track the obstacles to adoption and the business triggers that these companies are looking for in order to make the investment.

Non-users are asked to characterize their attitude toward BIM in one of five categories:

1. We have used it but decided not to use it any more:

This is the most negative attitude because the respondent is taking a position against BIM based on experience rather than ignorance.

2. We have not used it and have no interest in using it:

This is a moderately negative category because it is not based on experience, but it may still be a legitimate objection due to the respondent's role in the industry or the primary type of project.

3. We have not used it but are open to exploring its potential value for us: This is considered to be a neutral position, neither for nor against.

4. We have not used it and believe it will be valuable for us but have not begun evaluating it: This is a moderately positive attitude because the respondent has come to believe BIM may be valuable but has not started an evaluation process.

5. We have not used it but are actively evaluating it: This is the most positive stance because the non-user is in the active evaluation process.

For analysis purposes, these five categories have been consolidated into three main tiers of non-user attitudes toward BIM:

- **Positive Attitude:** Consisting of respondents in categories 4 and 5, these are the non-users most likely to adopt BIM.
- **Neutral Attitude:** These are the respondents from category 3 who could be convinced if they began an evaluation process.
- **Negative Attitude:** These are the non-users from categories 1 and 2 who have decided not to adopt and are unlikely to change their minds.

Attitudes Toward BIM by Non-Users in Australia and New Zealand

Well over half (59%) of contractor non-users display a positive attitude toward BIM. This far exceeds A/E non-users, among whom only 8% share that view.

- Contractors show the least negative attitude toward BIM, with only 23% in that tier compared with 33% of A/E non-users.
- The majority of A/E non-users (58%) have a neutral attitude.

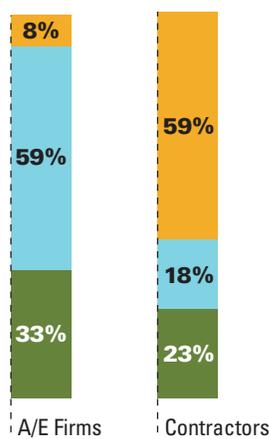
Project type also plays a small role in non-user attitudes, with companies focused on buildings having 36% of their non-users in the negative tier, compared with only 24% of those in infrastructure.

There is no statistical difference between firms that work on projects only in Australia and New Zealand versus those also working in other locations, which suggests that there is a global similarity among firms that are not yet using BIM.

Non-User Attitudes Toward BIM in Australia and New Zealand

Source: McGraw Hill Construction, 2013

- Positive Attitude
- Neutral Attitude
- Negative Attitude



Parallels With Non-Users in North America

Non-users now comprise 29% of firms in North America, and they have been hardening their resistance since McGraw Hill Construction started polling them in 2009. Starting that year, the percentage of negative non-users grew by 131%, while the ranks of neutral and positive non-users shrank by 23% and 18%, respectively. Where only 13% of non-users were negative in 2009, now almost a third (30%) have adopted that attitude.

As any major technology trend matures, a certain level of non-adoption is natural and can be expected. Based on these trends, a similar pattern is a likely forecast for Australia and New Zealand in the coming years.

Attitudes of Non-Users in North America

Source: McGraw Hill Construction, 2013

	2009	2012	% Change
Negative Attitude	13%	30%	+131%
Neutral Attitude	43%	33%	-23%
Positive Attitude	44%	36%	-18%

Most Important Reasons for Not Adopting BIM

Non-users express a variety of objections and identify a number of obstacles preventing them from adopting. The chart shows the percentage of non-users that rated each of these reasons either high or very high in impact on their decisions not to adopt BIM.

- **Lack of demand is the leading reason for not adopting BIM in every research study conducted by McGraw Hill Construction.** Design professionals rate this particularly high, aligning with the need of users for hard metrics demonstrating the value of BIM and the lack of owners that demand BIM (see page 21).
- **Costs of hardware and software are another consistent top objection,** a case felt more strongly by contractors and by over twice as many firms primarily working on building projects as those working primarily on infrastructure or industrial projects.
- **Difficulty of using BIM software is consistent between A/E non-users and contractor non-users, but is highly rated by three times as many firms working on buildings as those working on infrastructure/industrial projects.** This objection scores even higher in South Korea (51% of non-users), where BIM is newer to the market.
- **A/E firms (33%) significantly outnumber contractors (9%) in believing that their current methods are better.** The differential in this finding aligns with contractor users' generally positive views on the business benefits of BIM.

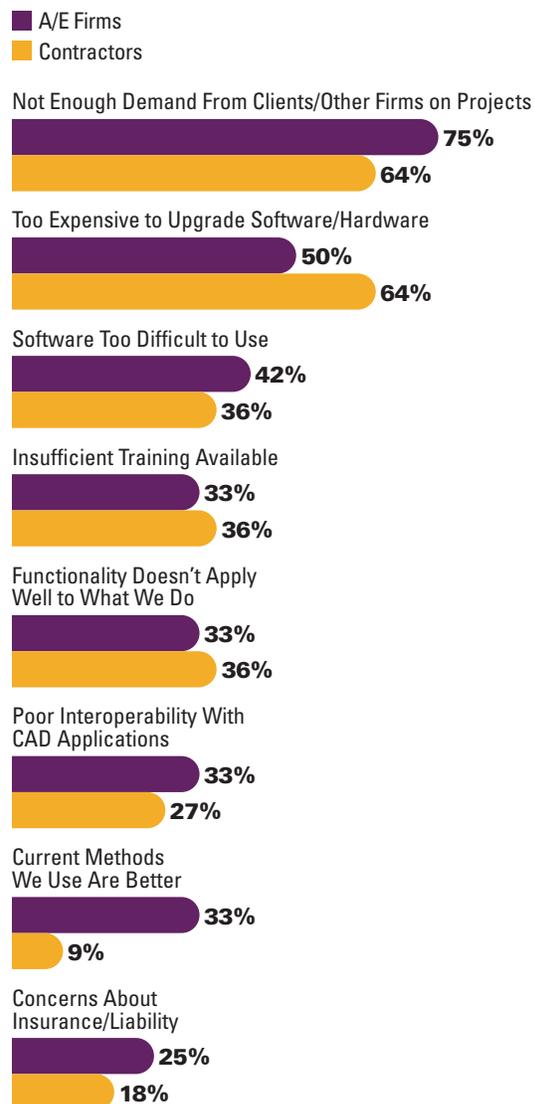
Contractors and A/E firms generally agree on the relative importance of the other top reasons for not adopting, with A/E firms somewhat more concerned about poor interoperability and liability issues, and contractors more focused on lack of available training and inapplicable functionality for their needs.

There are a couple areas where firms that work only in Australia and New Zealand (local firms) differ from their counterparts that also work on projects outside the country (global firms).

- **Functionality of BIM and the difficulty in using software** are challenges to a greater percentage of local firms, likely because these firms don't have the resources that firms working in multiple markets might have access to. It also points to education needed in the Australian and New Zealand local markets.
- **Liability,** on the other hand, was a concern to significantly fewer local firms, which may be due to a stronger familiarity between these local firms and their clients and partners.

Most Important Reasons for Not Adopting BIM (According to Non-Users by Company Type)

Source: McGraw Hill Construction, 2013



Perception of Competitors' and Clients' Use of BIM

Competitive pressure can be a powerful factor in driving companies to adopt BIM. As an ongoing feature of its BIM research, McGraw Hill Construction asks non-users for their perceptions about the amount of BIM activity that is going on among competitors and clients in their markets.

Non-User's Perception of BIM Use by Clients

Three-quarters of the non-users surveyed (75%) believe that there is some level of BIM activity taking place among clients in their areas.

- Among those, most (52%) perceive the BIM use by clients to be at a low level (less than 15% of projects).
- Only 1% believe it is taking place at a very high level (more than 60% of projects).
- Over twice as many firms working primarily on infrastructure/industrial projects (35%) perceive no BIM use by their clients compared with firms focusing on building projects (15%).

Non-Users' Perception of BIM Use by Competitors

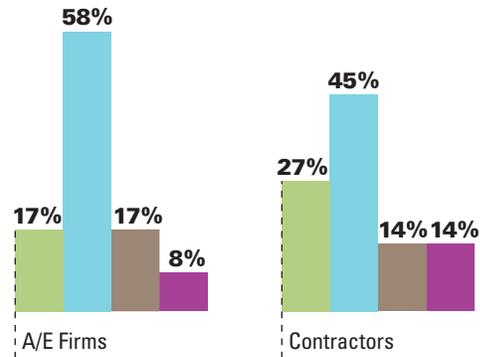
Sixty-five percent of the non-users surveyed believe that their competitors are using BIM.

- Among those, 40% believe their competitors are generally at a low implementation level (less than 15% of projects).
- No non-users perceive any competitors at a very high implementation level (more than 60% of projects).
- Firms working primarily on infrastructure/industrial projects (41%) are more likely to perceive no BIM use by their competitors than those working primarily on building projects (24%).
- All of the large contractors (those with annual revenues of \$250 million or more) perceive BIM use by their competitors, with half believing it to be taking place at a high level of implementation (more than 30% of projects). This accurately reflects the generally higher level of BIM activity that is actually going on at larger firms.

Perception of Competitors' Use of BIM (According to Non-Users By Firm Type)

Source: McGraw Hill Construction, 2013

- No BIM Activity
- Low BIM Activity (Less Than 15% of Projects)
- Moderate BIM Activity (15%–30% of Projects)
- High BIM Activity (30%–60% of Projects)



Variation by Firms Working Only in Australia/New Zealand and Those Also Working in Other Regions

For firms working only domestically, there is a much larger percentage that do not believe that their competition or clients are using BIM at all—38% believe that their competitors are not using BIM, and 29% believe that their clients do not use it. This is a misperception, suggesting that education on the true adoption and use of BIM in Australia and New Zealand would help encourage some non-users to start utilizing BIM as they recognize the market demand and the competitive need for doing so.

Top BIM Benefits That Would Convince Non-Users to Consider Adopting BIM

Since BIM is a fairly recent phenomenon, every current BIM user was a non-user at some point and was driven to adopt by some set of circumstances or opportunities. Non-users were asked to rate the relative importance of a variety of factors that, if demonstrated to be valid, would encourage them to adopt BIM.

The chart shows the responses that earned a high or very high rating from at least half of both A/E and contractor non-users.

- Contractors rated most of the benefits as more highly influential than A/E firms, a finding that is in keeping with their generally lower resistance to adoption (see page 43).
- Process improvements dominate the top five drivers (better documentation, communication and cost-estimating capabilities, as well as fewer field coordination problems and requests for information (RFIs)).
- Also making the top list is more owner demand, which aligns with the top reason for not adopting: lack of demand from owners (see page 45).
- Improved project outcomes (reduced construction costs and schedule) round out the list, but these are the least compelling of the top benefits.

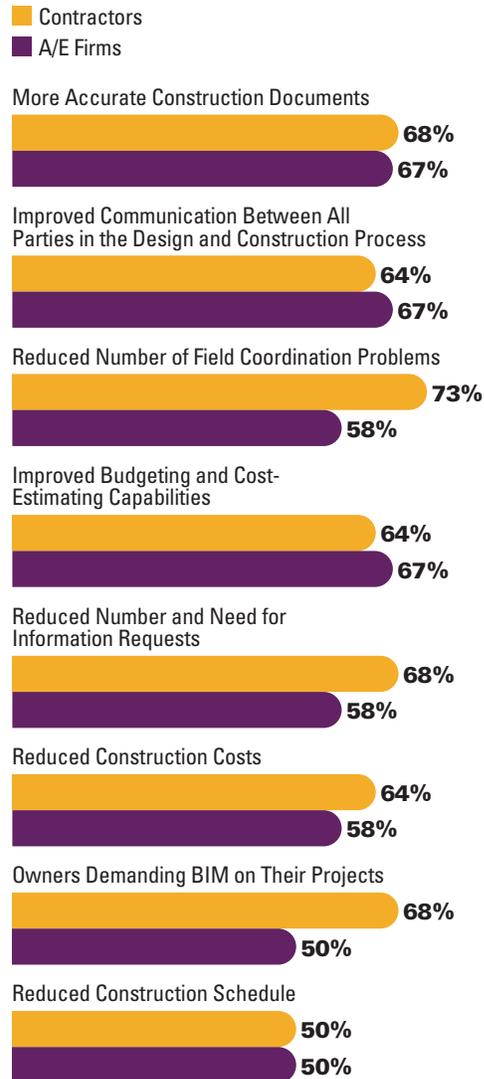
Variation by Country/Region

In general, higher percentages of North American and South Korean non-users gave top ratings to these benefits than did the non-users in Australia and New Zealand.

- Over 20% more non-users in North America and South Korea feel that owner demand would sway them to adopt.
- In South Korea, a higher percentage of non-users would be attracted by the promise of more accurate construction documentation and improved budgeting/cost estimating.
- In North America, benefits of fewer field problems and

Top BIM Benefits That Would Convince Non-Users to Consider Adopting BIM (According to Non-Users by Firm Type)

Source: McGraw Hill Construction, 2013



THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND DATA

reduced construction costs would provide a greater incentive than in Australia and New Zealand.

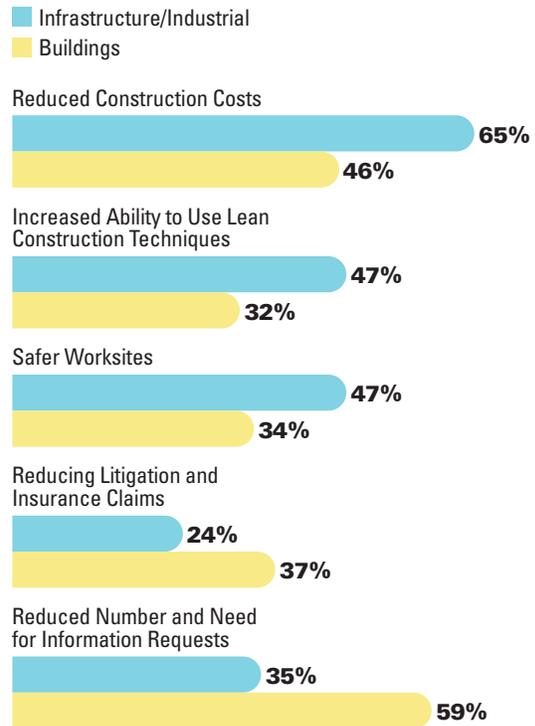
Variation by Types of Projects Undertaken by Firms

Non-user companies primarily involved with infrastructure work show a different perspective on which benefits would convince them to adopt BIM than their buildings-focused counterparts.

- **Reduced construction costs, increased ability to use lean construction techniques and safer worksites would be the top adoption drivers for non-user infrastructure firms.**
- **Buildings-related companies would be more motivated by fewer RFIs and reduced litigation/insurance claims.**

Top BIM Benefits That Would Convince Non-Users to Consider Adopting BIM (According to Non-Users by Type of Project)

Source: McGraw Hill Construction, 2013



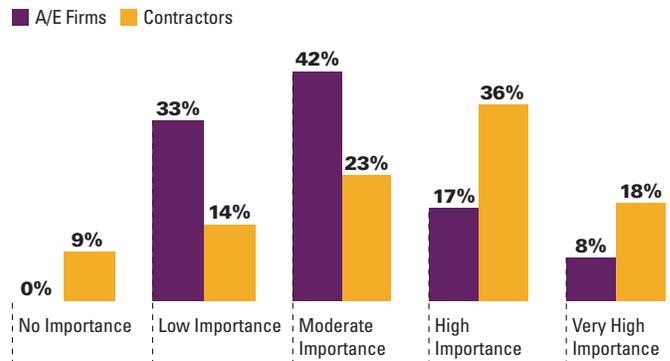
Importance of BIM in the Next Five Years

To assess a sense of urgency among non-users, they were asked how important they believe BIM will be to the design and construction industry in five years.

- **Forty percent of all non-users believe that BIM will be of either high or very high importance in five years, and only 12% foresee no importance.**
- **Among company types, over twice as many (54%) contractors predict high/very high importance than A/E firms (25%), yet at the same time 9% of contractors imagine that BIM will have no importance, while A/E firms are unanimous in their view of its inevitable importance.**
- **More infrastructure non-users (47%) anticipate high/very high importance than buildings companies (32%), perhaps foreshadowing faster growth of BIM adoption in that segment of the industry.**

Importance of BIM in the Next Five Years (According to Non-Users by Firm Type)

Source: McGraw-Hill Construction, 2013



Factors Delaying the Decision to Use BIM

Non-users cite a variety of obstacles that are standing in the way of their adoption of BIM. The chart shows where contractors and A/E firms agree and differ on the relative importance of eight leading factors.

About half of contractors (ranging from a low of 45% to a high of 59%) rate the importance of each of these obstacles as high or very high. A/E firms, on the other hand, express a wider range of opinions (from 17% to 92%) about the leading impediments to adoption.

- **The vast majority of A/E non-users (92%) feel strongly that BIM is not appropriate for smaller projects, as do half of contractors.** Over twice as many firms working on building projects (59%) feel that way than do those working on infrastructure projects (29%), likely because of the higher frequency of smaller projects in the buildings market.
- **Very few A/E non-users (17%) are concerned about BIM contracts or unclear roles of project team members compared with contractors (45%),** probably because these tend to impact the relatively larger build team more than the comparatively smaller design team.
- **Contractors (55%) are also more concerned about ownership and maintenance of models than A/E non-users (33%),** which makes sense because contractors have to deal with restrictions on implementing A/E firms' models, creating models when they aren't available from A/E firms, keeping models current during construction, and for some, servicing facility management models for owners.

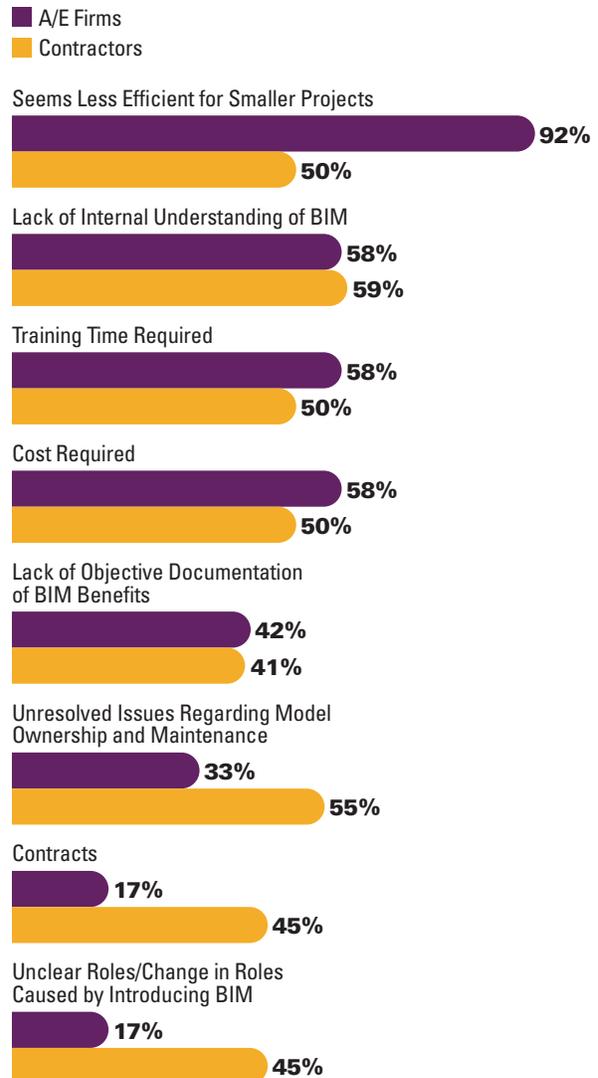
There is general agreement (within eight percentage points) between A/E and contractor non-users on the impact of the other four top obstacles, with lack of objective documentation of the benefits being the least important among them.

Variation by Firms Working Only in Australia/New Zealand and Those Also Working in Other Regions

Significantly more firms working on projects only in Australia and New Zealand are concerned with BIM's applicability to smaller projects. These firms also tend to be smaller, which suggests that if the industry could demonstrate BIM's applicability and effectiveness to these small projects, adoption would increase dramatically for these domestic firms.

Factors Delaying the Decision to Use BIM (According to Non-Users by Type of Firm)

Source: McGraw Hill Construction, 2013



Most Important Factor Encouraging BIM Adoption

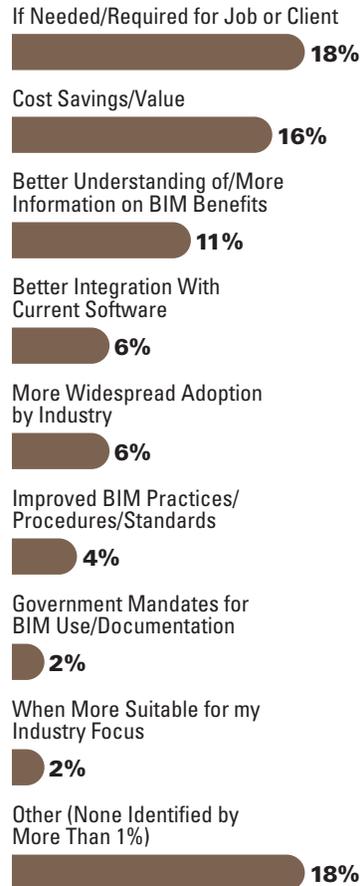
Through an open-ended question, non-users were asked to identify the single most important factor that would encourage them to adopt BIM. In keeping with the diverse nature of the design and construction industry, responses varied widely. Top categories include:

- **Demand:** 20% of non-users would be ready to adopt if needed or required for a job or a client, or mandated by government. This aligns with the finding (see page 45) that the most cited reason for not adopting is lack of demand.
- **Benefits:** 27% want either tangible cost savings/value (16%) or evidence of other forms of BIM benefits (11%).
- **Integration and Standards:** 10% indicate that improved practices, standards and interoperability would make them seriously consider BIM. This relates to the finding (see page 45) that 30% of non-users cite poor interoperability with CAD as a top reason not to adopt.
- **Adoption and Industry Focus:** Another 8% want BIM either to be more widely adopted or to apply more directly to their businesses in order to be interested, aligning with the finding (see page 45) that over one-third of non-users feel that BIM functionality doesn't apply well enough to what they do.

Interestingly, 16% did not identify a trigger that would compel them to adopt, saying instead that BIM is simply not relevant to their companies. This percentage is a likely predictor of the size of a future permanent group of non-users, which is a natural feature with any emerging process or technology as it matures and adoption reaches a stable plateau in an industry.

Most Important Factor Encouraging BIM Adoption (According to Non-Users)

Source: McGraw Hill Construction, 2013



BIM Standards and Guidelines in Australia and New Zealand

Efforts are under way to help standardize the use of building information modeling (BIM) and related tools to help the industry streamline sharing of project information, thus reducing duplication while helping firms to avoid issues and conflicts on projects.

Given the diverse software used on construction projects, various industry efforts are under way to guide and standardize use of BIM and related tools. Although the federal governments in Australia and New Zealand have yet to mandate BIM on federal projects, governments in other countries, such as the United Kingdom, have adopted such requirements. Regardless, BIM use is growing in Australia and New Zealand, and industry groups are working together to establish a framework to improve adoption.

NATSPEC

NATSPEC, a not-for-profit organization focused on national building specifications in Australia, released its National BIM Guide in September 2011. A main goal of the guide is to help project teams clarify their BIM requirements prior to detailed project planning in order to avoid issues and conflicts later. By providing these requirements on a consistent national level, the goal is to create a common framework that can be applied broadly to construction projects, saving duplication from project to project.

The guide advocates open global systems, not proprietary ones, to help ensure that information can be exchanged across various platforms. The guide's approach is not prescriptive; instead it presents an outcome-based approach that is more general rather than detailed.

In part, the guide serves as a checklist of project elements that should be addressed, not a set of prescriptive standards that should be followed.

According to NATSPEC, the BIM Guide can be used during three stages of a project.

- **Initial Discussions:** As a framework for discussion and a comprehensive list of items for consideration when deciding the scope of BIM use.
- **Detailed Project Planning:** As a means of documenting mutually agreed decisions about how BIM is to be implemented.
- **Project Execution:** As a common reference to communicate and enact decisions made about BIM implementation to project teams.

The NATSPEC guide followed the National Guidelines for Digital Modeling, released by the Cooperative Research Centre (CRC) for Construction Innovation in 2009. Similar to NATSPEC, the CRC approach did not take a technical and prescriptive approach but instead addressed larger process issues.

BIM-MEP^{AUS}

Across the globe, mechanical contractors are adopting BIM because of the advantages that it provides for effective spatial coordination and model-driven prefabrication of complex assemblies: saving time, enabling more efficient use of labor and materials and avoiding

costly rework.

To facilitate the growth of BIM usage among mechanical contractors in Australia, the Air Conditioning and Mechanical Contractors' Association (AMCA) has initiated an ambitious standards initiative called BIM-MEP^{AUS}. It consists of:

- **Practices:** To provide documented instructions for the performance of particular operations and functions throughout the BIM design process and workflow.
- **Specifications:** To detail explicit sets of requirements to be satisfied by a design model of plant, equipment and fittings.
- **Guidelines:** To provide information and options to support the use of other BIM-MEP^{AUS} standards.
- **Models:** 3D representations of the physical, functional and spatial characteristics (specifications) of particular pieces of plant, equipment and fittings.
- **Workflows:** To promote the efficient transfer of building information throughout the project lifecycle.

ANZRS

While some initiatives focus on high-level interoperability issues, others are more specific. As an example, the Australian & New Zealand Revit Standards (ANZRS) initiative has a working relationship with groups such as NATSPEC and buildingSMART, but specifically targets the need for better quality content for Revit users. ■

Data: BIM Utilization

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND DATA

Top BIM Activities

Not only is it important to monitor how much BIM activity is going on in various regions, but it is also useful to track the frequency of specific BIM activities. Users in Australia and New Zealand were asked to rate how often they perform specific activities in the design/pre-construction, construction and post-construction phases of their projects. The charts on these two pages show the relative rankings among the activities that occur with either high or very high frequency.

Design and Pre-Construction

The top activities, visualization of design intent (56%) and multi-trade coordination (43%), are also both consistently identified as frequent and valuable activities by BIM users in all McGraw Hill Construction research, including the 2014 *SmartMarket Report* on BIM activity by construction firms in 12 different countries from around the world. Among other regions, users in the U.S. are especially active in multi-trade coordination (82%).

Only about one-third of Australia and New Zealand users are doing a large amount of cost and schedule integration (4D)/(5D) or deriving quantities from models.

This aligns with other McGraw Hill Construction research indicating that users' perceptions of the potential value of these activities are higher than their current frequency of use. Thus these activities are all likely to show strong growth in the near future as functionality and practices mature to meet demand.

The use of modeling for constructability evaluation (29%) and jobsite logistics (13%), while currently scoring relatively low in Australia and New Zealand, rate more highly with contractors in the UK (44%) and U.S. (45%) markets, indicating that their tangible value to projects will probably drive significant growth in the future.

Other activities related to value engineering, laser scanning and safety planning are still being performed at relatively low frequency in all regions studied by McGraw Hill Construction in the 2014 study on BIM users around the world, but each can be expected to show increasing use because of their potential value.

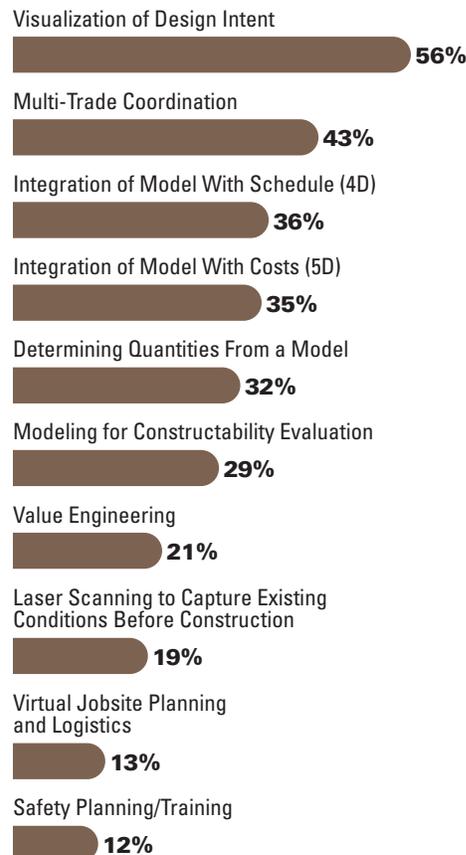
Construction

Model-driven layout in the field (50%) and model-driven prefabrication (40%) are both highly rated construction-phase BIM activities in Australia and New Zealand.

In addition, these two activities rank first and second among contractors in nine other global markets surveyed by McGraw Hill Construction, underlining the global

Top BIM Activities During Design and Pre-Construction in Australia and New Zealand

Source: McGraw Hill Construction, 2013



BIM Utilization

Top BIM Activities CONTINUED

importance of each.

The use of BIM for project status and progress monitoring is also important both to Australia and New Zealand users and to global users, although there are no regions where over half of respondents are doing it at a high or very high frequency.

Emerging activities at this stage include:

- **Augmented reality and laser scanning** are emerging technologies that show enormous potential and are especially gaining traction with German users (47% and 44%, respectively).
- **Supply chain management** rates highly with only 20% of users in Australia and New Zealand, but is more popular in both the UK (35%) and Japan (37%), indicating that the practice may gain more use over time, especially as more supply-chain members become engaged with BIM.
- **Model/GPS control of equipment and onsite robotics** are still in early stages of use in most markets, although, among other regions studied, contractors in France (39%) are leading with equipment and Japan (35%) with robotics.

Post-Construction

Creating as-built models for owners is a high or very high frequency BIM activity for 59% of BIM users in Australia and New Zealand. It also rates highly among contractors in many other markets, including South Korea (77%), Japan (73%), UK (67%) and Germany (66%). Clearly, this is an important trend.

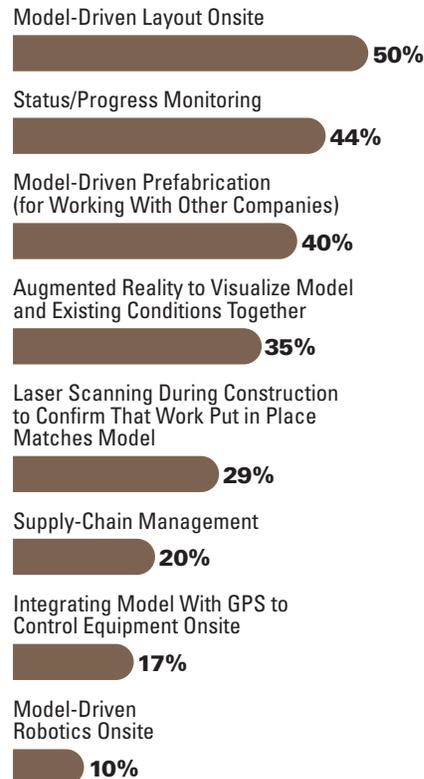
Enhancing an as-built model with maintenance and operation data is also reported to be a common post-construction service by over half (54%) of Australia and New Zealand BIM users. Contractors in France (87%), Japan (83%) and Germany (75%) are doing this service even more, indicating that users in many regions see its value.

Forty-one percent of Australia and New Zealand users are frequently managing models for an owner after construction. This new service opportunity is popular with contractors in Japan (77%), France (68%) and Germany (66%), though still relatively rare in the U.S. (14%).

Leveraging the model for close-out is the least frequently reported post-construction BIM activity in Australia and New Zealand (36%). This is the same frequency as in the U.S., but contractors in several other regions report much more activity, including Japan (90%), Germany (75%) and France (68%).

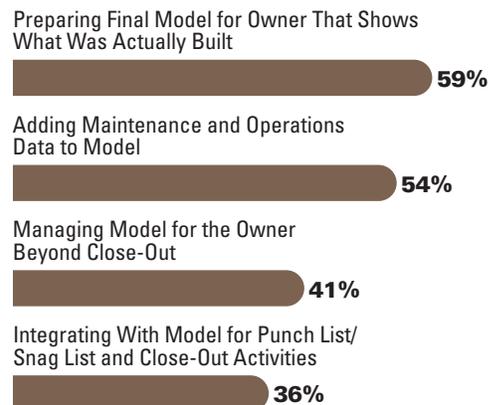
Top BIM Activities During Construction in Australia and New Zealand

Source: McGraw Hill Construction, 2013



Top BIM Activities During Post-Construction in Australia and New Zealand

Source: McGraw Hill Construction, 2013



Tools Used to Make Models Accessible to Field Personnel

The ability of contractors to bring the value of BIM to the field is one of the big trends happening everywhere that BIM is being deployed, as revealed clearly in the *Information Mobility SmartMarket Report* published in November 2013. The chart shows what percentage of contractors in Australia and New Zealand responded that they are either often or always utilizing each of these methods

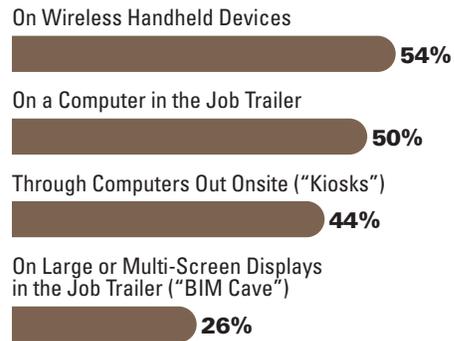
Comparisons with results from other countries, drawn from the findings of McGraw Hill Construction's 2014 *SmartMarket Report* on the use of BIM by construction firms around the world, reveal wider use of many of these technologies outside Australia and New Zealand.

- **Wireless handheld devices (54%) are slightly more popular than the more traditional computer in the trailer (50%) in Australia and New Zealand.** Other regions show a more dedicated commitment to these tools with almost all contractors in France (97%), Japan (87%) and Germany (85%) providing access in the trailer, and about three-quarters of French (71%) and German (75%) firms deploying wireless devices.
- **Kiosks out on the jobsite are a newer approach that is popular in Japan (84%) and also France (61%).**
- **The advent of a more immersive visualization experience available in a "BIM Cave" is the least used method of bringing BIM to the field in Australia and New Zealand (26%),** but it is more well established among contractors in Germany and France (each 62%), and Japan (60%).

Technologies Used to Make Models Available to Workers Onsite in Australia and New Zealand

(According to Contractors Using BIM Either Often or Always)

Source: McGraw Hill Construction, 2013



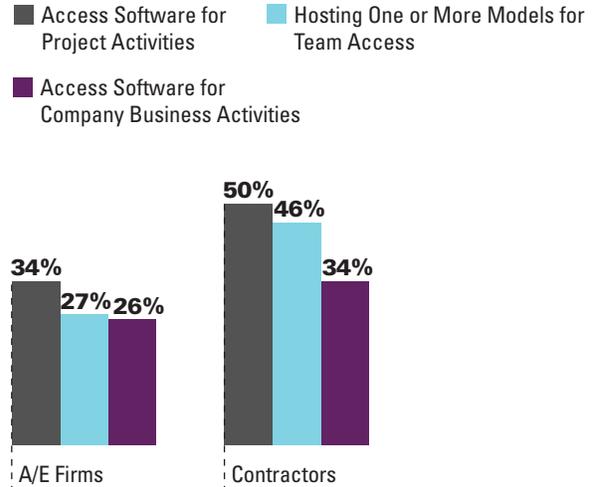
Use of the Cloud

Another important trend among BIM users is the shift to cloud computing instead of hosting data and applications locally or on their network servers. These services are seeing wider adoption despite the fact that security is often a concern. Both these points were clearly revealed in the *Information Mobility SmartMarket Report* published in November 2013. The chart shows how many companies in Australia and New Zealand are either often or always using the cloud for specific activities.

- **Contractors are far more active in all cloud-based activities than A/E firms, with half (50%) reporting high usage for project activities versus only one-third (34%) of A/E firms.** This makes sense because of the larger number of companies that contractors work with that can benefit from cloud access, as well as the contractors' need to access information both in the office and at the site.
- **Among regions, France, Germany and Japan are the most active users of cloud capability, with French contractors (84%) particularly focused on hosting models and Germans (78%) accessing software for projects.**
- **Regarding data security, large contractors (83%) are the most concerned, perhaps because of the sizes of their projects and the amount of data related to them.** Among the global regions studied by McGraw Hill Construction in 2014, South Korean (79%) and U.S. (66%) contractors express the greatest concern about security, while those in Germany (31%) and Japan (43%) show the least.

Activities Conducted in the Cloud in Australia and New Zealand

Source: McGraw Hill Construction, 2013



Multi-Party BIM Execution Planning

Adelaide Oval Redevelopment

ADELAIDE, AUSTRALIA

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND

In redeveloping the iconic Adelaide Oval, the project team aims to transform the facility into a multisport venue with expanded capacity and a range of contemporary amenities.

To achieve its goals and increase seating capacity from 32,000 to 50,000, the project team established a broad-reaching BIM plan tailored to meet the \$535 million project's tight program.

The design aims to respect and preserve elements of the venue's heritage, including local Moreton Bay Fig trees and Northern Mound, the 1911 scoreboard and views of the Cathedral and surrounding parkland.

Portions of the project had to remain operational throughout construction, which began in March 2012 and will be completed in March 2014.

Project Execution Planning For BIM

As BIM would be used throughout the design and construction phases, the team decided to create a BIM execution plan based on the Penn State Project Execution Planning Guide.

Multiple team members from a variety of disciplines would need to

author models and access project data. Cox Architecture as Lead Architect, working in collaboration with Walterbrooke and Hames Sharley made up the design team with Cox serving as the BIM manager for the entire project. Other team members who would leverage BIM data included engineering firms Arup, Walbridge and Gilbert, Aurecon and AECOM, contractor Boulderstone and subcontractors OPIs, Hindmarsh, Neilsen, Trojan, Laser Linings and SKS Survey.

The team recognized that, as an emerging technology, there would be a wide range of proficiency with BIM tools among the team members, according to Dan Jürgens, national BIM manager, Cox Architecture. In developing the BIM execution plan, the team contractually established terms and expectations.

The team then followed up with workshops to clarify goals and determine how success would be measured. Cox also found it critical to support the firms that weren't as proficient in BIM, assisting them in being able to provide required project deliverables.

Whenever possible, team members worked within native BIM formats, minimizing the need to convert to other formats. As a result, data exchange between designers and contractors was "reasonably seamless," according to Jürgens.

All parties agreed to regular uploads of project data to a management platform specified by the contractor. As such, data wasn't necessarily exchanged in realtime but instead at agreed stages of the project for coordination purposes among disciplines, according to Jürgens.

During the design phase, most of the parties worked in a project office where they had direct access to a central server. Aecom and Aurecon live linked their service models and maintained real-time coordination, hence there was no issuing of models between Aurecon and AECOM because they were always referencing the working files.

Reduced RFI Through Early Clash Detection

The BIM execution plan proved critical when BIM data was leveraged for clash detection of building



To develop the Adelaide Oval, multiple team members from a variety of disciplines needed to author and access project data. The team created a BIM execution plan to contractually establish terms and expectations.

CONTINUED

Adelaide Oval Redevelopment ADELAIDE, AUSTRALIA

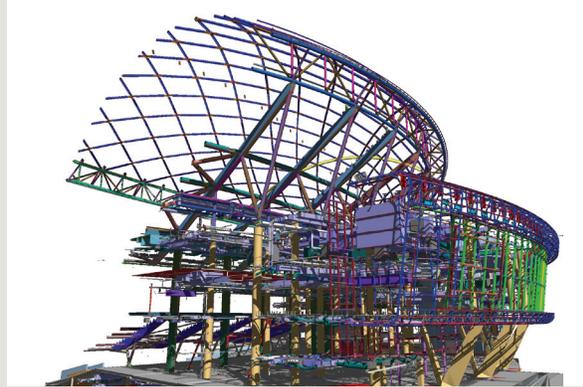
systems. A “clash-detection priority matrix” was established to help team members focus on the most critical potential clashes, and a clash-detection resolution process was also developed. Weekly reviews were conducted with modelers to review clashes and to identify what needed to be escalated. These reviews were followed by engineer review meetings to discuss issues. From there, meetings were held with the contractor to review project issues.

The team identified and responded to requests for information (RFI) earlier and with greater efficiency than would be anticipated on a traditional project. AECOM estimates that, if a traditional process had been used, significantly more RFI would be expected on a project of this complexity.

In terms of time savings, the team saw mixed results. Due to the reduction in RFI, consultants saved weeks of work during the RFI process communicating with the contractor. However, contractors spent double the estimated drafting time coordinating and modeling shop drawings, directly as a result of using these new workflows.

To help preserve the facility’s Moreton Bay fig trees, laser scans and an arborist were commissioned, as a very limited number of limbs could be cut. The level of detail achieved with the laser scans enabled the team to run clash detection on the proposed design and the fig trees.

These designs translated across into construction, where the surveyor used the BIM for digital site set out. Any point of the BIM model could be located accurately, rather than using traditional chalk lines on the ground. This meant that the contractors could proceed with a high degree of certainty that the proposed design would work.



The team could pull multiple disciplines into a federated model, enabling improved visualization and clash detection.

Enabling Prefabrication Through BIM

BIM also aided in prefabrication of steel and precast concrete. In one example, architects provided models to shop drawers for the façade’s precast concrete. The contractor used the architect’s shell as the basis of their shop drawings, adding further detail to enable fabrication. Cox estimates that this approach saved nearly six weeks in the shop drawing process and also meant that architectural intent was preserved. Without the BIM model, the design might have been value-managed out of the process, according to Jürgens.

Value Of Visualization Across The Project Team

Although the team had some limitations due to BIM being a new process for many firms, visualization proved to be a significant benefit for all parties, regardless of their respective experience levels. All parties could look at the model and know what they were looking at, enabling everyone “to understand instantly what we’re building,” according to Jürgens.

Trying to fit concessions under concrete plats in one area of the oval required constant model review

from all teams to ensure that the spatial requirements were met in terms of mechanical performance, server equipment, minimum height clearances, disabled-access requirements and structural integrity. ■

Project Facts and Figures

stats

Architect

Cox Architecture, in collaboration with Walterbrooke Architects and Hames Sharley

Contractor

Baulderstone

Project Manager

Mott McDonald

Type of Project

Sports venue

Construction Start

March 2012

Completion

March 2014

BIM-Enabled Benefits

- Reduced RFIs
- Improved Clash Detection
- Time savings during precast-panel shop-drawing process
- Enhanced visualization

Interview: Thought Leader

Mark Tait
General Manager Commercial Developments,
Investa Group



Mark Tait specializes in complex large-scale developments and has worked across a number of Investa's commercial office assets. Mark is a board member of buildingSMART Australasia and was a coauthor of the National Building Information Modeling Initiative Report.

THE BUSINESS VALUE OF BIM IN AUSTRALIA AND NEW ZEALAND

What is your experience with BIM historically?

TAIT: Back in 2006/2007, we delivered our first fully integrated BIM project on a building called "The Ark," or Coca-Cola place, in North Sydney.... It finished in 2010 and was successful, fully tenanted and won numerous awards. It was the first high-rise commercial building in Australia that I'm aware of to have a BIM solution.

What benefits have you received from using BIM?

TAIT: We [reduced risk on] the project through coordination with and collaboration among the entire team. That has certainly de-risked the deliverables and given us better-quality outcomes. Then we saved time along the way because we've been able to manage things that would have been disruptive but weren't because we did them in a 3D, virtual world before we went inside.

What kind of specific quality outcomes are you seeing?

TAIT: Typically, we have had clash detection, and we see the layout of images, fixtures and other things. They go in once and not do have to be rebuilt because they've all been coordinated and stored correctly off the virtual model. That has led to a better-quality outcome for the product.

Time wise, we had a fairly intrusive concrete culvert on The Ark coming in from the building next door. That

probably would have shut us down for about a month, but because we were aware of it, we lost one day while we dealt with it. You don't report that you saved that month, but if we would have lost [track of] it, we would have been in a fairly awkward contractual position with the tenants that were coming into the building.

What do you think are the key drivers to using BIM today?

TAIT: If the owner says it's a BIM project, there will be no hesitation. If you're talking about the trades, I think a lot of them are trying to do it for a competitive advantage.

Are you facing any challenges in using BIM for new buildings?

TAIT: Because we don't typically deal with the same party over and over again, we continually have to reeducate and reestablish expectations, outputs and deliverables. Generally, owners are uneducated in Australia, so that's a hurdle that [we need] to get over because if [BIM adoption] is going to be led by the owners, then the owners need to be educated [about expectations and outcomes] to know what they're actually asking for.

How are you using BIM in building operations and maintenance?

TAIT: We're doing it on the North Sydney [project that we are working on], and we're setting it up now as we come through the first year of construction on our Melbourne

project. So when that finishes in August 2015, it will be a fully BIM operational usage.

What are the challenges preventing you from going back and looking at existing buildings with BIM?

TAIT: Acceptance within the market and skill base within the market is one [significant challenge]. A standard set of procedures and object libraries is the other issue that Australia is still struggling with. If we can get on top of those issues and have a common implementation program, then we'd be a lot more comfortable in rolling [BIM] out across all our projects.

There is a growing knowledge base—the majority of companies we deal with now have BIM managers rather than CAD managers or those who have never heard of BIM. A lot of them are BIM proficient or at least claim to be so, but we're finding there is a wide variance in the [actual] level of expertise.

What do you think is the future of BIM in Australia?

TAIT: I think it will get adopted. I think the government will have to mandate it for government projects because that will bring the market to task a lot quicker than it would otherwise.... [Getting that mandate in place] is the most important thing in Australia to help accelerate BIM adoption. ■

Interview: Thought Leader



Michael Haines
CEO, VANZI Ltd.

As a member of the Austroads Intelligent Transport Industry Reference Group, Michael Haines was instrumental in establishing VANZI, and he brings more than 40 years of experience across a range of industries to the VANZ (Virtual Australia and New Zealand) project.

VANZI, a not-for profit organization running the Virtual Australia and New Zealand (VANZ) project, was set up to broker the development, legal framework and web services architecture among key stakeholders in order to create an integrated 3D model of the natural and built environment for use throughout the entire property cycle.

How will VANZ work?

HAINES: If we look at the evolution of the 3D built environment, it's going to happen fairly quickly over the next five years through commercial and government building owners wanting their own models for facilities management and leasing, financing and insurance purposes. The questions then arise: If you have all these individual models, how do you integrate them into a holistic virtual world?... What we're trying to do is say, "Well, if each owner is going to be creating their own models, using their own software, collecting their own data, how do we securely integrate those to protect privacy and the basic property rights that people have in the real property?"... We want to establish a capability where you can deposit your property model securely in an "account" [similar to how you deposit money in a bank account], and the "banks" would be a combination of commercial entities and government entities [that] would hold your property model and integrate that model with the local community model together with the models of the utilities—the power,

the water, the gas, wastewater—that services your property. And all of the rights, responsibilities and restrictions that relate to your property in a legal sense, are converted into 3D legal objects.

Why is it important to include the legal rights?

HAINES: If you think about a virtual world that is a true mirror of your physical world on every scale that you need for decision-making—and it's used for traffic management, emergency management, property development, construction, leasing and financing—then it's absolutely integral to the operation of our cities. That piece of infrastructure needs to be well regulated and protected.... The worst thing you could have is have big hunks of your virtual world sitting on servers in some other country, subject to somebody else's laws. We need to have a legal framework that enables [regulated] commercial entities [to hold your digital information] just like commercial banks are regulated to hold your money.... Your property exists only in law, and we need to ensure that those property rights are mirrored in the virtual world if we're going to create a virtual world that is as simple as possible to transact business in. That's the basic principle that we're working on; whatever rights you have in the real world, those same rights will exist in the authorized, virtual world.

How do you see this being used by building owners?

HAINES: If you sell a property, then you will give a physical key to the new owner but also a virtual key to your virtual property. That becomes the official data set.... You can link the ownership of the property back to the titles office, so when you register a change of ownership, the previous owner is locked out of the model automatically, and the new owner gets access to it automatically. And you can give a lessee access [in the model] to just the rooms that they are leasing in the real world.

How will the creation of VANZ impact the property, design and construction industries?

HAINES: At the moment, every time you have a new project, you have to sit down with all of the project players, the fabricators and consultants and work out "OK, who's going to do what and how are we going to share this data?" Where we see, in time, each stakeholder will have one relationship, [which] will be with their "bank." So if I am the architect or the mechanical engineer, the electrical engineer or the surveyor, I will do my bit of work using whatever software I choose, and I will lock the results and lodge it in my bank. And then...I can give access to X, Y and Zed for the duration of the project to this model. It's much easier for a limited set of banks to develop expanded protocols for sharing data than it is for all sorts of different parties on every project. ■

BIM in Australia and New Zealand Study Research

This study continues McGraw Hill Construction's investigations into the *Business Value of BIM* in different markets around the world. This study expands that research to the Australian and New Zealand markets. It investigates industry professionals' use of and attitudes toward building information modeling (BIM).

The research was conducted through an internet survey of industry professionals between September 25, 2013, and November 5, 2013. The survey was open to design and construction industry professionals who were classified as either BIM users or non-users based on how they responded to a question about BIM engagement.

The total sample size (435) used benchmarks at a 95% confidence interval (CI) with a margin of error (MOE) of less than +/- 5% for categorizing participants as BIM users or non-users. Australia's 331 respondents benchmark at a 95% CI with an MOE of +/- 5.37%. New Zealand's 93 respondents benchmark at a 95% CI with an MOE of +/- 10.15%.

The use of a sample to represent a true population is based on a firm foundation of statistics. The sampling size and technique used in this study conform to accepted industry research standards that are expected to produce results with a high degree of confidence and low margin of error.

BIM User Definition

For the purpose of this survey, BIM was defined as the creation and use of digital models and related collaborative processes among companies to leverage the value of these models.

Practitioners or users are

individuals who are authoring and/or using models or deriving direct benefits from the use of models by others (e.g., owners).

Survey Sample

The study respondents were recruited through a combination of professional-association invitations and a supplemental industry panel. The sample splits into the following demographics.

RESPONDENT BY PLAYER

The survey was open to architects, engineers, contractors (general and specialty), owners, consultants and other professionals that use BIM. Player results were as follows.

- **Architectural/engineering (A/E) firms** include architects, engineers and multidisciplinary design firms: 185 respondents (42.5%).
- **Contractors** were grouped into the two following categories. When the term "contractor" is used in the data, it is referring to all contractor respondents.
 - **GCs** refer to general contractors, full-service contractors, construction management companies (CMs) and GCs/CMs at-risk: 93 respondents (21.4%).
 - **Trade contractors** refer to specialty subcontractors, fabricators and installers: 58 respondents (13.3%).
- **Owner/consultants:** 26 respondents (6.0%).
- **Other:** 73 respondents (16.8%).

RESPONDENT BY FIRM SIZE

The distribution by size of firms includes 29% small firms, 29% medium firms and 23% large firms. The remainder either refused to answer or did not know their firm size. The following is the definition of

projects by firm size.

- **Architect/Engineer/Owner**
 - Small: Less than \$1 million
 - Medium: \$1 million to less than \$10 million
 - Large: \$10 million or more
- **Contractors**
 - Small: Less than \$50 million
 - Medium: \$50 million to less than \$250 million
 - Large: \$250 million or more

RESPONDENT BY PROJECT TYPE

The respondents engaged in building and non-building work. In comparisons on BIM in buildings versus infrastructure or industrial work, the primary project type identified by the respondent was used. The respondent pool split into the following primary work types.

- **Buildings: 65%**
- **Infrastructure/Industrial: 19%**
- **Landscape/Parks/Recreation: 2%**
- **Mining/Minerals: 3%**
- **Other: 11%**

Comparisons With Other Regions

Throughout the report, McGraw Hill Construction compares the findings from this study with findings on South Korea and North America published in the 2012 *Business Value of BIM SmartMarket Reports (SMRs)* issued on those regions. A nearly identical survey was used for all these studies so that comparisons could be made directly.

Other global findings are drawn from the 2014 *Business Value of BIM for Construction in Major Global Markets SMR*, which includes data on BIM use by contractors in 10 countries. ■

Resources

Organizations and websites that can help you get smarter about building information modeling.



McGraw Hill Construction

Main Website: construction.com

Dodge: construction.com/dodge

Research & Analytics:

construction.com/dodge/

dodge-market-research

Architectural Record: archrecord.com

Engineering News-Record: enr.com

Sweets: sweets.com

SmartMarket Reports:

construction.com/market_research

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Autodesk
www.autodesk.com.au



AECOM
www.aecom.com

Premier Partners

Autodesk: autodesk.com.au

AECOM: aecom.com

Contributing Partners

Aconex: aconex.com/BusinessValueOfBIM

Air Conditioning and Mechanical Contractors' Association (AMCA): amca.com.au

A. G. Coombs Group Ptd Ltd: agcoombs.com.au

BIM-MEP^{AUS}: bimmepaus.com.au

CSI Global Services: csigs.com.au

Consult Australia: consultaustralia.com.au

Laing O'Rourke: laingorourke.com

Zuuse: zuuse.com.au

Other BIM Resources:

BIMForum: bimforum.org

buildingSMART Alliance: buildingsmartalliance.org

National Institute of Building Sciences: nibs.org

Australian & New Zealand Industry Associations

Association of Consulting Architects Australia: aca.org.au

Australian Contractors' Association: constructors.com.au

Australian Construction Industry Forum: acif.com.au

Australian Institute of Architects: architecture.com.au

Australian Institute of Building Surveyors: aibs.com.au

Australian Institute of Project Management: aipm.com.au

Australian Institute of Quantity Surveyors: aiqs.com.au

Green Building Council of Australia: gbca.org.au

CIOB Australasia: ciob.org.au

Engineers Australia: engineersaustralia.org.au

Association of Consulting Engineers

New Zealand: acenz.org.nz

Certified Builders Association of

New Zealand: certified.co.nz

New Zealand Contractors' Federation:

nzcontractors.co.nz

New Zealand Green Building Council: nzgbc.org.nz

New Zealand Institute of Architects: www.nzia.co.nz

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