SmartMarket Report

McGraw Hill CONSTRUCTION
connecting people_projects_products

The Business Value of BIM in Europe

Getting Building Information Modeling to the Bottom Line in the United Kingdom, France and Germany

Premier Corporate Partner

Autodesk®

Premier Association Partners

buildingSMARTalliance™

National Institute of BUILDING SCIENCES

Association Partners

ARCHITECTS' COUNCIL OF EUROPE
CONSEIL DES ARCHITECTES D'EUROPE

CIOB
THE CHARTERED INSTITUTE OF BUILDING

FIEC

The Institution of Structural Engineers

RIBA

■ Design and Construction Intelligence

SmartMarket Report

McGraw-Hill Construction

President
Keith Fox

Vice President, Product Development
Kathryn E. Cassino

McGraw-Hill Construction Research & Analytics/Alliances

Vice President, Global Thought Leadership & Business Development
Harvey M. Bernstein, F. ASCE, LEED AP

Senior Director, Research & Analytics
Burleigh Morton

Director, Partnerships & Alliances
John Gudgel

Director, Green Content & Research Communications
Michele A. Russo, LEED AP

The Business Value of BIM in Europe SmartMarket Report

Executive Editor
Harvey M. Bernstein, F.ASCE, LEED AP

Editorial Advisor—BIM
Stephen A. Jones, Senior Director

Editorial Director
John E. Gudgel, PME, MPM

Senior Group Art Director
Francesca Messina

Contributing Art Director
Donald Partyka

Production Manager
Alison Lorenz

Contributing Editors
Bruce Buckley
Enver Fitch
Donna Laquidara-Carr, LEED AP

Research Project Manager
Dana Gilmore, MRA, PRC

For further information on this SmartMarket Report or for any in the series, please contact

McGraw-Hill Construction Research & Analytics
34 Crosby Drive, Suite 201
Bedford, MA 01730

1-800-591-4462

MHC_Analytics@mcgraw-hill.com

McGraw-Hill CONSTRUCTION

About McGraw-Hill Construction

McGraw-Hill Construction (MHC), part of The McGraw-Hill Companies, connects people, projects and products across the design and construction industry, serving owners, architects, engineers, general contractors, subcontractors, building product manufacturers, suppliers, dealers, distributors and adjacent markets.

A reliable and trusted source for more than a century, MHC has remained North America's leading provider of construction project and product information, plans and specifications, industry news, market research, and industry trends and forecasts. In recent years, MHC has emerged as an industry leader in the critical areas of sustainability and interoperability as well.

In print, online and through events, MHC offers a variety of tools, applications and resources that embed in the workflow of our customers, providing them with the information and intelligence they need to be more productive, successful and competitive.

Backed by the power of Dodge, Sweets, Architectural Record, Engineering News-Record (ENR), GreenSource and 11 regional publications, McGraw-Hill Construction serves more than one million customers within the $5.6 trillion global construction community. To learn more, visit us at www.construction.com.

Introduction

Building Information Modeling (BIM) is one of the most visible aspects of a deep and fundamental change that is rapidly transforming the global construction industry.

For centuries we have used symbols on paper (i.e., drawings and specifications) as the primary means to represent and communicate design intent for client approval, bidding, procurement, fabrication, construction and installation. These abstractions have no native intelligence in them and require human interpretation (i.e., reading) and manipulation (e.g., take-offs, redlines) to provide meaning and value. All other major capital and knowledge intensive industries (manufacturing, finance, etc.) have long since transitioned to data-rich environments that enable virtual and automated design, analysis, fabrication and communication. And they have reaped the rewards of higher productivity, accuracy, quality and worker safety.

The growing worldwide adoption and implementation of BIM for its powerful data-based modeling, visualization, analysis and simulation capabilities represents the start of a transition to an integrated digital information infrastructure that will ultimately revolutionize almost all aspects of the construction industry.

This *SmartMarket Report* presents findings from research conducted in 2010 about how architects, engineers and contractors in Western Europe (defined for the purposes of this report as the United Kingdom, France and Germany) are adopting, implementing and deriving value from BIM. It also provides comparisons to findings from similar research conducted among North American companies in 2009, published in the McGraw-Hill Construction *SmartMarket Report, The Business Value of BIM: Getting Building Information Modeling to the Bottom Line*. The 2010 research reveals both commonalities and distinct differences between BIM in Western Europe and North America. For example, although BIM adoption—defined as the percentage of companies reporting some use of BIM—is currently higher in North America than in Western Europe, the adoption process has been underway longer in Western Europe. As a result, the level of implementation—defined as the percentage of a BIM user's projects on which BIM is used—is generally much higher than in North America.

This finding that European BIM users—though fewer by percentage—are generally more deeply committed to BIM than their counterparts in North America is an example of the unique opportunity this *SmartMarket Report* provides to compare and contrast two research efforts and study how BIM is becoming integrated in multiple major western economies on a parallel path with local distinctions.

In addition to the research data in the report, several case studies exemplifying the breadth of BIM's application to solving real world business challenges are featured. We also provide industry leader insights with a global perspective on BIM adoption and implementation.

We want to acknowledge the support of our sponsors who enabled McGraw-Hill to conduct this research and make it available to the global construction industry.

Harvey M. Bernstein
F.ASCE, LEED AP
Vice President
Global Thought Leadership
& Business Development
McGraw-Hill Construction

Stephen A. Jones
Senior Director,
Business Development
McGraw-Hill Construction

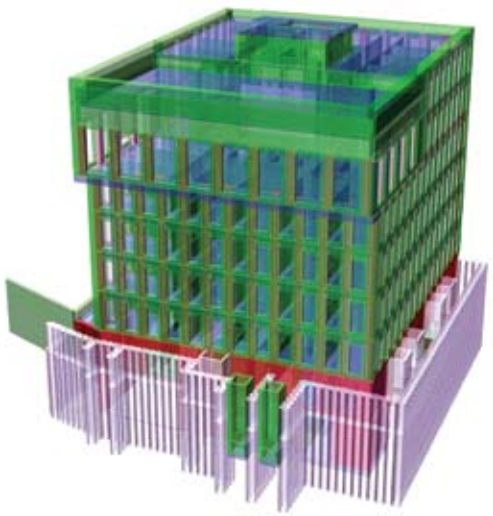
John E. Gudgel
Director,
Partnerships & Alliances
McGraw-Hill Construction

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 research and analytics group, including 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.

Stephen A. Jones leads MHC's initiatives in BIM, interoperability and integrated project delivery as well as developing alliance relationships with major corporations for technology and content. Prior to joining MHC, Jones was a vice president with Primavera Systems, one of the world's leading providers of project management software. Prior to that, he spent 19 years in creative, marketing and management roles with design firms. Most recently he was a Principal and Board of Directors member with Burt Hill, one of the world's largest architectural and engineering firms. Jones holds an M.B.A. from Wharton and a B.A. from Johns Hopkins.

John E. Gudgel is responsible for managing MHC's relationships with both national and regional industry associations. He also produces and offers thought leadership on construction technology, managing MHC's SmartMarket Reports on BIM and Interoperability. He has over 17 years of experience in technology project management in the computer and telecommunications industries. John has an M.S. in eCommerce from George Mason University, an M.S. in Telecommunications from the University of Colorado and a B.S. in Geological Engineering from the Colorado School of Mines.

TABLE OF CONTENTS



This page from left to right:
La Bongarde,
Centre Commercial de
Villeneuve-la-Garenne;
ESEAN Children's Hospital,
Nantes, France

Front cover image:
La Bongarde,
Centre Commercial de
Villeneuve-la-Garenne

Executive Summary

A Tale of Two Continents

Overall BIM adoption levels are lower in Western Europe vs. North America, but the longtime user community members are true BIM believers.

Adoption of BIM

In 2010, a little over a third (36%) of the Western European industry participants in this research reported having adopted BIM. This can be compared to the 49% adoption rate in North America (2009). Architects are the primary adopters (47%) followed by engineers (38%) and contractors (24%). However this is just the beginning of the story.

Of the BIM users in Western Europe, 45% consider themselves experts or advanced, which is higher than the 2009 North American findings of 42%. In terms of how long they have been using BIM, however, the markets are dramatically different:

- **Over a third of Western European BIM users (34%) have over 5 years of experience using BIM vs. only 18% in North America.**

Another striking difference appears in the adoption rate among contractors:

- **Contrary to North America, where BIM adoption has surged among contractors to 50%, BIM has only been embraced by 24% of Western European contractors.**

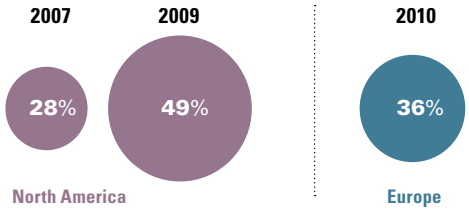
In the Western European findings, 70% of BIM experts report being heavy users, meaning more than 60% of a user's project portfolio involves BIM. This is in line with North American experts, of whom 67% are heavy users. Where the groups differ significantly is at the beginner level, where in Western Europe 46% are already committing over 15% of their work to BIM, whereas only 20% of American beginners are pushing its use above the 15% mark.

When projecting how much of their work will be in BIM in two years, the Western European respondent group shows great optimism, with all users forecasting a healthy increase. For example:

- **While nearly 60% of total respondents are currently frequent users, meaning they use BIM on at least 30% of their projects, the number using it at that level could increase to 75% in the next two years.**
- **Contractors anticipate the most aggressive increase in implementation, with the frequent user population expected to grow from 11% today to 54% by 2012.**

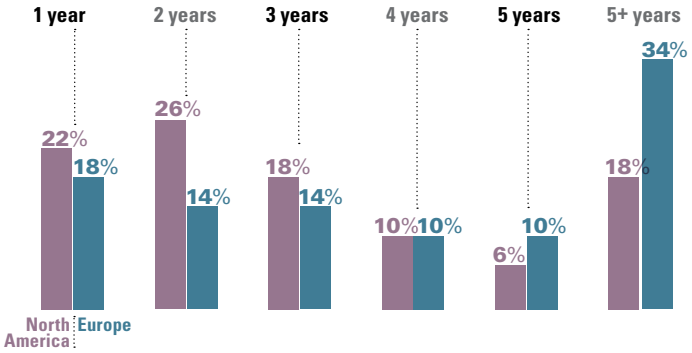
BIM Adoption—North America vs. Europe

Source: McGraw-Hill Construction, 2010.



Years Using BIM

Source: McGraw-Hill Construction, 2010.



Overall Value of BIM

Three-quarters of Western European BIM users (74%) report a positive perceived return on their overall investment in BIM, versus 63% of BIM users in North America.

In both markets, those who formally measure it report a higher ROI than those who base their judgment only on perception. In Western Europe almost half of BIM users report that they measure ROI on more than 25% of their projects. This compares favorably to North America, where less than a third of companies report that level of commitment to measuring the ROI on BIM.

In Western Europe, the commitment to measure ROI and the experience of higher ROI are both linked directly to the BIM users' experience level.

CONTINUED

- **Only 18% of BIM beginners report formally measuring ROI and only 46% report that they perceive ROI to be better than break-even.**
- **58% of BIM experts measure ROI and 80% report positive ROI, with 25% citing greater than 100%.**

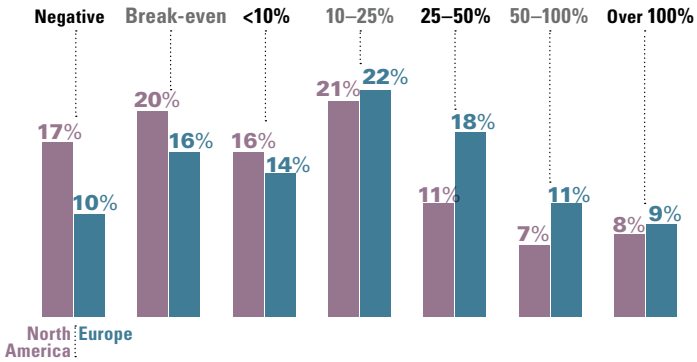
This improvement in ROI based on experience level is also consistent with the North American findings, although only 20% of the North American BIM experts reported over 100% ROI.

Although architects in both markets report the greatest ROI, the markets diverge sharply when it comes to engineers and contractors.

- **In Western Europe nearly 70% of engineers report positive ROI, in contrast to North America where only 46% report similar experience.**
- **In North America nearly three-quarters of contractors report positive ROI versus Western Europe, where only 40% cite ROI above break-even.**

Perceived ROI North America vs. Western Europe

Source: McGraw-Hill Construction, 2010.



Research Focus

For the purposes of this study, McGraw-Hill Construction has focused its research on three countries with the largest construction markets in Western Europe: France, Germany, and the United Kingdom, which together represent approximately 40% of the non-residential European construction industry. As such, the phrase "Western Europe" used throughout this report refers to these three countries. Research findings which refer to Western Europe are aggregated from the results of all three countries. Where relevant, the findings from individual countries are presented. Although BIM adoption, implementation and experience of value in other European countries may vary from these results, we feel that they appropriately represent the overall state of BIM in Western Europe in 2010.

For comparison purposes, this report also occasionally references the findings of a similar research study conducted in North America in 2009. The authors acknowledge that the differences between the construction industries of Western Europe and North America may impact the research results regarding BIM. For example, the density and age of existing structures in Western Europe generate a high percentage of smaller renovation projects relative to North America. Since research findings on both continents indicate the general belief that BIM applies more easily to larger, new projects, a difference in BIM adoption can naturally be expected. Similarly, since BIM adoption has been underway far longer in Western Europe than in North America, the percentage of projects that a user applies BIM to can be expected to be greater.

This along with differences in government regulations, player roles, degree of fragmentation, and the overall construction processes all can have an impact on how BIM is understood and utilized in Europe.

CONTINUED

Internal Business Value of BIM

There are a variety of ways that companies benefit internally from adopting and implementing BIM. Most of these improvements are related to productivity gains and an enhanced ability to secure new work.

With regard to productivity gains, the leading improvements cited by BIM users in Western Europe are:

- **Reduced errors and omissions in construction documents**
- **Reduced cycle time of specific workflows**
- **Reduced rework**

Although the overall perception of BIM's benefits for helping firms market themselves was reported to be greater in the North American research, Western European BIM users did report that BIM is generating a positive impact on:

- **Offering new services**
- **Marketing new business to new clients**
- **Maintaining repeat business with past clients**

In keeping with the overall experience of business value from BIM, those users with more advanced BIM skills enjoyed a higher level of these internal benefits. Western European BIM experts are two to three times more likely than beginners to report seeing high to very high levels of value.

Project Value of BIM

As more teams learn every day, BIM has growing implications for improving the broad scale project ecosystem and enhancing project outcomes for all parties. In the Western European survey, most of these gains are reported in the areas of better communication and understanding of a project, and the overall increase in project quality that BIM makes possible.

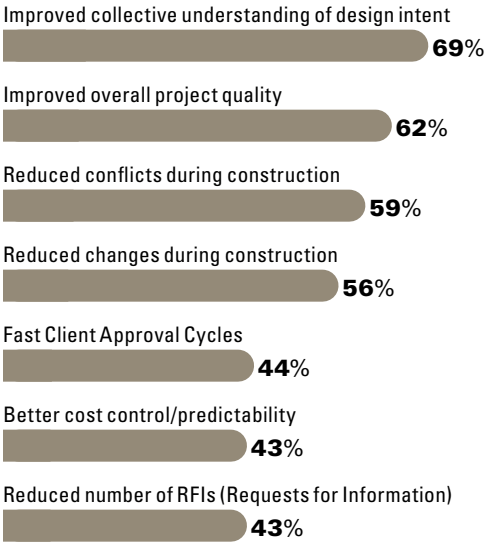
BIM is not perceived to contribute equal value to all phases of a project.

- **69% of BIM users assign a high or very high value to BIM during design development and 67% during technical design.**
- **This contrasts with less valuable stages such as mobilization (26%) or design brief (32%).**

Further, not all benefits of BIM provide equal value.

BIM Benefits Contributing the Most Value

Source: McGraw-Hill Construction, 2010.



Western European BIM users identified the following as the highest-value project benefits:

- **Improved collective understanding of design intent (69%)**
- **Improved overall project quality (62%)**
- **Reduced conflicts during construction (59%)**

Player Value of BIM

Each player on a construction project has its own unique workflow and demands; thus each also has a different value proposition in regards to BIM, and therefore a different experience of business value.

- **Architects in Western Europe find the most value in BIM's ability to improve their design process. Compared to North American firms, they report less interest in its collaborative potential than in how it affects their immediate processes.**
- **62% of engineers found high or very high value of BIM in the construction phase, more even than contractors (52%) and far more than architects (40%).**
- **Unlike architects and engineers, nearly half of the contractor respondents (46%) have been using BIM for one year or less. This is a likely cause of their relatively low perception of ROI, such that 40% expect to either break even or lose on BIM adoption, while only 8% report ROI of 25% or greater.**

Data: Adoption

Key Findings and Overview

Key Findings in Western Europe:

- **A little over one third of the industry in Western Europe (36%) has adopted BIM.**
- **Architects are the primary adopters (47%) with engineers (38%) and contractors (24%) lagging behind.**
- **45% of BIM users in Western Europe consider themselves experts or advanced.**

Key Findings vs. North America

- **Somewhat surprisingly, over a third of Western European BIM users (34%) have over 5 years of experience using BIM vs. only 18% in North America.**
- **Contrary to North America, where BIM adoption has surged among contractors (50%), BIM has not yet been widely embraced by Western European contractors (24%).**

Overview: Western European Adoption vs. North America

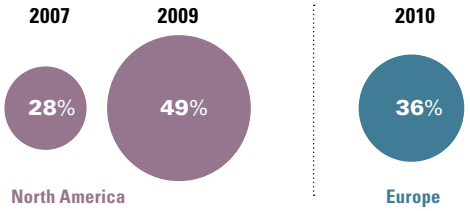
The adoption of building information modeling in Western Europe is lagging behind North America. In 2010, a little over a third of Western European respondents (36%) report using BIM or BIM-related tools versus nearly half of North American respondents (49%) in 2009.

Unlike North America, a very high percentage of Western European BIM users (34%) have been using BIM for over 5 years. Thus, it appears that in the countries surveyed, BIM was embraced by a core group of early adopters. However, growth has been relatively flat until relatively recently. This can be compared to North America, where the bulk of BIM adoption (66%) has occurred in the past 3 years.

While the adoption levels of BIM in Western Europe lag those in North America (36% vs. 49%), the level of proficiency using BIM has not. Today, 45% of BIM users in Western Europe consider themselves expert or advanced vs. 42% in North America. This high level of proficiency is likely due to the large number of professionals that have been using BIM for more than 5 years.

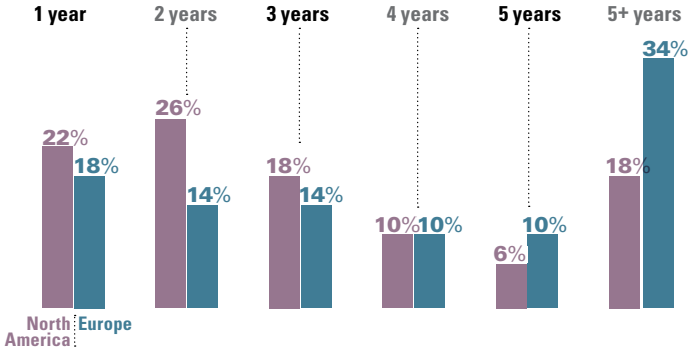
BIM Adoption North America vs. Europe

Source: McGraw-Hill Construction, 2010.



Years Using BIM

Source: McGraw-Hill Construction, 2010.

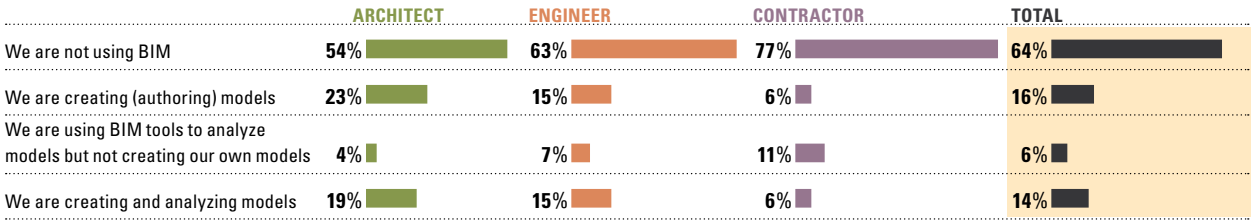


User Differences in Western Europe

- **Architects have the highest level of BIM adoption and proficiency. Nearly half of architects (46%) have adopted BIM, with 42% of architects creating BIM models and 19% also analyzing them. Today, 48% of architects who use BIM consider themselves advanced or expert.**
- **Nearly 4 in 10 engineers (37%) use BIM. They lag behind architects but lead contractors in adoption by a considerable margin. Interestingly, this adoption level among engineers in Western Europe is almost as high as among engineers in North America (42%)—who were shown in the 2009 North American study to be somewhat resistant to fully embracing BIM technology.**
- **Contractors have the lowest level of BIM adoption and proficiency, with only 23% saying that they are using BIM and only one quarter (26%) indicating that they consider themselves expert or advanced. Contractor adoption is also the most recent—68% having begun using BIM in the past 3 years.**

BIM Adoption and Usage

Source: McGraw-Hill Construction, 2010.



Authoring Vs. Analysis

Like in North America, BIM users in Western European typically create models, rather than working with existing ones. Although some team members, particularly contractors, use tools to analyze existing models, a majority of players author their own models. In some cases, this could be because the team member is the only one using BIM on a project. In other scenarios, multiple team members may choose to create their own models that focus on their individual needs rather than alter or add to an existing model.

User Differences

- **More than 4 in 10 architects (42%) create BIM models, with nearly half of this group (19%) also analyzing them.**
- **Engineers tend to author their own models, although at a lower level than architects (30%).**
- **11% of contractors use tools to analyze existing models—more than twice the number of architects (4%). However, nearly the same number of contractors (12%) create their own models—most likely because models from other players do not exist, are not being shared or do not contain the information that the contractor needs.**

Depth of Involvement

The use of BIM on projects directly corresponds to the level of BIM expertise that the user has achieved:

- **Nearly 70% of experts use BIM on more than 60% of projects.**
- **46% of beginners use BIM on more than 15% of their projects. This amount is far greater than beginners in North America, where only 20% use it on more than 15% of their projects.**
- **Among all Western European users, 59% use BIM on more than 30% of their projects. This is striking compared with North America, where 45% use it on 30% or more of their projects—despite the fact that North America has a higher adoption rate. This indicates that those Western Europeans who have adopted BIM have significantly integrated it into their internal processes.**

Non-Users Remain Open-Minded

Although nearly two-thirds of Western European building team members are not using BIM today, most non-users are open to evaluating its potential benefits. Only a small percentage (4%) have used it and then decided not to use it again.

Unlike North America, where 87% of potential users are interested in using BIM, in Western Europe there is a far higher percentage (27%) of potential users that have no interest in using it. The reason for this disinterest may be related to the differences in the construction economies. In Western Europe there are far more smaller projects involving the retrofit of older existing building—an environment less conducive to BIM use.

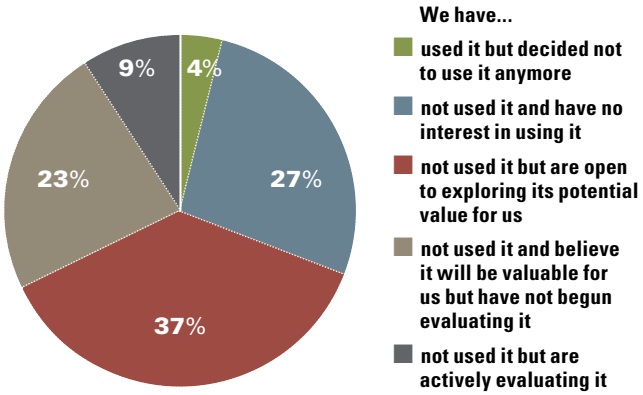
Among the various professional groups surveyed, contractors are actually the most intrigued, with 70% indicating that they believe it is a technology worth considering. This can be compared to engineers, where 33% have no interest in using it or have used it and decided not to use it in the future.

Key Findings about Non-users

- **37% of non-users are open to exploring BIM's potential value.**
- **Almost a quarter (23%) are already convinced it will be valuable.**
- **Only 9% are currently evaluating it but have not yet tried it.**
- **Over a quarter (27%) of non-users have no interest in using it, and 4% have tried it and decided not to use it.**
- **Architects who have not used BIM are the least likely to be actively evaluating it, but nearly a third are open to exploring its potential value.**

BIM Attitudes Among Non-Users

Source: McGraw-Hill Construction, 2010



Future Growth

As previously indicated, over a third of BIM adoption in Western Europe (34%) occurred over 5 years ago. Since that time BIM adoption has been steady but flat—averaging slightly more than 10% each of the subsequent years. However, in the past year there has been a slight surge, with nearly 20% of adoption taking place since early 2009.

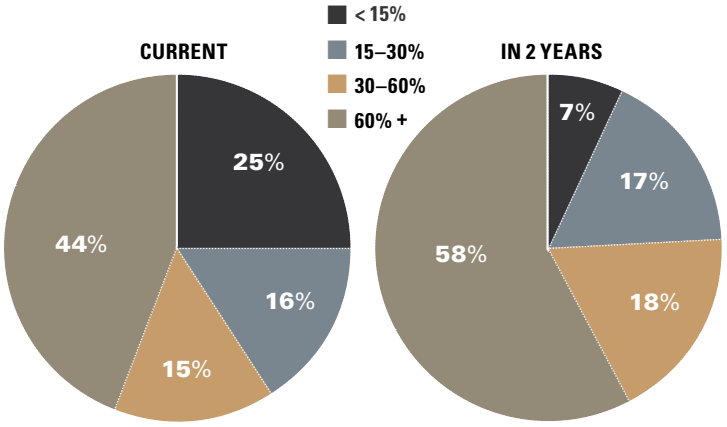
- **46% of users have adopted it within the last three years—this can be compared with 66% in North America.**
- **While 59% of users employ BIM frequently on their projects today (>30% of projects), the number using it at that level could increase to 76% in the next two years.**

User Differences

- **Beginners are very optimistic that they will expand BIM use quickly. While 54% use it on 15% or less of projects today, only 20% expect to use it at that level in two years.**
- **Today's expert users will continue to expand their use of BIM, with the percentage using it on 60% or more of projects rising from 69% in 2010 to 84% in 2010.**
- **Contractors expect the largest rise in BIM use, with 54% saying it will be used on more than 30% of their projects in 2012, compared to 11% who use it at that level today.**

BIM Usage on Projects

Source: McGraw-Hill Construction, 2010



Overview of Activity by Country

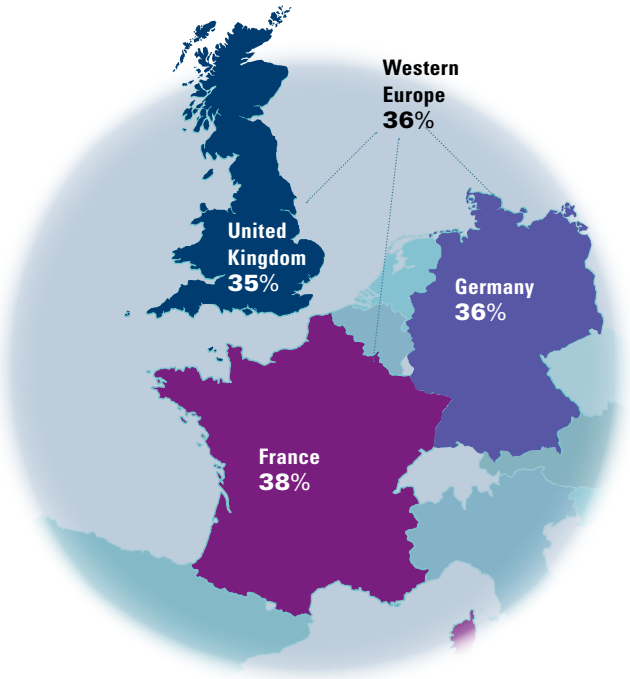
The adoption rate for BIM in Western Europe across all three countries surveyed was statistically the same (36% +/- 2%).

Architects led adopters by professional type in the United Kingdom and Germany but trailed engineer adopters in France. In all three countries, contractors had the least amount of adoption with less than 30% adoption in all three countries. However, the level of BIM use by contractors on projects in all three countries is expected to surge in the next two years.

Also, interestingly, the number of BIM adopters who consider themselves advanced or expert in using BIM is 45% in the UK and over 50% in both Germany and France.

BIM Adoption Rate

Source: McGraw-Hill Construction, 2010.



United Kingdom

The adoption rate for BIM in the United Kingdom among construction professionals surveyed is 35%. Adoption is led by architects (60%), followed by engineers (39%) and contractors (23%).

Among those that have adopted BIM, 45% believe they are advanced or expert—only 23% consider themselves beginners. This high level of BIM expertise corresponds with the fact that 38% of adopters have been using BIM for more than 5 years and 54% of adopters use BIM on 30% or more of projects. Thus, not surprisingly, BIM experience leads to BIM expertise, which then leads to willingness to use it more often on projects.

However, within the UK, contractors have not fully embraced BIM. Only 23% of contractors have adopted BIM, and only 7% use it on 30% or more of projects. Like in North America, there is an indication that BIM use will surge among UK contractors with heavy use (>30% of projects) expected to increase to over 50% by 2012.

71% of UK adopters perceive a positive return on investment (ROI) from BIM, with 37% reporting ROI of 25% or more. 13% of UK adopters perceive negative ROI—the highest total among the three countries surveyed.

UK users see the most value from BIM through:

- **Reduced conflicts during construction (70%)**
- **Improved collective understanding of design intent (69%)**
- **Reduced changes during construction (60%)**

Perceived ROI on Overall Investment in BIM

Source: McGraw-Hill Construction, 2010.

	UK	FRANCE	GERMANY
Negative	13%	5%	9%
Break-even	16%	13%	24%
< 10%	12%	17%	16%
10–25%	22%	23%	17%
25–50%	17%	17%	19%
50–100%	9%	13%	13%
Over 100%	11%	12%	2%

France

France has the highest adoption rate of BIM among construction professionals surveyed at 38%, although it is only slightly higher than rates in the UK and Germany.

Unlike the UK and Germany, engineers (44%) are slightly ahead of architects (40%) in BIM adoption. However, French architects began adopting BIM sooner, with 51% having 5 years of experience or more versus 37% of engineers. As in the other countries surveyed, contractors trail in adoption at 29%, with half adopting BIM in just the past 2 years.

A very high percentage of French adopters (72%) use BIM on 30% or more of projects. This heavy use is led by architect adopters, 83% of whom use it at that level. As in the UK, contractors are least likely to use BIM, with only 26% using it on 30% or more of their projects. However, this heavy use is expected to grow to 50% in number the next two years.

French BIM users are by far the most optimistic about the ROI they get from BIM. 82% of users perceive that they get positive ROI, with 42% seeing ROI of 25% or more. Only 5% report getting negative ROI.

French users see the most value from BIM through:

- **Reduced conflicts during construction (76%)**
- **Improved collective understanding of design intent (71%)**

Germany

The adoption rate in Germany sits right between the UK and France at 36%. As in the UK, adoption is led by architects (43%) followed by engineers (33%) and contractors (24%).

German advanced and expert users (51%) outnumber beginners (17%) 3 to 1. However, in a slight variance from the other countries surveyed, only 23% of German adopters began using BIM over 3 years ago. The majority (51%) began using BIM in the past 3 years. This recent adoption is led by contractors, with 50% of their adoption occurring in the past year.

German adopters as a group use BIM 47% of the time on 30% or more of their projects. This project use is led by architects (77%) followed by engineers (53%). Once again, contractors trail in this category, with only 10% using it on 30% of more of their projects. However, just like in the other surveyed countries, heavy use is expected to grow to 60% by 2012.

German BIM users have the lowest positive perceived ROI between the three countries at 67%.

German BIM users are more aligned with UK users in where they see the most value from BIM.

- **Reduced conflicts during construction (63%)**
- **Improved collective understanding of design intent (58%)**
- **Reduced changes during construction (58%)**

Benefits Contributing the Most Value

Source: McGraw-Hill Construction, 2010.

	UK	FRANCE	GERMANY
Faster client approval cycles	47%	42%	55%
Improved overall project quality	57%	44%	58%
Reduced changes during construction	60%	50%	58%
Improved collective understanding of design intent	69%	71%	58%
Reduced conflicts during construction	70%	76%	63%

Challenges to Adoption

The primary reason that non-users give for not implementing BIM is the lack of client demand. 55% of non-users surveyed indicated this was the number one reason followed by the lack of sufficient time to evaluate it (49%) and software being too expensive (41%). Non-users also believe that their clients are not using BIM–with 87% believing that clients are using it on 15% or less of projects.

Western European non-users also do not currently see an immediate competitive threat resulting from BIM non-use. 81% of non-users believe their competition is using BIM on less than 15% of their projects. This perception is particularly strong among architects, with 82% believing that their competition is using BIM on 15% or less of projects—this is despite the fact that architects have the highest adoption levels among industry professionals.

Future Outlook

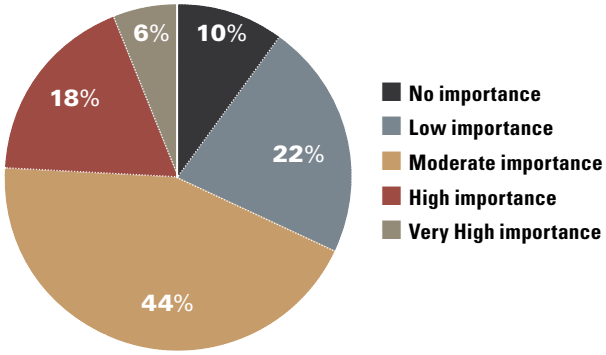
About one quarter of non-users (24%) believe that BIM will be highly or very highly important to the industry in five years. However, more non-users (32%) actually believe that BIM will have low or no importance. Most non-users (44%) believe that BIM will have moderate importance in the next 5 years. This contrasts with North America where 42% of non-users believe that BIM will have high or very high importance in the next 5 years.

Across the board, all three main professional groups—architects, engineers and contractors—nearly an equal amount believe that BIM will have moderate importance in 5 years. Other surveyed construction professional groups that included owners, planning firms and building product manufactures had the highest expectations for BIM, with 36% saying that BIM would be of high or very high importance to the industry in the next 5 years. Architects were the most negative, with 41% indicating that BIM would have low or no importance in 5 years.

One of the reasons for the somewhat negative perception of BIM's future may be that there is a lack of internal understanding of BIM. Lack of internal understanding of BIM (55%) was the number one reason why non-users have delayed their adoption of BIM. Other highly rated reasons included the cost to implement BIM (52%) and to purchase BIM software (51%) and also that it seems less efficient on smaller projects (50%). Thus, non-user concerns about BIM's cost and its perceived limited value on small projects may be delaying its deployment, especially among small firms in Western Europe.

Importance of BIM in Five Years

Source: McGraw-Hill Construction, 2010



Potential Adoption Drivers

There are a number of factors that could motivate non-adopters to begin using BIM. Just like those who are using BIM today, non-users want to see it improve communications, speed design, eliminate errors, make a safer worksite and reduce costs.

Productivity

Productivity issues are a primary driving factor. All non-users list improved communication among all parties in the design and construction process as their top benefit. Not surprisingly, architects welcome the prospect of less time drafting, more time designing.

Accuracy

Improved accuracy is also a big potential draw for non-users. Both architects and engineers have indicated that they see value in BIM producing more accurate construction documents. Every team player ranks this among their top benefits.

Schedule and Budget

Saving time and money is a core goal of any building team, especially contractors. Contractors believe BIM can lead to reduced construction costs and also can improve budgeting and cost estimating capabilities.

Worksite Safety & Lean Construction

Finally, non-users also believe that BIM can ultimately make the construction site safer and give them a better ability to increase the use of lean construction methods.

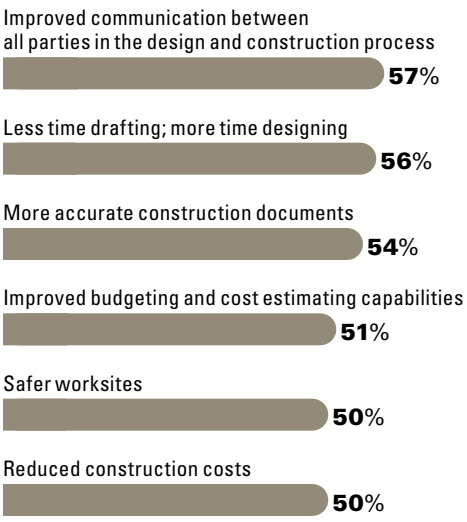
Less Influential Factors

Less than 40% of non-users said these potential benefits would highly or very highly influence their decision to adopt BIM.

- **Modifications of design parameters (41%)**
- **Improved operations, maintenance and facility management (36%)**
- **Reducing litigation and insurance claims (34%)**
- **Improved ability to do digital fabrication (32%)**

Potential Adoption Drivers in Western Europe

Source: McGraw-Hill Construction, 2010.

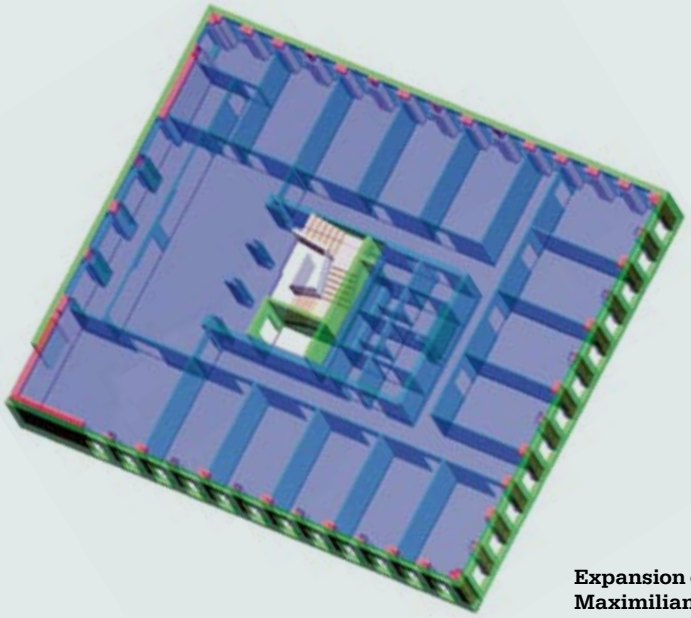


case study

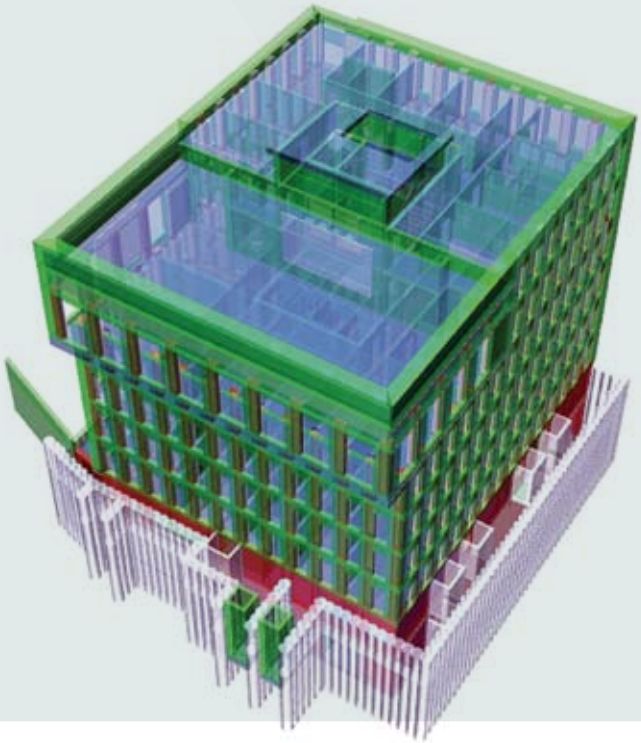
Finding Interoperability and Reducing Redundancies

Maximilianeum Expansion

MUNICH, GERMANY



Expansion of the Maximilianeum in Munich



One of the most appealing aspects of this emerging technology is the ability to create consistent project data in a building information model that can be used throughout the lifecycle of a building. Entering information once into a model and then sharing that information with other users helps eliminate the redundancy of reentering data and reduces the potential for errors. But such project goals come with considerable challenges. Adoption of BIM and BIM-related tools remains mixed in many parts of Europe and even among companies that do use the technology, finding interoperable means of data exchange does not always come easily.

The architecture firm Léon Wohlhage Wernik in Berlin is hoping to bridge the data exchange gap between designers and facility managers with the €14-million expansion of the Maximilianeum in Munich. The 4,500-sq-meter project will expand the Bavarian State Parliament facilities along the northside of the building, adding 65 offices, a large meeting room, three smaller meeting rooms, a server center and a fitness area. Design of the expansion began in spring 2009 and construction broke ground in May 2010. Completion is expected in spring 2012.

Gathering Facility Management Information

Siegfried Wernik, managing director of Léon Wohlhage Wernik, says that from the beginning of the project, the facility managers had an interest in getting building data from the design team so that it could be used for the eventual maintenance and

CONTINUED

Maximilianeum Expansion

MUNICH, GERMANY

management of the building.

"In the past, architects and engineers would fill in that facility management information manually," he says. "That is not an efficient thing to do. We have that data and we want to give it to the facility managers in one file."

The team launched a pilot project to export the geometric and alphanumeric data from the virtual building model using the IFC standard into the manager's software system.

Ensuring Accurate Information

In addition to improving efficiency, Wernik says the exchange will be particularly helpful in ensuring accuracy.

"Having consistent data is really important," he adds. "What usually happens if you do not have consistent data is you have information on the drawing which is 'A' and information on the schedule which is 'B' and information on the specification which is 'C.' That is the problem if the data are from various sources."

"The issue of whether we save time or money by using BIM doesn't really come up; without BIM, we wouldn't attempt these tasks in the first place."

—Siegfried Wernik, managing director, Léon Wohlhage Wernik

Missing the Contractor

Although BIM data will be shared between the designers and end users, the contractor on the Maximilianeum project is not using BIM. Wernik says that while some large German firms, like Hochtief, have adopted BIM, most other firms have not started using the technology.

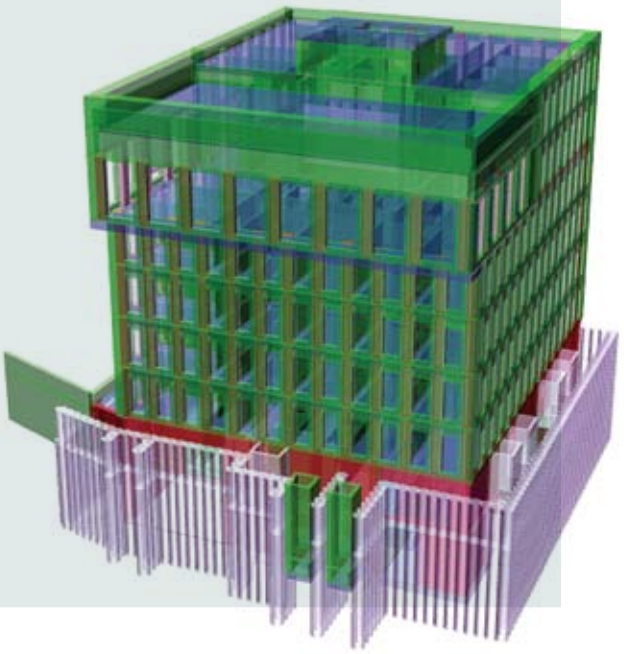
"A lot of contractors have no idea what BIM is," he says. "It's a strange scene in Germany. Some big companies deal with it, but it's not common knowledge yet."

Reaping the Benefits of BIM

Wernik says his company is reaping multiple benefits from the use of BIM. Designers use modeling to create multiple iterations of designs, each time adding additional information that could be used later. The ability to regularly calculate quantities also helps the firm stay on top of cost estimates.

Although Wernik recognizes the benefits of BIM, he does not think in terms of value because, in many cases, the technology has added capabilities that architects at the firm did not previous have.

"Whether calculating data of doors, windows or spaces in sustainability analysis or other relevant planning data, doing analysis in real time is possible only if you are working in the virtual building model," he says. "The issue of whether we save time or money by using BIM doesn't really come up; without BIM, we wouldn't attempt these tasks in the first place." ■



Expansion of the Maximilianeum in Munich

Data: Overall Value of BIM

Overview

Key Findings in Western Europe

- **Three-quarters of BIM users (74%) are experiencing a positive perceived ROI.**
- **82% of BIM users who formally measure ROI are seeing positive returns.**

Key Findings vs. North America

- **More BIM users in Western Europe are experiencing a positive ROI as compared to their counterparts in North America—a differential of 11%.**
- **46% of BIM users in Western Europe who formally measure ROI are seeing returns of 25% or more on their investments vs. 32% of users in North America.**

Overview: The Value Proposition of BIM in Western Europe vs. North America

Western European users are generally more positive about the value proposition of BIM compared to their North American counterparts.

Nearly three-quarters of Western European BIM users (74%) are experiencing a positive perceived ROI on their overall spending on BIM. Of this number, 38% believe they are getting 25% or more ROI. Only 10% of users believe they are getting negative ROI. This can be compared with North America, where two-thirds (63%) of users are experiencing positive ROI and 26% believe they are getting ROI of 25% or more.

As in North America, users in Western Europe who formally measure ROI on BIM report higher returns than those who estimate returns based on perception.

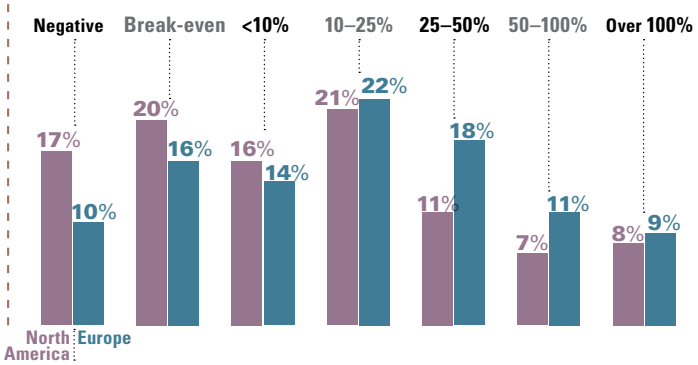
82% of Western European users who measure ROI report getting positive ROI, with nearly half (46%) measuring that they get ROI of 25% or more.

With experience, users can see more value—and in Western Europe there are more experts:

- **49% of users in Western Europe consider themselves advanced users or experts.**
- **92% of expert users see positive ROI with BIM compared to 46% of beginners.**
- **58% of experts formally measure ROI on 25% or more of their projects versus just 18% of beginners.**

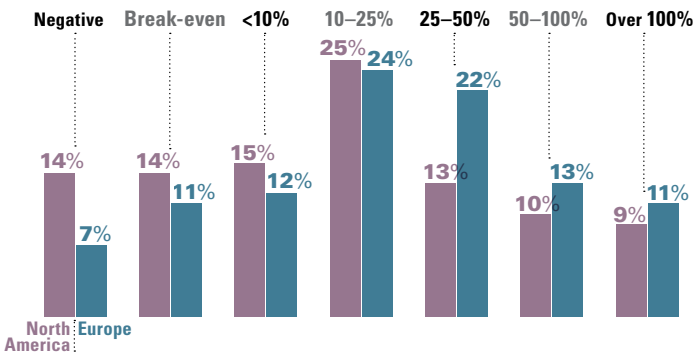
Perceived ROI North America vs. Western Europe

Source: McGraw-Hill Construction, 2010.



Measured ROI North America vs. Western Europe

Source: McGraw-Hill Construction, 2010.



User Differences

Architects

Architects in Western Europe see the highest ROI, with 8 out of 10 (82%) reporting positive results. As designers, they experience many intangible benefits such as improved coordination of drawings and documents. This ROI is much higher than that perceived by architects in North America (58%).

Engineers

Nearly 70% of Western European engineers surveyed experience positive ROI when using BIM. This is dramatically higher than in North America where only 46% of engineers report positive ROI and a stunning 32% report negative ROI.

Contractors

Western European contractors today see the least ROI from BIM, with 40% reporting negative or break-even ROI. This is also dramatically different from North America where contractors are today recognizing specific tangible benefits savings realized through clash detection. Similar attitudes towards BIM ROI existed among contractors in North America when first surveyed in 2007. This suggests that over the next two years contractors in Western Europe may also see a significant increase in the ROI and overall value that they will get from BIM.

Perceived ROI by Experience Level—Western Europe

Source: McGraw-Hill Construction, 2010.

	BEGINNER	MODERATE	ADVANCED	EXPERT	TOTAL
Negative	30%	8%	3%	0%	10%
Break-even	24%	22%	10%	8%	16%
< 10%	15%	17%	12%	12%	14%
10–25%	15%	28%	22%	18%	22%
25–50%	6%	11%	30%	22%	18%
50–100%	7%	8%	14%	16%	11%
Over 100%	3%	6%	9%	24%	9%

Perceived ROI on Overall Investment in BIM

Source: McGraw-Hill Construction, 2010.

	ARCHITECT	ENGINEER	CONTRACTOR	OTHER	TOTAL
Negative	5%	11%	20%	14%	10%
Break-even	13%	20%	20%	21%	16%
< 10%	11%	13%	26%	19%	14%
10–25%	23%	23%	26%	12%	22%
25–50%	19%	24%	4%	18%	18%
50–100%	14%	7%	2%	12%	11%
Over 100%	15%	2%	2%	4%	9%

Quantifying Results

In order to understand better the value of BIM, many users have made formally measuring ROI a part of their internal processes. Tracking ROI on BIM projects can be a tricky proposition. Users often need to gather a wide range of data from various sources and have a sufficient library of data on similar projects that can be used for comparison. As more industry-standard metrics are developed, the ability to track ROI could improve in the coming years.

Level of Measurement

Two-thirds (66%) of BIM users formally measure ROI on BIM. One-fifth of users (21%) measure it on a majority of BIM projects.

Expertise

The more expertise users have in BIM, the more likely they are to measure ROI on projects. Only 23% of experts do not measure ROI on projects while 21% measure it on 75% or more of their projects. This can be compared with beginners, 42% of which do not formally measure ROI on projects.

By User Type

Engineers are most likely to measure ROI, with 74% doing so on at least some of their projects. This is in stark contrast to North America, where engineers are the least likely user type to measure ROI. In Western Europe, contractors are least likely to measure ROI (57%).

Future Outlook

Many who do not formally track ROI are open to doing so in the future. Over 60% of them say they probably will in the future (32%) or have not decided if they will (29%). Of the various respondent groups, contractors are by far the most likely to measure BIM ROI in the future, with 75% indicating they probably will do so over the next few years.

Percentage of BIM Projects on Which ROI is Measured by Level of Experience

Source: McGraw-Hill Construction, 2010.

	BEGINNER	MODERATE	ADVANCED	EXPERT	TOTAL
None	42%	41%	27%	23%	34%
< 25%	39%	26%	22%	18%	26%
25–50%	10%	20%	22%	24%	19%
50–75%	1%	7%	10%	14%	8%
75–100%	8%	6%	19%	21%	13%

Percentage of BIM Projects on Which ROI is Measured by User Type

Source: McGraw-Hill Construction, 2010.

	ARCHITECT	ENGINEER	CONTRACTOR
None	32%	26%	43%
< 25%	22%	33%	35%
25–50%	17%	33%	15%
50–75%	10%	3%	0%
75–100%	19%	5%	7%

Where Users Invest

Developing BIM knowledge and experience requires investments in a broad range of products and processes. These areas of investment change over time, as some initial investments take a backseat to others that will deepen a user's BIM competency.

Areas of BIM Investment

DEVELOPING INTERNAL COLLABORATIVE BIM PROCEDURES

For Western European users this is the highest priority. 44% of respondents indicated this is where they are currently focusing their investments in BIM, and it was equally important to architects (43%), engineers (43%) and contractors (43%). This is a top rated priority for the most experienced users (59%), but less so for beginners (34%).

BIM SOFTWARE

Software is the tool that drives BIM. 42% of all respondents, investment in software is the second highest current investment priority, but it is especially high among expert (55%) and advanced (53%) users.

NEW/UPGRADED HARDWARE

Following closely in the path of software investment, new/upgraded hardware is also currently a focus of firms using BIM. 40% of respondents reported this is an investment priority.

MARKETING YOUR BIM CAPABILITY

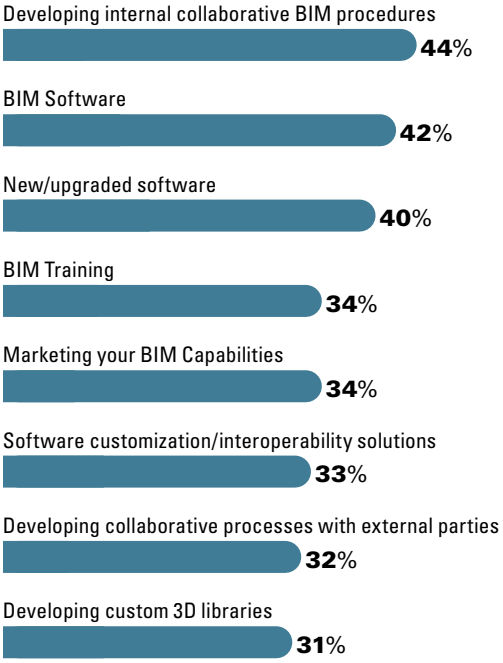
Marketing BIM capabilities was one of the higher investment priorities in North America (43%) but is less of a priority in Western Europe (34%). However, it has more importance for experts (45%) and advanced users (45%) who probably want to demonstrate their firms' BIM capabilities in order to win new clients and business.

BIM TRAINING

Training is a critical investment, particularly for new users. Some of the newest users in Western Europe are contractors who consider BIM training to be one of their highest priorities (41%).

Current BIM Investment Priorities

Source: McGraw-Hill Construction, 2010.



Value on the Horizon

A significant majority (90%) of Western European BIM users say they see value in BIM today but the full potential of its benefits has not yet been realized. On the extremes, very few BIM users say that they are getting everything out of BIM or getting no value from BIM—6% and 4% respectively. Most of the remaining users are evenly split between those saying they are getting a great deal of value out of BIM but believe there is more to be gained (50%) and those who believe they are just scratching the surface of what BIM can provide to them (40%).

Experience weighs heavily in users' accounting of the business value of BIM. 90% of experts believe they are either getting everything out of BIM that they can, or that they are getting a lot of value, compared to only 13% of beginners.

User Differences

- **A majority of architects (55%) and engineers (52%) believe they are getting a lot of value out of BIM but believe more can be gained.**
- **96% of contractors are getting some value out of BIM, but most are just scratching the service (61%).**

Level of Business Value of BIM—Total and By Level of Expertise

Source: McGraw-Hill Construction, 2010.

	BEGINNER	MODERATE	ADVANCED	EXPERT	TOTAL
We're getting no meaningful value from BIM	11%	3%	2%	0%	4%
We're just scratching the surface of how much value BIM can provide us	76%	52%	18%	10%	40%
We're getting a lot of value from BIM but believe there is more to be gained	13%	42%	75%	66%	50%
We're getting everything out of BIM that we believe it can provide us	0%	3%	5%	24%	6%

Level of Business Value of BIM—By Respondent Type

Source: McGraw-Hill Construction, 2010.

	ARCHITECT	ENGINEER	CONTRACTOR
We're getting no meaningful value from BIM	4%	5%	4%
We're just scratching the surface of how much value BIM can provide us	31%	41%	61%
We're getting a lot of value from BIM but believe there is more to be gained	55%	52%	35%
We're getting everything out of BIM that we believe it can provide us	10%	2%	0%

case study

Leveraging BIM to Demonstrate Value while Saving Time and Money

Aylesbury Crown Court

AYLESBURY, UNITED KINGDOM

Before the first shovel touched the ground at the new Aylesbury Crown Court in Aylesbury, UK, the design team reached the verdict that building information modeling had proven valuable on the £35-million project. Designers found multiple ways to leverage the technology to save time and money while improving communications with Her Majesty's Court Service and other team members.

The 5,200-sq-meter project, which was designed by the London offices of HOK with Turner & Townsend and AECOM, combines four courts into one facility along with public hall administration, consultation and witness rooms, judicial and custody accommodation and secure external areas.

Starting BIM in Schematic Phase

Although the team planned to use BIM on the project, the model was not created until the schematic phase. Femi Oresanya, vice president at HOK and the project manager, says the team chose to start with conceptual designs in basic 3D software during the conceptual phase before committing time and resources to creating a full BIM model.

"[BIM] requires us to make decisions much earlier in the process and you don't want to spend much time going back and forth at a conceptual phase," he says. "You don't want to commit resources to a proper BIM model until you've got a level of sign-off from the client."

Once the model began to take shape, it quickly proved its value to the client as a communications tool, says David Light, BIM specialist at HOK.

"Many clients don't fully understand a flat 2D world," he says. "When they see it in 3D, they get enlightened. It really helps sell the design and becomes a very relevant marketing tool."

Focus on Costs and Schedule

Because the project was public, a sharp focus was kept on costs. Oresanya says that by having detailed quantities in the model, the team could efficiently track costs in real time to keep the client apprised of budget issues.

The model also helped speed critical changes to the design. A 3D topographical survey, which was not commissioned until after the site was purchased, revealed water table issues and extra digging that would be required. The changes would increase costs so the team needed to redesign the scheme to meet the approaching end of the financial year.

"The clock was ticking," Light says. "On a project without [BIM], it would have taken two months to design this scheme, and we were able to do it in a couple of weeks. All of the information we needed to do the redesign was already in the model. That's where BIM really earns its money."

Showing Value to the Owner

Oresanya says the level of detail in the model was particularly helpful for validating areas for the client.

"We had to follow a court design standards guide that gives indicative areas in all of the spaces, and because it's public sector money, you

Aylesbury Crown Court: Site Plan

CONTINUED

Aylesbury Crown Court

AYLESBURY, UNITED KINGDOM

Aylesbury Crown Court: The main entrance positioned to the northeast end of the site

have to spend a lot of time validating those areas," he says. "We were able to fire those off very quickly, even on a daily basis."

The team was able to connect the model with an external database of room specifications to control room data requirements and generate room datasheets.

Enabling Sustainability

The HOK model also proved useful for architects doing early energy analysis of the building, which is aiming to achieve a BREEAM (voluntary green building rating program in the UK) excellent rating for its sustainability characteristics.

"It gives us a broad-brush view of the sustainability of the project and allows us to have that commentary with those engineers," Oresanya says. "We can be better involved in those discussions about things like how the building is oriented on the site."

Helping the Contractor Bidding Process

At the owner's request, the model was also passed to contractors to help with the bidding process. One contractor used the model for a walk-through presentation to the client and used the data to show 4D [schedule] construction. Oresanya says he expects the BIM model to prove valuable through to completion of the project, as data are used by the contractor for construction models. ■

Data: Internal Business Value of BIM

Overview

Key Findings in Western Europe

- Reduced errors and omissions in construction documents is the top rated business value of BIM.
- As the level of expertise of BIM use increases, so does the level of internal business benefits experienced.
- Better multiparty communication and understanding from 3-D is seen as most important to improving ROI on BIM.
- Non-interoperability of BIM software is rated as the greatest obstacle to improving value.

Key Findings in Western Europe vs. North America

- Over half of Western European BIM users (52%) see reducing cycle time of specific workflows as a top benefit vs. only 31% in North America.
- Contrary to North America where contractors see BIM use bringing a high level of benefit to their practices (56%), a much smaller portion of Western European contractors (35%) are seeing it as a high-level benefit.

Overview: Internal Benefits in Western Europe vs. North America

Similar to North American users, Western European users are seeking real business value from their investments in BIM technology. The benefits of BIM are primarily being experienced in the form of increased efficiency and productivity gains through reduced errors and omissions, reduced rework and reduced cycle times of workflows. Meanwhile, better communication and improved project process outcomes are seen as the top ways to improve value from BIM.

However, internal business benefits are not happening overnight. Only with experience do users begin to see how BIM can offer considerable value to their companies.

- Experts are 2 to 3 times more likely than beginners to see a high level of internal benefits.
- 8 in 10 experts say reduced errors and omissions in construction documents bring high to very high value.

Relative Importance of Internal Benefits

Source: McGraw-Hill Construction, 2010.

	DID NOT ANSWER	NONE/LOW	MODERATE	HIGH/VERY HIGH
Reduced errors and omissions in construction documents	2%	13%	24%	61%
Reducing cycle time of specific workflows	4%	16%	28%	52%
Reducing rework	7%	18%	25%	50%
Offering new services	4%	18%	31%	47%
Marketing new business to new clients	3%	26%	25%	46%
Reducing overall project duration	2%	24%	33%	41%
Maintaining repeat business with past clients	3%	28%	32%	37%
Increased profits	4%	26%	33%	37%
Younger staff's learning of how buildings go together is improved	7%	26%	32%	35%
Reduced construction cost	4%	36%	30%	30%
Overall better construction project outcomes	0%	36%	37%	27%
Fewer claims/litigation	13%	38%	26%	23%
Recruiting and retention of staff	10%	34%	36%	20%

Business Benefits

Key Findings: Top Rated Business Benefits

- **Reduced errors and omissions in construction documents**
- **Reduced cycle time of specific workflows**
- **Reduced rework**

Top Rated Business Benefits

REDUCED ERRORS AND OMISSIONS IN CONSTRUCTION DOCUMENTS

Virtual design and construction with BIM creates the potential to identify problems earlier in the building process. With interoperable exchange of models and data, team players can better ensure that information is complete and accurate. A majority of all users (61%) see this as a significant benefit. More experienced users recognize its value compared to others.

REDUCED CYCLE TIME OF SPECIFIC WORKFLOWS

BIM assists in significantly reducing lifecycle time by facilitating better communication and management of delivery times. A majority of architects (56%) see reduced cycle time of specific workflows providing a significant benefit to their practices. As the level of expertise increases, so does the level of internal business benefit.

REDUCING REWORK

Fixing problems early means fewer issues in the plans and ultimately fewer hassles on the construction site. Many contractors (52%) see the potential of BIM to reduce rework as a significant benefit. This is the top benefit that is being realized by all groups. It is also the second highest-ranked benefit reported by expert users (71%), compared to fewer beginners who see it that way (50%).

OFFERING NEW SERVICES

BIM is a way to bring new, technologically advanced offerings to a mature business. Many users (47%) say adding BIM to their toolbox brings a high level of benefit to their practices.

MARKETING NEW BUSINESS TO NEW CLIENTS

BIM opens doors for design and construction companies in the built environment. 46% of Western European adopters think this is a key benefit. As more clients begin to require BIM on jobs, team members need to have BIM skills to capture that business. On the flip side, companies can also introduce the technology to new clients that are not requiring BIM and use it as a marketing feature to provide a competitive advantage in their bids. This is particularly true for more experienced users who are promoting this skill.

Business Benefits in Western Europe

While North American users are eager to capitalize on the buzz created by BIM and see marketing and promoting of new BIM-related services as a top benefit, Western European users see this as less important than other top benefits. This could be attributed to BIM still being an emerging process in North America while in Western Europe a large percentage of BIM users have been using BIM for over 5 years.

Productivity issues—such as reduced errors and omissions in construction documents, reduced cycle times in specific workflows and reduced rework—ranked higher than benefits related directly to time savings and cost reduction. Similar to North America, this reflects the fact that Western European users of all levels could see BIM as helping them work more efficiently, but cost savings are more likely to be realized by primarily by experienced users.

The Value of Experience

In Western Europe, as in North America, internal business benefits increase as BIM users gain experience. There is a significant divide between novices and seasoned users in how they perceive the value BIM brings to their practices. Among a broad range of possible benefits, experts are roughly two to three times more likely than beginners to report seeing high to very high levels of value. This is a natural, but dramatic, progression. As users get started with BIM, they make investments in software, hardware, training and other related initial costs. Meanwhile, they are likely to be less productive with the technology until they gain proficiency. Once users learn how they can leverage the technology to their advantage, they begin to bank those benefits. When comparing expert and beginner opinions about what aspects bring high to very high value:

- **BIM reduces errors and omissions in construction documents—80% of experts versus 44% of beginners.**
- **BIM reduces rework—71% of experts versus 33% of beginners.**
- **BIM helps in reducing cycle time of specific workflows—71% of experts versus 34% of beginners.**
- **BIM helps in offering new services—62% of experts versus 40% of beginners.**
- **BIM helps in marketing new business to new clients—51% of experts versus 32% of beginners.**
- **BIM increases profits—49% of experts versus 28% of beginners.**

Improving Business Value

Top Rated Reasons For Improving ROI:

- **Better multiparty communication and understanding from 3-D visualization**
- **Improved project process outcomes**
- **Reduced cycle time for project activities and delivery**

Improving Business Value

Similar to North America, most BIM users in Western Europe see positive ROI, while they also see room for improvement. Users report various ways that they could see better returns on BIM, ranging from less tangible benefits—such as improved communication—to more defined savings, such as reduced requests for information (RFI), improved project delivery times and prevention of costly mistakes.

Top Rated Ways to Improve Value

BETTER MULTIPARTY COMMUNICATION AND UNDERSTANDING FROM 3D VISUALIZATION

By sharing information through BIM, the team can better communicate its actions and ideas. Three-quarters (75%) of users see this as highly important, with all parties except engineers ranking it as their top improvement.

IMPROVED PROJECT PROCESS OUTCOMES, SUCH AS FEWER RFIS AND FIELD COORDINATION PROBLEMS

By identifying issues before they show up in the field, users can prevent costly mistakes. The majority of users (71%) see this as highly important, with engineers ranking it at the top of their list.

CONTINUED

Improving Business Value CONTINUED

REDUCED CYCLE TIME FOR PROJECT ACTIVITIES AND DELIVERY

BIM assists in significantly reducing project delivery times during the design phase and construction phase. Nearly 7 in 10 users (69%) see this as a highly important area of improvement.

IMPROVED PRODUCTIVITY OF PERSONNEL

One of the top rated ways that BIM users can be more productive is by sharing data seamlessly with other users, eliminating the need to reenter data. Many users (68%) see this as a highly important area of improvement.

INCREASED PREFABRICATION

When BIM is used to coordinate shop drawings and eliminate clashes before they could happen in the field, users can employ prefabrication with more confidence. The majority of contractors (69%) report that more model-driven prefabrication will improve their returns.

Relative Importance of BIM Benefits to Improving ROI

Source: McGraw-Hill Construction, 2010

Challenges to Value

Most Western European users experience value from BIM but see several factors that limit their ability to realize better results. Interoperability between software applications and enhanced functionality of BIM software are top areas that need to be addressed to improve business value. The ability to obtain more detailed manufacturer-specific building product data is also seen a necessary improvement. These concerns are not limited to novices. Users of all levels report that these issues need to be addressed if they are to improve the benefits they hope to gain.

Top Rated Areas for Improvement

IMPROVED INTEROPERABILITY BETWEEN SOFTWARE APPLICATIONS

The lack of interoperability limits the potential of BIM, especially in an environment where data is exchanged between various build team members. As BIM has developed and new tools have been introduced, interoperability has become increasingly important. Although efforts to create standards are underway, issues remain. A large majority of BIM users (76%) say there is a significant need to improve interoperability. This need is expressed by a majority of all users at all experience levels.

MORE 3-D BUILDING PRODUCT MANUFACTURER SPECIFIC CONTENT.

Incorporating more detailed manufacturer-specific building product data in the BIM model allows users to better convey design ideas in the early conceptual stages, form more accurate energy analyses and obtain earlier cost estimations. The majority of users (70%) see this as a significant area of improvement, with architects ranking it as the most important.

IMPROVED FUNCTIONALITY OF BIM SOFTWARE

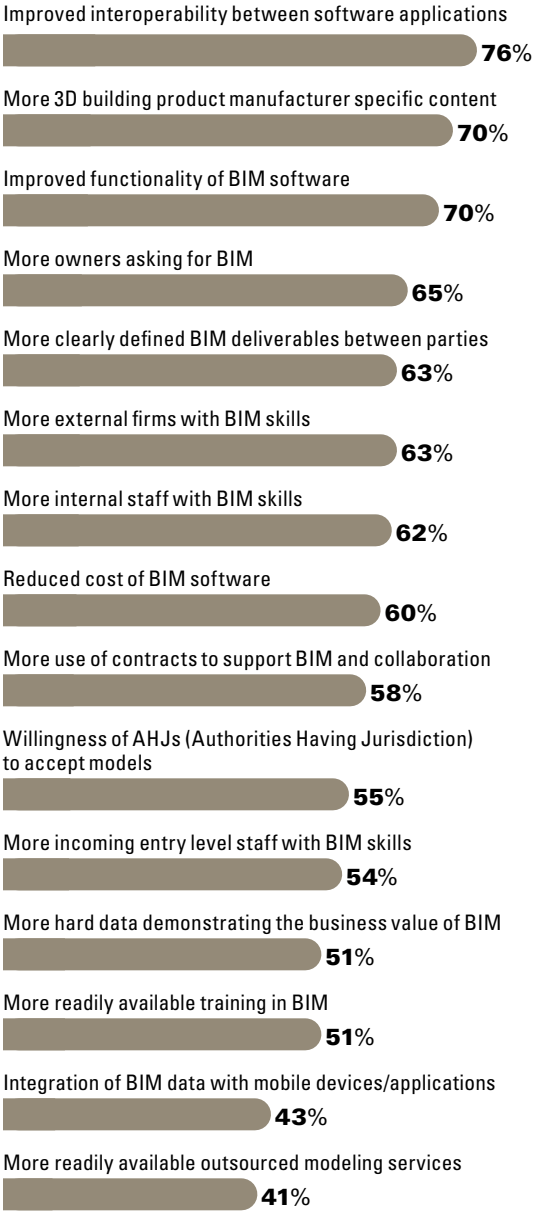
Functionality is a typical struggle for emerging technologies. As software companies develop BIM tools and users put them into practice, new demands arise. Users are looking for additional ways to leverage benefits from BIM. 7 out of 10 users (70%) say improved functionality would greatly enhance value.

MORE OWNERS ASKING FOR BIM

Functionality is a typical struggle for emerging technology. When the client wants BIM on a job, it immediately gains a level of value to users. While BIM may be used largely by the design and construction community, BIM users are looking for owners to take the initiative on whether the technology should be utilized on a project. Contractors are particularly swayed by owner demand—three-quarters say this is highly important.

Top Ways to Improve Value of BIM

Source: McGraw-Hill Construction, 2010.



Interview: Industry & Technology
Perspectives

Interview with Jay Bhatt

As senior vice president of AEC Solutions for Autodesk, a world leader in 2-D and 3-D design, engineering, and entertainment software, Jay Bhatt is responsible for Autodesk technology delivered to building and infrastructure industry participants globally. Autodesk AEC Solutions is focused on helping customers create and extend digital design information throughout the entire building and construction process.

Is the value proposition of BIM perceived differently in Western Europe than in the U.S?
BHATT: It's pretty consistent between both markets, but there are some interesting differences. In Europe, design companies actually produce the shop drawings, where in the U.S. they're done by fabricators. So drafting productivity around BIM is much more important in Europe than in the U.S.

Also legal constraints in construction are less onerous in Europe, so the value proposition of BIM for sharing and collaborating becomes even more relevant because the lines aren't drawn as strictly between the two areas [of design and construction].

A big movement that's very consistent between the two, for which BIM really is one of the only answers, is sustainable analysis. [BIM has] the information to be able to do the kinds of energy, carbon and solar analysis that architects, engineers, contractors and ultimately owners are specifying.

How do the differences impact BIM innovation?
BHATT: Even though roles and responsibilities are different between Europe and the U.S, and European countries are highly diverse regarding standards and requirements, BIM is flexible enough to deal with it, so there's innovation going on everywhere.

Some of the most interesting innovations are happening on a third-party developer ecosystem on the technology side, where applications are being built around BIM that serve local needs. For example, RIB is a pretty big European software company focused on the application of BIM to construction, particularly in cost management, so we created a joint solution with them for a seamless workflow from design into building, covering 4-D and 5-D simulations of construction process cost elements.

"...the reason to do BIM is to create a database of information that represents the design and [enables] digital organization...[and] there needs to be a very clear BIM value proposition for the owner."

Are there companies doing things on specific projects in Western Europe that you consider really leading edge?
BHATT: Scott Wilson Group, a UK-based global integrated design engineering consultant agency, has identified how information created in the BIM model can be implemented more effectively in managing assets through the lifecycle, whether it's a building or infrastructure.

Another example is Max Bogl, a really progressive contractor in Germany that has developed a Digital Process Chain using BIM to optimize three critical workflows—acceptance of fabrication-level information, precast element production and onsite erection assembly. They're decreasing project risks and delivering in a timely and cost-efficient manner. They've also extended the BIM model to monitor and control information for asset management afterwards.

Are you seeing BIM successfully incorporated into educational curriculums?
BHATT: In both North America and Europe we actively build strong relationships with top schools to develop BIM curriculums and support student activities. Some of the best technical schools in Europe, such as RWTH Aachen University in Germany, use BIM around a portfolio of design, engineering and construction.

Is there a common theme you see about BIM globally?
BHATT: It's the "I" in BIM. When I talk to people really implementing BIM the same idea exists everywhere—that the reason to use BIM is to create a database of information that represents the design and [enables] digital organization. Also, there needs to be a very clear BIM value proposition for the owner. ■

Data: Project Value of BIM

Overview

Key Findings in Western Europe

- **Phases that experience the most BIM value during a project:**
  - Design development
  - Technical design
- **Benefits that generate the highest returns:**
  - Improved collective understanding of design intent
  - Improved overall project quality
- **Factors with the greatest impact on BIM success on projects:**
  - Interoperability of software used by team members
  - Project complexity

Key Findings vs. North America

- **Users in Western Europe and North America agree that interoperability of software used by team members is an important factor in determining BIM's overall project value.**
- **Reducing conflicts during construction contributes the most value in North America but is a lesser benefit in Western Europe.**

Overview: Gaining Value Collectively

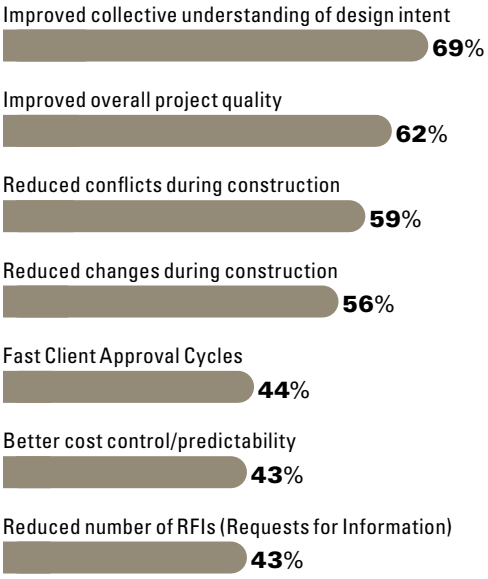
Most users recognize that more than just individual build team members or firms benefit from using BIM. In fact, most users recognize that the collective use of BIM on projects can drive better results.

Through the sharing of models and the implementation of new collaborative approaches to design and construction, building teams are redefining traditional roles and workflows and finding better and faster ways to communicate ideas, reduce errors and improve productivity.

Users recognize that having other BIM-knowledgeable team members on a project and being able to seamlessly share information from models with them can significantly benefit a project overall.

BIM Benefits Contributing the Most Value

Source: McGraw-Hill Construction, 2010.



- **Nearly two-thirds of users (61%) recognize that interoperability between software applications used by team members has a significant impact on the value gained during a project.**
- **57% of users say that the number of BIM-knowledgeable individuals on a project is highly important to a project's success.**
- **Project size and complexity also play an important role in user perception of BIM's value. BIM is seen to be particularly beneficial on large, complex projects.**

Value by Project Phase

Western European BIM users can garner benefits throughout the life of a project, but they are experiencing greater value in some phases than others. Users see the greatest value as designs are fully developed and construction moves forward.

Design Development and Technical Design Phases

69% of users see the highest project value during the design development phase, while almost as many (67%) see high or very high value in the technical design phase. The design capabilities of BIM are among its most obvious and immediately understood aspects, particularly as more detailed models are created.

Concept Phase

European BIM users are also finding high or very high value during the concept phase, where BIM allows the project team to work with the client and both internal and external stakeholders to define the parameters of the project.

Production Information and Tender Documentation Phases

Half of users surveyed found that BIM provided substantial value during the production information and tender documentation phases, where BIM aids in the organization of data and helps improve communications between designers and the building team.

Construction Phase

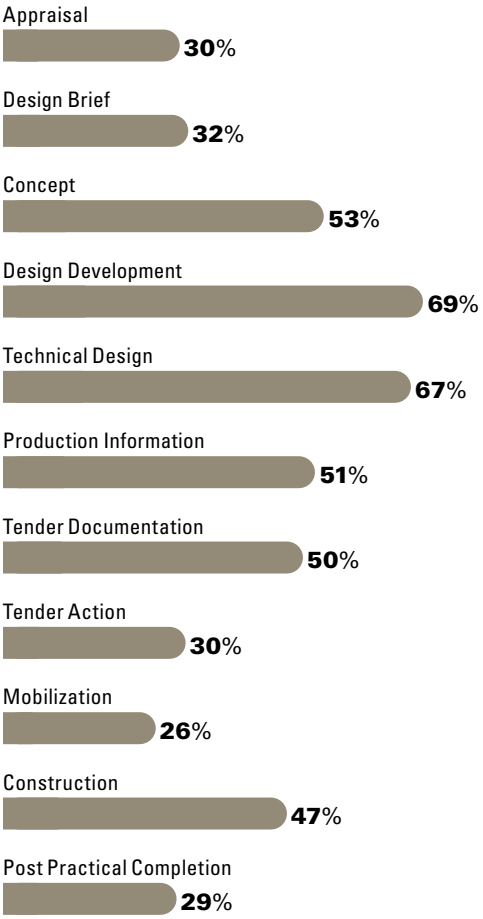
BIM can save time and money during the construction phase. For example, it can reduce the number of system clashes and thus help to better control the project budget and schedule.

User Differences

- **All users across the board see the greatest value from BIM occurring during the design development and technical development phases.**
- **Architects, in particular, see the highest value during the design development phase (83%) and technical phase (70%), but also see higher than average value during the concept phase (62%).**

Perceived Value of BIM by Phase

Source: McGraw-Hill Construction, 2010.



- **62% of engineers see high value during the construction phase and over half also see high value during the tender documentation phase.**
- **Over half of contractors experience high value during construction, when the bulk of costs are generated and opportunities to save time and money arise.**
- **BIM is not seen as particularly valuable during the mobilization (26%), post practical completion (29%), appraisal (30%) and tender action (30%) phases.**

Factors Affecting Value

One of the key factors impacting the ability of users to perceive value on projects is the ability to share information between team members. Many BIM users working in a team environment have already discovered that the lack of interoperability between software applications can limit the team's success.

BIM is particularly showing its value on large, complex projects. Most users believe that the more complex a project is, the more valuable BIM can be.

Users also recognize that having BIM-knowledgeable design professionals engaged throughout the project is a key to project success.

Top Rated Factors

INTEROPERABILITY BETWEEN SOFTWARE APPLICATIONS USED BY TEAM MEMBERS

The ability to exchange project data between various team members is the top rated potential benefit of using BIM. Interoperability is key to making this exchange seamless. 61% of all users recognize this as a highly important factor. Interoperability of software applications is particularly important to expert users (71%).

PROJECT COMPLEXITY

60% of users see project complexity having a major impact on BIM value. Skill level influences this view also, with only 49% of beginners versus 67% of experts rating it as highly or very highly important.

BIM-KNOWLEDGEABLE DESIGN PROFESSIONALS ON THE PROJECT

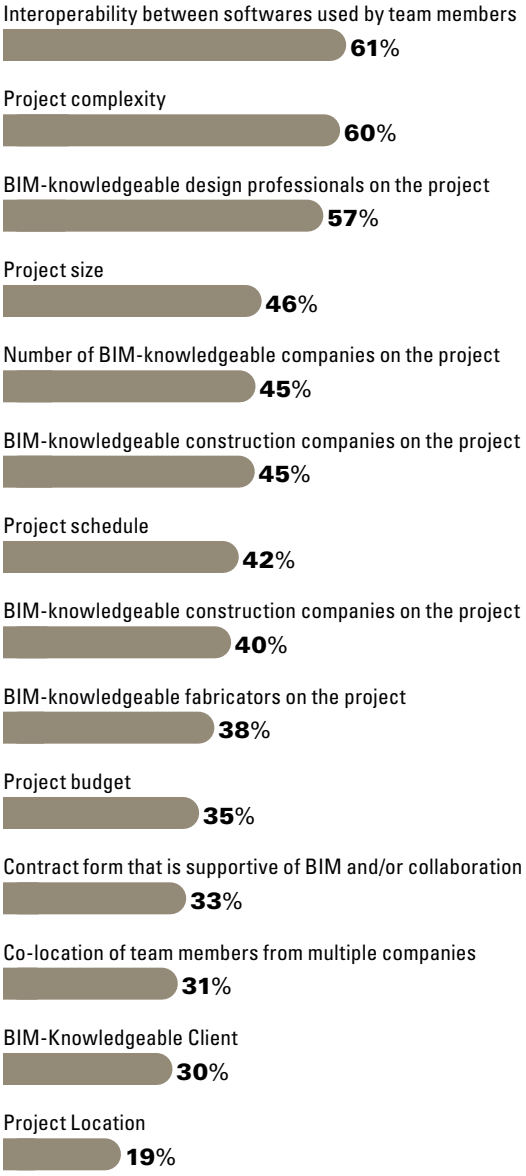
More modeling during design improves everyone's process. 57% of all users say this factor is highly important to the success of a project.

NUMBER OF BIM-KNOWLEDGEABLE COMPANIES ON THE PROJECT

Though other factors ranked higher, 45% of all users felt that having more BIM-knowledgeable firms on projects has high or very high importance. Contractors (63%) and experts (55%) felt much more strongly that this is an important factor as compared to other firms.

Impact of Project Factors on BIM Value

Source: McGraw-Hill Construction, 2010.



Banking on the Benefits

There is general consensus among BIM users about which benefits bring the most value to a project.

Improved Collective Understanding of Design Intent

All respondents indicated that this is the most important BIM benefit that contributes to value on a project. Because of BIM's ability to allow 3-D visualization and its rich database of project information, over two-thirds of users (69%) say collective understanding of design intent provides a high level of value. Most contractors (78%) and architects (76%) believe this and rank it as the highest area of value, likely because they can use models to better understand and monitor ideas that carry through the lifecycle of a project.

Improved Overall Project Quality

Users believe that the value of BIM on projects can be seen in the finished project. Most BIM users (62%) feel that the cumulative benefits across the life of a project add up to a highly valuable end result for the owner. Architects (65%) are the most likely to believe this.

Reduced Conflicts During Construction

Conflicts in the field are costly, affecting both budget and schedule. 59% recognize that reducing conflicts produces the highest rewards on a project, particularly contractors (70%). Engineers also rank this as the greatest benefit on a project.

Reduced Changes During Construction

When BIM reduces conflicts, it helps teams avoid costly changes in the field. All users rank this among their top benefits, including a majority of contractors (74%) and engineers (56%).

Benefits with Limited Value

Few say these are contributing high value:

- **Improved jobsite safety (24%)**
- **Faster regulatory approval (25%)**

Future Opportunities

Over the next five years, users in Western Europe believe that they will be able to further unlock BIM's potential and receive even greater value than they are seeing today. Among the key future benefits:

Better-Designed Projects

Two-thirds of users (66%) believe that BIM will result in better-designed projects. This perception is especially prevalent with architects (70%).

Greater Professional Satisfaction with Project Outcomes

Predictability and improved performance are important in making a company feel good about its work on a project. 62% see this benefit as having a high value in the future. Both advanced (66%) and expert users (69%) see this as a substantial future benefit.

Better-Performing Buildings/ Infrastructure

Many users (61%) also believe that BIM will ultimately result in better performing buildings and infrastructure. This belief is particularly strong among architects (62%).

Prefabrication of Larger, More Complex Parts of Projects

60% of users say prefabrication will bring high value to projects in the coming years. Two-thirds of contractors (67%) see this as very beneficial.

Lower Risk and Better Predictability of Outcomes

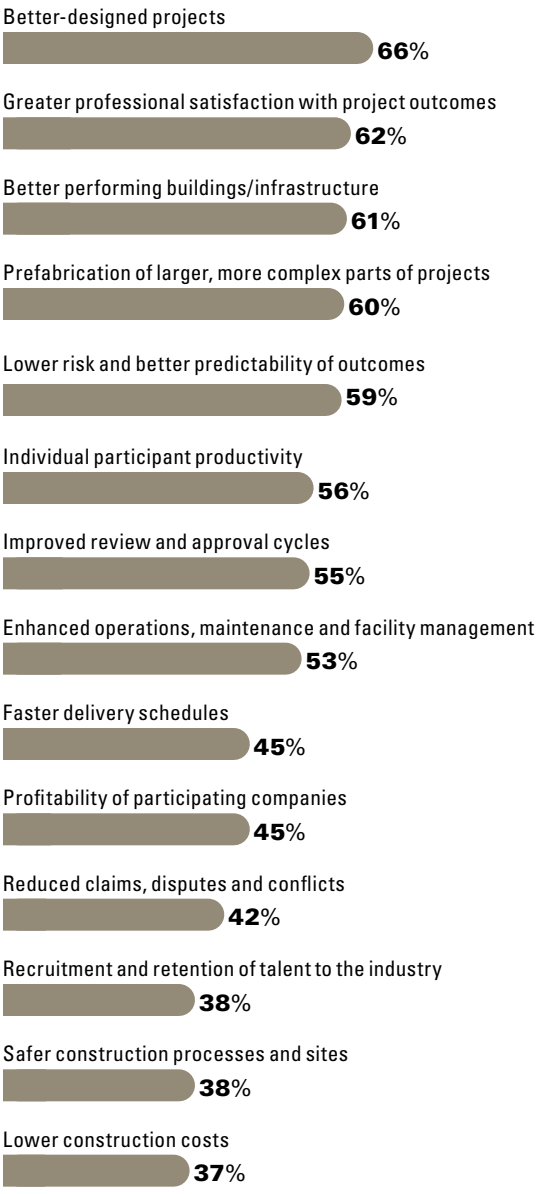
As more users share information across models in the future, the ability to lower risk will improve. 59% of users see this having high value five years from now, with over 75% of contractors reporting it.

Improve Review and Approval Cycle and Enhance Operations, Maintenance and Facilities Management

Over 50% of users believe that BIM can drive both of these improvements. It is especially espoused by contractors.

Perceived Value of BIM—Five Years from Now

Source: McGraw-Hill Construction, 2010.



Interview: Thought Leader

Mark Bew
Chair, buildingSMART Alliance United Kingdom

Mark Bew, the group business systems director at Scott Wilson in London, was appointed chair of buildingSMART UK in November 2009. With a focus on improving interoperability in the construction industry, Bew leads buildingSMART's efforts to address process- and technology-based issues that limit collaborative relationships in cross-disciplinary teams.

Improving interoperability is a central part of buildingSMART's mission. Is improving how different software applications exchange data the key to increasing users' return on investment in BIM?

BEW: Technology is not the main issue. If we can articulate what the [cross-disciplinary team] wants to swap and how we want to swap it, companies can write script for us to do it. What we haven't done is be to clear about the process with the technology guys. If you go back to the paper days, when you finished a drawing you gave it to the lead designer, who would sign off in the corner. Then, they'd come up with 10 copies and those were signed. All of those were known processes that we took for granted. All of those have been lost. Once we started emailing things to each other, all of that discipline disappeared. If we're going to do that with BIM tools, we need to redefine those processes so we're crystal clear. That means everyone across the whole market. When we get there, we'll be back in control again. It's not a technology issue. If we can define it, they can build it.

How are the barriers between the various disciplines affecting the free exchange of project information?

BEW: It's one thing to have a shared aspiration to coordinate and collaborate. It's when you try to make those processes run as the norm without the protection of contracts, ownership and copyright that you find a big lack of understanding and a lack of trust. If I give you the model, am I liable for it? Do I want to give it to you? Do I understand why I am or am not giving it to you? That's a very immature debate right now. The more we come across it and the more we try to find ways to make it work, the better it gets, but it's in the early days. In the past, when you were only passing drawing information, it was pretty clear what was printed on a piece of paper with a signature in the corner. Now it's a bit less tangible when you're passing datasets. With all of the attached data that are appearing and all of the derived data from the calculations in the dataset, it's very hard to put hand on heart to really know every time what's going down that piece of wire. Certainly, as it matures and we get better at it, that will come.

"If the government can prove to the market that they can deliver better performing assets by using interoperable data, that will reach into the public market as well."

As the client, can't owners play a big role in promoting the need for improved interoperability as a way to improve overall value?

BEW: One of the areas we're looking at now is use of interoperable data in government procurement and asset management, and how we can improve this process. We're looking at how the government can derive better-performing assets in terms of best value, whole-life costs and carbon footprint through the use of interoperable data. It doesn't have to be BIM-derived data, it can be data that talk to each other and are reused through the lifecycle. If the government can prove to the market that they can deliver better-performing assets by using interoperable data, that will reach into the public market as well.

Owners face strict sustainability requirements these days. Could the need for data to monitor the performance of buildings be an effective argument for improved interoperability?

BEW: The hypothesis we've put together for the government includes carbon at the center of the strategy. It's hard to imagine how you truly measure the carbon performance of a building throughout its lifecycle without some type of BIM or BIM-like tool. Whether it's BIM or FM or BMS or smart-meter datasets from the utility suppliers of the building, there are a whole number of tools that come together that give you the data to measure that output. They need that data, and all of that data need to be interoperable. ■

Data: Player Value of BIM

Overview

Key Findings

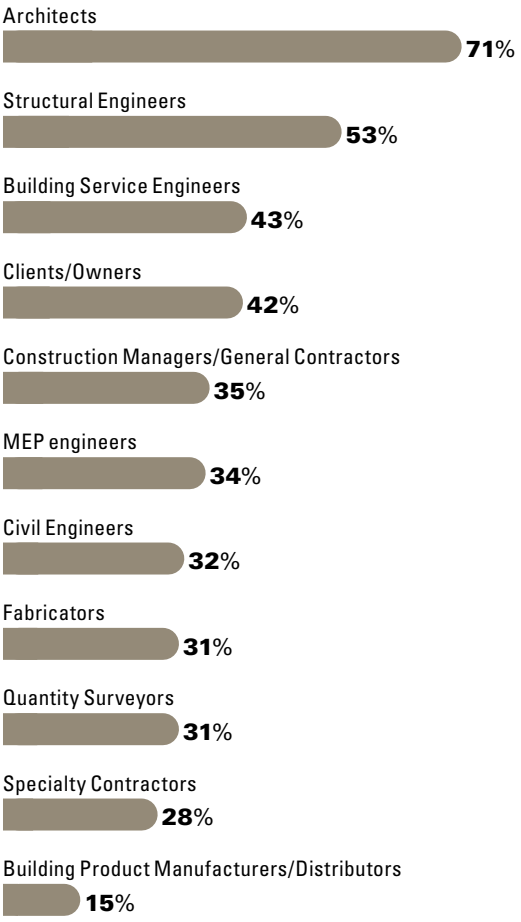
- **All players believe increased interoperability is highly important for BIM to provide value on a project.**
- **Architects show mature adoption patterns and experience high ROI but with a focus on their workflow for BIM benefits.**
- **Engineers most highly value BIM's ability to increase productivity in the construction phase.**
- **Contractors highly value BIM for its ability to support collaboration with designers.**

Overall Player Value

Each player on a construction project has their own unique workflow and demands. Therefore, each also has a different BIM value proposition. Further, BIM tools are still being developed that address different disciplines, so the ability to gain value from BIM varies by discipline and continues to grow. One area that all major players agree is critical to their ability to experience value from BIM is the interoperability between software used by team members.

Project Participants Who are Perceived to Experience the Most Value

Source: McGraw-Hill Construction, 2010.



Who Gets the Most Value?

Architects

Architects have the most experience with BIM, and they are perceived by all players as one of the greatest beneficiaries of BIM. This perception is especially strong among the architects themselves, with 80% arguing that architects as a discipline achieve a high level of value.

Engineers

The only group in which a slightly higher majority selects their own profession as the major beneficiaries of BIM is engineers, with 66% indicating that structural engineers experience a high level of value from BIM. Over half of the architects and contractors surveyed also view structural engineers as obtaining the most value. At this point, better tools for structural design exist in BIM compared to those for some other engineering disciplines, such as electrical engineering.

Contractors

Contractors are currently perceived to experience a much lower level of value than the other major players. Even among themselves, fewer than 50% of contractors recognize a high level of value in BIM for either construction managers/general contractors or specialty contractors. Architects in particular do not see a great deal of value in BIM for contractors.

Architects

Architects in Western Europe find the most value in BIM's ability to improve their design process. Compared to U.S. firms, they are less interested in its collaborative potential than they are in how it affects their immediate processes.

However, as more experienced users—77% of firms have used BIM for 3 years or more—Western European architects experience a stronger perceived ROI than any other player or than their North American counterparts. **48% of the architects surveyed report a perceived ROI of 25% or greater**, compared to only 26% of the architects in North America.

Visual Impact and Communication

For architects, the visual impact of BIM is critical to improving their business. 3-D modeling is the most frequently cited way that BIM improves their company in general, but it is also most frequently cited by architects as saving them time and money. This result is supported by the finding that, **for over three quarters (76%) of architects, the ability of BIM to improve the collective understanding of design intent is a critical way it adds value to a project**, along with its ability to reduce conflicts during construction (53%). Both of these are the direct result of the visualization tools in BIM, and they no doubt contribute to why 61% of architects, more than any other player, report greater client engagement as an important value they derive from BIM.

Better Design Process

Architects also note the value of BIM in improving the design process. The most frequently cited internal business benefit for architects is reducing errors and omissions in construction documents, noted by 65%. 49% also regard reduced rework as a key benefit.

Architects relate a better design process directly to their bottom line. Many note a faster/easier design process and the ability to make design changes easier as the most important way BIM saves them time and money.

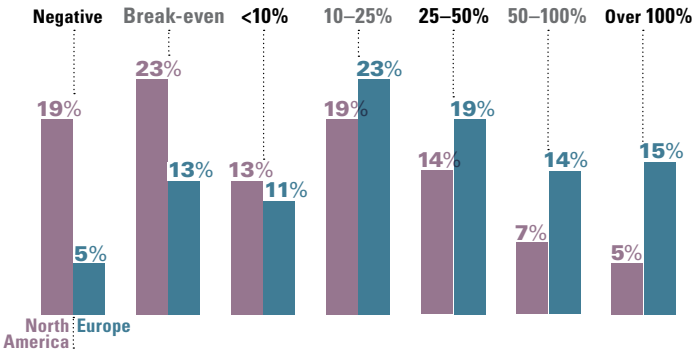
Functionality

As experienced BIM users, architects see improved functionality as one of the most important factors for increasing their ability to achieve business benefits from BIM. In particular, approximately three quarters of them would like to see:

- Improved interoperability between software applications—76%
- Improved functionality of BIM software—72%

Perceived ROI Architects

Source: McGraw-Hill Construction, 2010.



Experienced BIM Users

At first glance, given the high perceived ROI they report, the architects surveyed seem remarkably pragmatic about how BIM affects the design process and its overall functionality. However, this may be due to the fact that, unlike many of the North American respondents, these firms have used BIM for a long time in a relatively stable market. Therefore, many of the practices and expectations around BIM are more ingrained, leading to less intense concern about seeking others with BIM skills and more focus on their immediate, direct workflows.

Engineers

Like the architects in Western Europe, **engineers also have experienced a much higher perceived ROI than those in North America, with over one third of engineers in Europe (34%) expecting an ROI of 25% or higher compared with only 12% in North America.** More years of experience and higher reported levels of BIM expertise no doubt contribute to this differential.

Greater Efficiency in Construction Phase

62% of engineers found the greatest value of BIM to lie in the construction phase—more than even contractors (52%) and far more than architects (40%).

In fact, the three benefits of BIM that engineers feel contribute the most value to a project are all construction related:

- **Reduced conflicts during construction**
- **Reduced changes during construction**
- **Reduced number of RFIs**

Each of these benefits increases the efficiency and lowers the total cost. This corresponds to the finding that, for engineers, one of the most critical ways for BIM to save time and money is to increase productivity and efficiency. Also, half of the engineers surveyed reported that lower project cost was important to the overall value they experience from BIM.

The value of BIM for increasing productivity and reducing project cost was also more strongly perceived by engineers in Western Europe than by those in North America. European engineers see much greater value in the following categories:

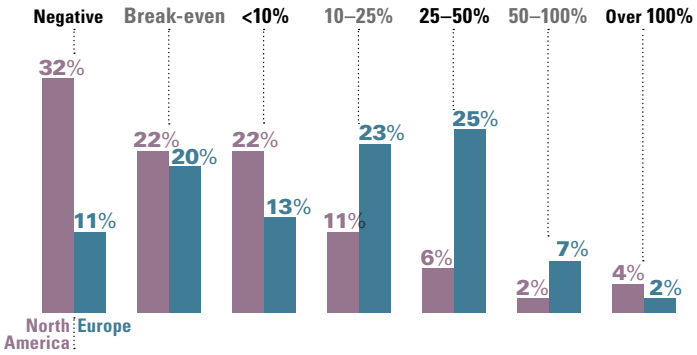
- **Increased profits**
- **Reduced overall project duration**
- **Reduced rework**
- **Reduced construction cost**
- **Reduced cycle time of specific workflows**

Greater Teamwork

One way engineers seek to find greater efficiency through BIM is in improved communication. 88% of engineers note that better multiparty communication is an important contributor to the value they experience from BIM—the most for any individual value.

Perceived ROI Engineers

Source: McGraw-Hill Construction, 2010.



Marketing

More than any other discipline, engineers who have adopted BIM view it as important for ensuring their market position, with 69% of the engineer respondents citing the positive impact on marketing as an important value they receive from BIM. Of the internal business benefits measured, marketing new business to clients and offering new services were also deemed important by the largest percentage of engineers (54%). A larger percentage of engineers note that BIM gives them a competitive edge as compared to both architects and contractors.

Cost of Adopting BIM

Engineers view cost as a major concern impacting their adoption of BIM. 61% cite reducing the cost of BIM software as key to increasing their ability to experience stronger business benefits from BIM. Among engineers who are not BIM users, 30% feel that lowering the cost of BIM would be an important factor in increasing adoption.

Owner/Client Influence

Another factor that is more important to engineers than to other players for encouraging BIM adoption is the impact of the client. The highest percentage of engineers view more owners asking for BIM as important to increasing the business benefits they experience from BIM. In addition, client requirements are a significant driver for engineers who have not yet adopted BIM.

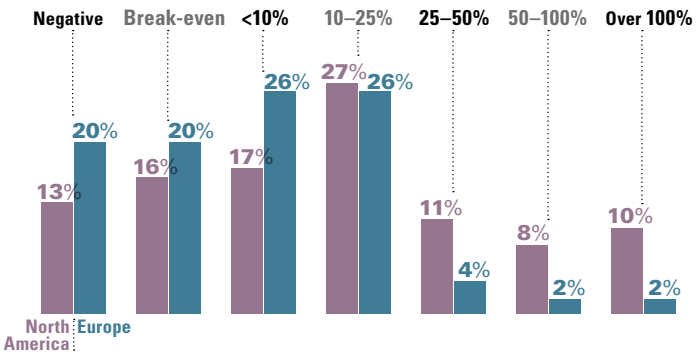
Contractors

Compared to the other major players in the industry, contractors in Western Europe perceive the lowest ROI from BIM use. 40% expect to either break even or lose on BIM adoption, while only 8% have a perceived ROI of 25% or more. This is in striking contrast to contractors from North America, where 29% have a perceived ROI of 25% or higher and an equal percentage (29%) expect to break even or lose on BIM.

Experience may be a factor in the lower perceived return. Unlike architects and engineers, nearly half of the contractor respondents (46%) have been using BIM for one year or less. Both this study and the North American BIM study demonstrate a direct correlation between BIM experience and perceived ROI. However, a larger percentage of contractors across the board place value on a variety of benefits provided by BIM compared to the other major players, suggesting potential for strong growth in the future.

Perceived ROI Contractors

Source: McGraw-Hill Construction, 2010.



Collaboration

More than any other players in Western Europe, contractors using BIM place a high value on collaboration. Approximately 20% more contractors than architects or engineers credit the number of BIM-knowledgeable companies as an important factor for experiencing the value of BIM on a project. One of the four categories selected by the most contractors as important to improving their ROI is better multiparty communication. In addition, nearly half the contractors (48%) view contracts that support BIM and collaboration as contributing to their ability to experience value from BIM.

Contractors also value the ability of BIM to improve collective understanding of overall design intent, with this factor recognized by the largest number of contractors (78%) as a BIM benefit that contributes the most value to a project. In fact, a slightly higher percentage of contractors selected this as compared to architects, demonstrating how high a value contractors place on collaboration in the design process.

Scheduling, Budgeting and Cost Control

Most of the other aspects of BIM most highly valued by contractors relate directly to key elements in their workflow. In construction, scheduling and cost control are tightly aligned, and they are reflected in the responses of contractors as well.

Nearly half (48%) of contractors selected 4-D scheduling as contributing to a high level of value from BIM. Half the contractors consider reduced overall project schedule a high-value benefit from BIM, and 61% consider better cost control/predictability important. Other issues cited that improve the workflow for contractors and lead to lower costs include reduced changes (74%) and reduced conflicts (70%) during construction. For each of these categories, significantly more contractors than architects or engineers regarded them as contributing high value through BIM.

Comparison with North America

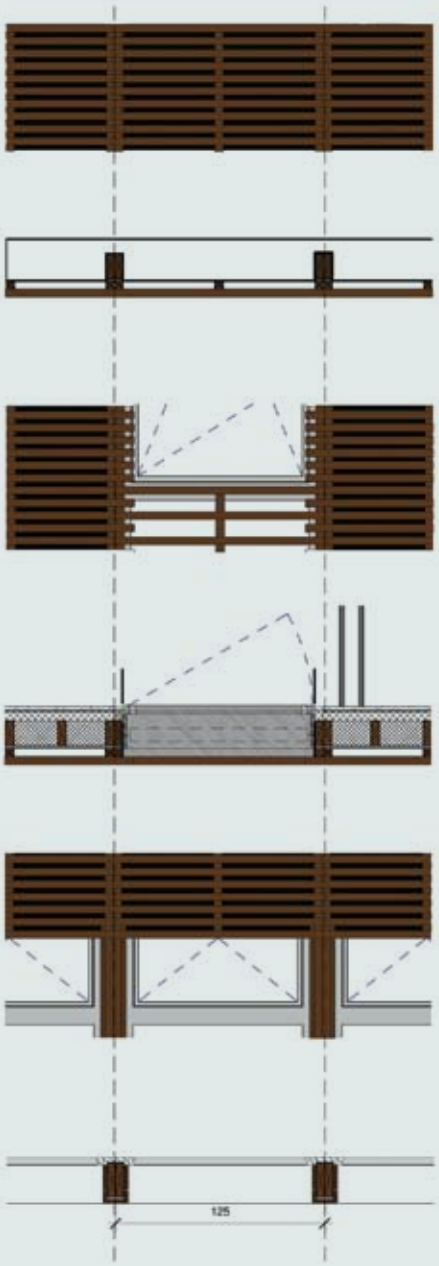
Western European contractors are also more attuned to the benefits of BIM for scheduling and budget than North American contractors, with a much higher percentage seeing increased profits and reducing cycle time of specific workflows as critical to BIM's internal value contribution. However, they see BIM in terms of their existing work more than North American contractors, who place a much greater value on BIM's ability to offer new services.

case study

Applying BIM to Projects of Any Size

ESEAN

NANTES,FRANCE



ESEAN Children's Hospital, Nantes, France

Many early adopters of building information modeling initially focused on applying the technology to large complex projects. However, those attitudes are changing. Brunet-Saunier Architectes, a Paris-based firm that focuses primarily on hospital projects, initially saw BIM as a way to improve its design process on large projects, many of which are up to 70,000-sq-meter in size. But Jacques Lévy-Bencheton, architect and computer manager with the firm, says BIM is used throughout the practice today.

"We see value for all kinds of projects now," he says. "We started with big projects, but [BIM] has become more of a method than a tool for us. Now, most new projects of every size are being started in [BIM]."

The firm used BIM to design the recently completed 6,700-sq-meter ESEAN children's hospital in Nantes, France. The €10-million project, which is designed to accommodate around 90 patients, includes a ground-floor outpatient hospital and an upper-floor inpatient hospital with patient rooms and public areas.

Enabling Design Flexibility

As with most of its healthcare projects, Brunet-Saunier used a unique design concept known as "Monospace." This concept is used to gain maximum design flexibility throughout all design and construction phases, enabling architects to quickly and easily change the location of entire hospital wards, as necessary.

"The Monospace concept is linked to BIM's capability to be fast and

CONTINUED

ESEAN

NANTES, FRANCE

ESEAN Children's Hospital, Nantes, France: The Architectural Coherence Views Management & Work in the 3 Dimensions

flexible," Lévy-Bencheton says. "Without [BIM], we couldn't do that."

During schematic design, the surface area of the project was reduced by 10%, forcing architects to completely redesign the facility. However, this process was significantly accelerated by using BIM, which allowed for real-time updating of data in the model. The team could also better communicate changes with the owner.

A main aesthetic design element and sustainable feature of the building is the curtainwall panels fitted with wooden pieces.

"BIM allowed [the designers] maximum flexibility to study different versions of the same façade and decide what was the best solution," Lévy-Bencheton says.

Reaping the Benefits: Minimizing Staffing and Improving Contractor Bidding

BIM also enabled Brunet-Saunier to minimize staffing of the project. Lévy-Bencheton says that, once construction started, only one project manager was required. No additional staff members were used.

"On traditional projects with CAD, we would have needed three to four people on a project like this," he says. "With [BIM] we are able to follow up with only one person."

Quantities were calculated regularly to help monitor budgets, and Lévy-Bencheton says that proved particularly helpful for the owner as the project went out to bid for construction of the building.

Better Communication

Overall, Lévy-Bencheton says by having a BIM model as the single source of project data, architects are not only more efficient, but they are also more confident that the information is accurate. The team drew all data from the model to communicate with external engineering firms, ensuring that every team member would be provided with precise documents.

"Generally, the synthesis of the building is done at the end of the design," he adds. "But we know at the beginning that everything is correct because it is a single model; as a result there will be fewer issues when working with structural engineers, MEP engineers or others involved in the project." ■

case study

Navigating the Road to BIM Adoption

University Campus Suffolk

IPSWICH, UK

With more clients demanding use of building information modeling, the design and construction community is quickly responding, but BIM adoption isn't without its challenges. The Cambridge, UK-office of RMJM has used its work with University Campus Suffolk in Ipswich, UK, as an opportunity to gain BIM proficiency. As part of the recent expansion at the campus, the client requested BIM models of its projects for future use with facility management.

RMJM first attempted to use BIM on the £20-million University Campus Suffolk Waterfront Building project. The 10,500-sq-meter project incorporates a complex series of internal spaces including a Learning Resources Centre, a "one-stop shop" for student support services and enquiries, as well as informal and formal teaching areas. At the tender stage the building was rated as "excellent" under the BREEAM rating system (voluntary green building rating program in the UK).

Design work began in 2006 with construction start in April 2007. The project was completed on time and on budget in September 2008.

Early Issues

Although the project presented numerous complexities that could benefit from BIM, the scope of the project proved daunting for a first foray with the technology, says Eirini Tsianaka, senior architect at RMJM.

"Our computers couldn't handle it," she says. "The whole model collapsed and we realized we couldn't meet the deadline if we continued."

Tsianaka says the company instead chose to design the project in 2D and wait until after the project was completed to create an "as-built" BIM model of the facility. This model includes architectural geometries that can be used for basic facility management tasks, as RMJM was not able to create a fully-coordinated and detailed model after completion.

The team built on its lessons learned at the Waterfront project and moved on to the Phase 2 Academic Building. Although a BIM model would also be required at completion, RMJM chose to find ways to use BIM throughout the project.

"You don't have any benefit from doing an as-built model," she says. "The beauty of using a 3D model is being able to use it for things like coordination and construction drawings. We wanted more from the model."

Architectural models for the first module of University Campus Suffolk Phase 2 were created by RMJM with BIM software.

CONTINUED

University Campus Suffolk

IPSWICH, UK

Additional Resources

Getting the team up to speed on BIM required some up-front resources. Tsianaka says RMJM had to invest in computer upgrades, training of its staff and technical support.

The £45-million Phase 2 includes a six-story academic building, which will be connected by a pedestrian bridge to neighboring student accommodations.

For budgetary reasons, the owner split the 15,000-sq-meter Phase 2 into three "modules" with separate delivery dates for each. RMJM used BIM on all three modules up to RIVA Stage D [detailed proposals], so that the entire project could be used for planning approvals.

The 4,000-sq-meter first module will include an exhibition area, a student union centre, various teaching and administration spaces, learning resource spaces, cafés and a restaurant, laboratories and teaching spaces. The project began in 2009 and will be completed in October 2010.

Tsianaka says that initially, the firm did not use BIM for early conceptual designs, as a high level of detail was not required. After RIVA Stage D, the team developed a full BIM model. Tsianaka says the initial benefit reaped from the model was improved visualization, allowing the team to easily pull a variety of views to share within the team and with the client.

Sharing Information

The design team was also able to share some information to help facilitate coordination. The structural engineer provided a BIM model that was imported into the architectural model for full coordination. Tsianaka says the team was able to identify all possible clashes. The MEP designers were working in 3D, but not in BIM and Tsianaka said that information had to be reentered into the architect's model for coordination.

Although the design team saw some success with collaborative uses of BIM, the construction team did not use BIM so construction drawings were provided in 2D.

Tsianaka says the team was challenged by added the costs and training of its staff on BIM, but that benefits such as improved visualization, clash detection and reduced reentry of data proved valuable.

Future Use

Going forward, Tsianaka says the team can build on its lessons learned to streamline the process, such as determining what level of detail is required and when. However, some challenges will remain. As BIM is early in the adoption curve, Tsianaka says that the number of architects who are proficient in BIM is limited. Since it first started using BIM, some architects it trained have left the firm and other designers or new hires have to be trained to replace them.

Tsianaka says that client demand is the main reason that the company made the switch to BIM, and that factor remains an important business driver. For the first module of Phase 2, the client paid an additional fee to have the project modeled in BIM. However, there has since been a change in leadership on the project and it is uncertain if a BIM model will be required by the client in the future.

"We probably wouldn't have used [BIM] without the request from the client," she says. "We're not sure if the client will insist on it again, but it's good that we went through this process because we expect there to be more clients requesting a proper 3D model in the future." ■

View of the Phase 2 Module 1 model

case study

Value of BIM in Commercial Building

La Bongarde

VILLENEUVE-LA-GARENNE, FRANCE

While building information modeling has quickly gained acceptance on several institutional projects around Europe, commercial developers are also beginning to realize the benefits. At the 250,000-sq-meter €140-million La Bongarde project, a new commercial center being built in Villeneuve-la-Garenne, France, designers are using BIM to quickly and accurately provide ongoing design changes for prospective tenants and help the owner keep a close watch on costs.

© DGLa | Orion Capital Management and Altarea Cogedim

La Bongarde, Centre Commercial de Villeneuve-la-Garenne

Supporting Commercial Building Goals

Marie-Laure Langlois, project manager and BIM manager at the Paris-based architecture firm DGLa, says many of the benefits of BIM align well with the demands of commercial developers. In addition to knowing that data are consistent and accurate, developers must also be able to quickly and consistently track quantities in a model.

"Obviously, when an owner decides to create a [commercial] project, he will want to be sure he gets the right return on investment," she says. "He is basing all calculations on how much he can earn for each square meter."

Enabling Faster Design Modifications

La Bongarde will include 86,000-sq-meters of retail space plus the three levels of parking with 3,000 parking spaces. The project will include one hypermarket as well as 150 shops and restaurants. Langlois says that in a large commercial center like La Bongarde, the interior space can be very dynamic, as tenants lease space and request changes.

"There can be daily modifications on these types of projects as the owner sells internal spaces for shops," she says. "The owner may ask to change sizes or move interior partitions for a tenant. This can be done quickly with BIM."

In fact, Langlois says that, on average, modifications in BIM can be made in half as much time in BIM as in the traditional process.

Expediting Permitting

Although the project is now modeled in BIM, it was originally designed in basic 3D software when work began in 2003. As the project moved to permitting in 2006, it was developed in a BIM model. Langlois says preparing renderings for permits is expedited by using BIM, as the process moves quickly and easily.

Minimizing Staffing Needs

The firm was able to keep staffing on the project to a minimum once it was switched to a building information model. One architect was assigned to the early phases of the model development. Today, six people are working on the project as interior spaces for tenants are

CONTINUED

La Bongarde

VILLENEUVE-LA-GARENNE, FRANCE

La Bongarde, Centre Commercial de Villeneuve-la-Garenne

being determined. Construction is expected to start in the first half of 2011 with completion in the fourth quarter of 2013.

"The fact that there are fewer people working on a large project like this shows how efficient the process is," Langlois says. "We put fewer people on the project so we have a better return on investment. Also the BIM process is faster, so this is good for the owner. It is an advantage for both [the design firm and the owner]."

Improving Marketing and Communications

Architects also regularly create renderings from BIM model to help the owner market the facility to prospective clients.

"[BIM] is important in terms of communication of the project because the designers are able to produce perspectives, like small interior views of the project, which show the scale of the project to the owners and their customers," she says. "Generally these guys, who are more financial people, don't have the ability to understand the space that they are reading on a 2D flat document. It is much better for visualization."

Addressing Complexity

Although other design team members did not use BIM, Langlois says they benefitted from the data and visuals created with the software.

"The volumes of these buildings are quite complex," she says. "For professionals like the structural engineers and the cost estimator to understand the complexity of the geometry, we had to produce 15 sections in each part of the building. We could make them easily and quickly with [BIM]. We would have never tried that before. There would be too much manual work, and it would have taken too much time." ■

Glossary:

Definition of Terms Used

3-D Parametric Modeling:
Model elements not only have the visual aspects of the building aspects they represent but also have the properties of the solids they represent.

4-D Model:
Term used to describe the linkage of a schedule to a model.

5-D Model:
Term used to describe the linkage of cost estimating to a model.

Building Information Model (BIM):
A BIM is a digital representation of physical and functional characteristics of a facility. As such, it serves as a shared resource for information about a facility and forms a reliable basis for decisions during its lifecycle from inception onward. BIM also refers broadly to the creation and use of digital models and related collaborative processes between companies to leverage the value of the models.

Collaboration:
Collaboration means working together cooperatively, as a team. This assumes that all individuals who collaborate have the same goals in relation to the work that needs to be performed. True collaboration requires all of the team members to have a single understanding of these goals so that their efforts can be supportive and complementary of one another.

Construction Budget:
The project owner or client will generally determine the construction budget. It is the task of the project team to deliver a finished project to the owner, maximizing project value within the budget.

Construction Project:
This is synonymous with building project, and it refers to the planning, preparation and construction of a building or other structure.

Field:
The term usually refers to the physical construction site when it is used in a discussion of construction topics.

Integrated Design Process:
Active participation in all stages of design for all disciplines involved in the design, construction and, at times, the operation of the building. An integrated design team usually includes an owner's representative; architect; mechanical, electrical and structural engineers; and construction manager and/or general contractor. It can also include future building occupants, facility managers and maintenance staff, subcontractors for major trades and building product manufacturers.

Integrated Project Delivery:
The delivery of a construction project according to a contract that calls for an integrated design process and that clarifies the legal responsibilities and risks born by all members of the project team.

Definition of Terms Used

CONTINUED

Interoperability:
The ability of data-rich models to share valuable data, either through import or export.

Lean Construction:
The translation and adoption of lean manufacturing principles and practices to the end-to-end design and construction process. Lean construction is concerned with the holistic pursuit of concurrent and continuous improvements in all dimensions of the built and natural environment: design, construction, activation, maintenance, salvaging and recycling. This approach tries to manage and improve construction processes with minimum cost and maximum value by considering customer needs.

Lifecycle Analysis:
A lifecycle refers to the entire life of a project—from the earliest planning until the building's demolition and recycling of materials. The energy consumption and maintenance costs of a project are important aspects of the lifecycle cost.

Prefabrication:
The practice of assembling components of a structure in a factory or other manufacturing site and transporting complete assemblies or subassemblies to the construction site where the structure is to be located. Model-driven prefabrication describes the use of the BIM model to enable prefabrication and assembly of building components both off and on the construction site.

Project Schedule:
The time line for the events related to the project planning and construction. A construction schedule may also address the resources required to accomplish the tasks as well as the dependencies of the tasks to one another.

Project Team:
All the individuals directly involved (on a more than occasional or one-time basis) with the planning and realization of the construction process.

Quantity Takeoff:
The quantity takeoff for a project is the list of materials required to construct that particular project. The BIM model is a very effective means to generate such a list, since the list will automatically update itself with changes made to the model. This information will become the basis for the cost estimate for the project.

Risk:
The chance of injury, damage or loss. Risk is an important consideration in construction projects. Ultimately, the owner of a project will generally assume the majority of the risk for a project. It is, however, in the interest of the project team members to reduce risk to a minimum.

Value Engineering:
Analysis conducted late in the design process or during construction aimed at reducing the cost of construction.

Visualization:
The creation of a clear picture of something in the mind. A 3-D model is a symbolic representation of an object that is to be designed in order to aid in the visualization of that object.

Methodology:

Value of BIM in Europe Study Research

McGraw-Hill Construction conducted the 2010 Business Value of BIM in Europe Study to assess adoption of BIM across the construction industry in France, Germany and the United Kingdom and to gauge the perception of value that firms are receiving by implementing BIM.

The research in this report was conducted through an Internet survey of industry professionals between May 27 and August 13, 2010. The survey had 948 complete responses. The "total" category displayed throughout the report includes 404 architects (43%), 162 engineers (17%), 194 contractors (20%) and 188 other industry respondents (20%)—including owners, planners, building product manufacturers, government agencies, various integrated firms and consultants. A total of 313 responses were collected in France, 177 responses in Germany, and 458 responses in the United Kingdom.

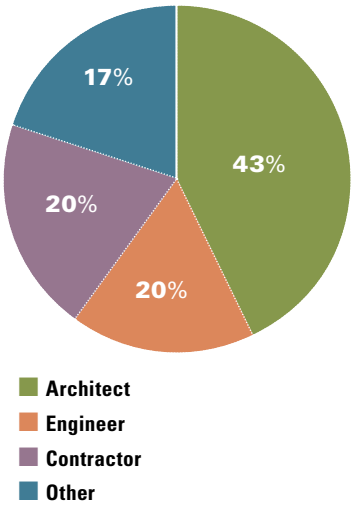
The use of a sample to represent a true population is based on the firm foundation of statistics. The sampling size and technique used in this study conform to accepted industry research standards expected to produce results with a high degree of confidence and low margin of error.

The total sample size (948) used in this survey benchmarks at a 95% confidence interval with a margin of error of +/-3%. For each of the Western European architect, engineer, and contractor respondent groups, the confidence interval is also 95%. The margins of error for architects is +/-5%, for engineers is +/- 8%, and for contractors was +/-7%.

For all three countries, the confidence interval is 95% with a margin of error of +/- 6% in France, +/-7% in Germany, and +/-5% in the United Kingdom. ■

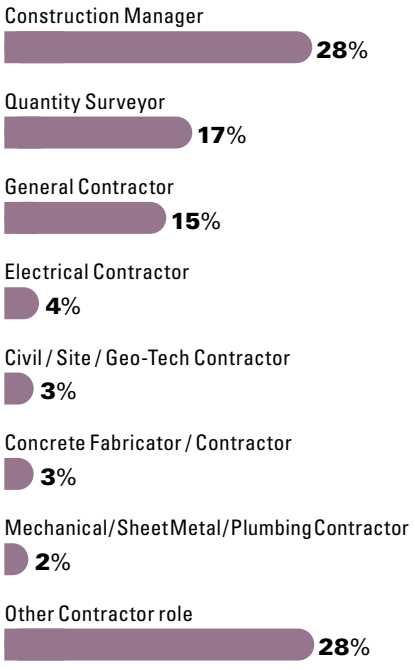
Respondent Profile

Source: McGraw-Hill Construction, 2010



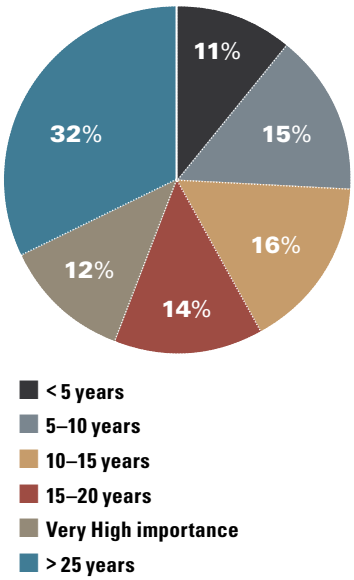
Contractor Profile

Source: McGraw-Hill Construction, 2010.



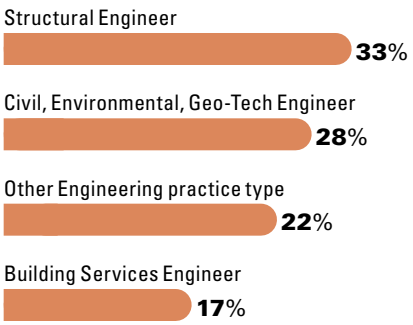
Respondent Industry Experience

Source: McGraw-Hill Construction, 2010



Engineer Profile

Source: McGraw-Hill Construction, 2010.



Resources

Organizations, websites and publications that can help you get smarter about building information modeling in Europe

McGraw Hill CONSTRUCTION

McGraw Hill Construction
Main Website: **construction.com**
Research & Analytics: **construction.com/market_research**
GreenSource: **greensourcemag.com**
Achitectural Record: **archrecord.com**
Engineering News-Record: **enr.com**
Sweets: **sweets.com**
BIM Website: **bim.construction.com**

ACKNOWLEDGEMENTS:

The authors wish to thank our association partners for helping us to translate and disseminate the survey in Europe. Specifically, we would like to thank Frank Faraday, FIEC; Adrian Malleson and Richard Waterhouse, RIBA Enterprises; Adrian Joyce, ACE-CAE; Robert Amor and Robert Owens, CIB; Markus Balkow, BINGK; Robert Jost, BAK; Saleem Akram, CIOB; Martin Powell, ISE; Alan Cripps, RICS; Isabelle Moreau, CNOA; Michael Hall, ACE; Jan Stuck, BAYIKA; and Deke Smith, buildingSMART Alliance North America.

We appreciate Mark Bew from Scott Wilson Group and Jay Bhatt from Autodesk for sharing their expertise with us as well as the contributions of all the interview subjects that talked with our authors. We would also like to thank those individuals that helped us identify case studies, including David Light, Lee Miller and Paul Duggleby from HOK; Marianne Sims from Graphisoft; and Alex Kunz from Gehry Technologies. Also, we would like to thank Roger Flanagan and Carol Jewell of the University of Reading for their help in clarifying the differences between the European and North American construction markets.

Finally, we appreciate the contributions of the team at Autodesk in the United States, Germany, France and the United Kingdom for their support and guidance throughout the project.

buildingSMARTalliance™

Premier Association Partner
buildingSmart Alliance
www.buildingsmartalliance.org

nbs

Premier Association Partner
National Institute of Building Sciences
www.nibs.org

Autodesk®

Premier Corporate Partner
Autodesk
www.autodesk.com/bim

European Associations

Architects Council of Europe: **www.ace-cae.org**
Association for Consultancy and Engineering: **www.acenet.co.uk**
Bayerische Ingenieurekammer Bau: **www.bayika.de**
Bundesarchitektenkammer: **www.bak.de**
Bundesingenieurkammer: **www.bingk.de**
Conseil International du Bâtiment: **www.cibworld.nl**
Conseil National de l'Ordre des Architectes: **www.architectes.org/accueils/cnoa**
European Construction Industry Federation: **www.fiec.org**
Institution of Structural Engineers: **www.istructe.org**
Royal Institution of Chartered Surveyors: **www.rics.org**
The Chartered Institute of Building: **www.ciob.org.uk**

■ Design and Construction Intelligence

SmartMarket Report

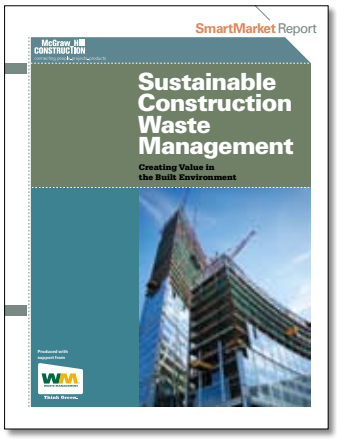
www.construction.com

McGraw-Hill Construction SmartMarket Reports™

Get smart about the latest industry trends.

For more information on these reports and others, visit

www.construction.com/market_research



$189

ISBN: 978-1-934926-27-7

9 781934 926277 90000

The McGraw-Hill Companies