FMI/CMAA EIGHTH ANNUAL SURVEY OF OWNERS

The Perfect Storm — Construction Style

SofO

FMI
Management Consulting • Investment Banking
for the CONSTRUCTION INDUSTRY

Acknowledgements

This *Eighth Annual Survey of Owners* is possible only through the leadership provided by Construction Management Association of America (CMAA). FMI and CMAA would like to thank all owners contributing to the results of this survey. Special thanks go to the owner members of CMAA, Construction Users Roundtable (CURT), Council of Educational Facility Planners International (CEFPI), Construction Owners Association of America (COAA), National Association of Industrial and Office Properties (NAIOP), and Society of American Military Engineers (SAME) for their guidance and participation in this year's survey. In addition, FMI and CMAA would like to thank Derek Moretz, with North Carolina State University's College of Management, for his work developing the survey questionnaire, providing analytical input for the data analysis and overall support of this research.

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EXECUTIVE SUMMARY

The Future.

Imagine a thriving 2025 construction industry where construction costs fall rather than rise each year. In this future, the industry innovates, accelerating productivity gains faster than all other industries, and attracts new, young, and excited recruits, ending the aging workforce crisis. Commodity material costs are mitigated. Owners integrate designers and contractors early into the concept-formation process, using value engineering and constructability techniques routinely. Owners segregate sourcing strategies, using a consistent and logical framework between projects requiring traditional versus collaborative models. Sustainability and green building concepts are incorporated as standard operating procedure, and globalization is embraced for what it is — a tool to achieve efficiency.

"Firms that recognize the market trend towards the integration of new technology…will succeed and become leaders within our industry."

—Large Public Owner

Not possible? Granted this envisioned future is a stretch from where we are today. Yet, FMI and CMAA believe the scenario is possible, and feedback from this *Eighth Annual Survey of Owners* supports this notion and provides the initial inklings of how leading owners will thrive in this future.

Leading owner organizations are striving to meet a set of seven challenges that are established and well known. As these challenges increase in intensity together, they will act as a catalyst, causing unexpected changes in the construction markets and demanding new approaches. Today, in an initial response, leading owners are creating, using, and coordinating digital information to refine project decision-making; integrating designers with construction management (CM) firms and contractors early in the concept phase; producing high-quality construction documents; accurately estimating costs or predicting cost and schedule performance; completing realistic construction planning; and lowering lifecycle costs. A fresh tool — Building Information Modeling (BIM) is enabling and supporting this change in philosophy, process, and approach, which will allow owner organizations, in turn, to weather the coming storm of construction industry challenges.

The future impact of any one challenge can be easily understood with linear projections of construction spending, market forces, and key trend impacts. When several trends accelerate in parallel, the use of linear projections fails to take into account disruptive results and unanticipated consequences that ultimately shape the future. It is just this type of disruption that is nearly impossible to predict but always acts as the catalyst when a marketplace changes direction. Today, a set of seven challenges are

accelerating in parallel and FMI and CMAA believe this will cause the construction markets to change direction. Owner anticipation and effective response will help achieve the described 2025 future that addresses the following challenges:

- Aging infrastructure in nearly every market segment is at or beyond its current useful life. The highway, street, bridge, marine port, airport, inter-modal, rail, K-12 and higher education facilities, water, sewer/waste disposal, electric transmission, and electric/gas distribution markets represent trillions of dollars in necessary spending over the next 10 to 20 years to upgrade and replace these assets.
- An aging workforce within owner design, construction, and operations units, as well as in their construction industry service providers. This skill and experience is standing at the door ready to exit.
- Attraction of Generation Y (born between 1983 and 2000), retention of Generation X (born between 1966 and 1982), and retention of baby boomer staff (born between 1946 and 1964) is a necessary focus of senior management. Yet, the majority of firms do not have strategies in place to respond to these demographic trends.
- Owners' accelerated schedules, demand for global design and construction skills, and use of complex facility aspects, all demand new skills from design and construction firms.
- Use of alternative financing and project delivery systems is requiring design and construction firms to demonstrate competence in financial, accounting, operations and maintenance, and other traditionally tangential skills.
- Increased global competition for resources and assets is realigning the balance of power enjoyed by the United States over the past 60 years toward developing economies.
- Needed investment in training and education to drive attraction, retention, and productivity improvement. Subsequent measurement is also required to demonstrate links between investment and outcomes.

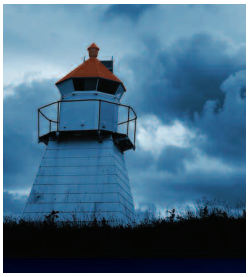
> "It should be possible to have a flexible, customizable system that is in the 'best' interest of the general contractor, subcontractors, design professionals, associated consultants, and the owner equally."
>
> —*Public School System Owner*

The parallel development of these trends will dramatically alter the market we know and understand today. The changes effected by these trends will require adaptation of existing and new approaches, processes, and relationships in order for owners, designers, CM firms, and contractors to thrive.

SURVEY RESPONSE HIGHLIGHTS REVEAL OWNERS ADAPTING TO INDUSTRY DRIVERS

The following survey responses highlight the change in process philosophy and approach that owners are currently undertaking. Many of the responses describe enablers that are transforming the traditional processes used to construct a facility.

- Approximately 35% of all respondents have used BIM processes and technology for one or more years. (The frequency of BIM use compared to total spend is likely much lower and below 5% in FMI's opinion, although owners were not specifically asked this question.)
- Less than 10% of all respondents are attempting to build customized software systems to support the design and construction process; the vast majority of owners — nearly 70% — are purchasing off-the-shelf systems and making little or no modification.
- Owners apply technologies in a way that has limited observable impact, making financial- or productivity-based justifications for their use difficult.
- Nearly 25% of survey respondents do not know how much information technology (IT)- related spending takes place on individual projects to support achieving project objectives.
- Nearly 10% of all respondents make no use of electronic documents throughout the entirety of the design and construction process.
- Survey respondents cite lack of expertise and lack of industry standards as two of the greatest hurdles to collaborative construction processes and BIM adoption.
- Seventy-four percent of respondents who are current BIM users would be likely or very likely to recommend use of BIM systems.
- Respondents identified improved communication and collaboration among project participants as the greatest benefit of BIM. (Also high-ranking were "higher quality project execution and decision-making," "greater assurance of project archival," and "more comprehensive planning and scheduling.")
- Design/build as a construction-execution technique is used by at least 17% of owners on the majority of their capital construction programs. This figure is up from less than 10% in 2005. (Owners rating their approach as blended and highly variable were excluded from this figure.)
- Traditional construction execution using design/bid/build is used by at least 54% of owners on the majority of their capital construction programs, down from almost 66% in 2005. (Owners rating their approach as blended and highly variable were excluded from this figure.)
- At least 79% of all owner capital construction is carried out by hiring a firm or individual to act as general contractor, construction manager, or program manager.
- A maximum of 21% of all owner capital construction is carried out by an owner acting as the construction manager supported only by hiring of trade contractors.



- When asked to list the most important software application used to support performing capital construction, owners responded that Microsoft's Excel was the first choice 16% of the time.
- Users of BIM differ from their counterparts in the following ways:
  - They are much more likely to be private/closely held and much less likely to be municipalities or state or provincial agencies.
  - They are much more likely to construct energy, education, or manufacturing facilities and much less likely to construct transportation, water supply/waste water facilities, or public safety and administrative facilities.
  - They are much more likely to have a construction program with more than 50 projects and much less likely to have a construction program with less than 10 projects.
  - They are much less likely to construct only in a single state, province, or local jurisdiction.
  - They undertake capital construction programs nearly one-third larger than non-users.
  - They are less likely to use design/bid/build as a construction-execution approach and more likely to use collaborative design/build or a highly variable approach, recognizing that different projects and different programs ought to be handled differently.
  - They are much more likely to hire a firm or individual to act as the construction manager or program manager.
  - They are more likely to have as-built drawings, bids or bid documentation, design drawings, and operations and maintenance documentation delivered electronically.
  - They are much more likely to purchase a commercially available system and install as-is or purchase a commercially available system and modify it, rather than develop a customized system in-house.
  - They frequently observe the following on their projects: broader strategic perspective and innovation, improved communication and collaboration among project participants, more consistent performance against project budget, and easier-to-achieve process standardization.
  - They believe lack of experience is the greatest obstacle to BIM use while non-users see lack of executive buy-in as the main challenge.
  - They are much more likely to see the aging workforce and globalization as making the greatest impacts on the construction industry and slightly less likely to see material costs in this way.

SURVEY FOCUS:
Accelerating Owners' Transformation of Construction Management

The FMI/CMAA Owners Survey has become a definitive resource within the industry on construction owners' perspectives. Capital asset owners serve as the bellwether of construction industry trends and movements due to their control of capital spending. Once again, our eighth annual survey of owners offers insights on current industry issues, enhancing observed trends from previous surveys.

Past observed trends include owners' increasing use of program management techniques to better cope with rising material costs, workforce demographics, globalization, and LEED/green building requirements, which was explored in the seventh annual survey. Prior to that, the sixth annual survey investigated owners' call for greater collaboration and communication and detailed specifics on how owners drive this practice forward. This year, our the *Eighth Annual Survey of Owners* is focused on how owners are accelerating the transformation of the construction process through the use of technologies to enable program management, collaboration, and effective communication strategies.

FMI and CMAA asked a wide array of owners about the current processes and enablers used in their construction programs as well as the issues and challenges expected in construction over the next five to 15 years. The following analysis is based on more than 200 international and North American responses.

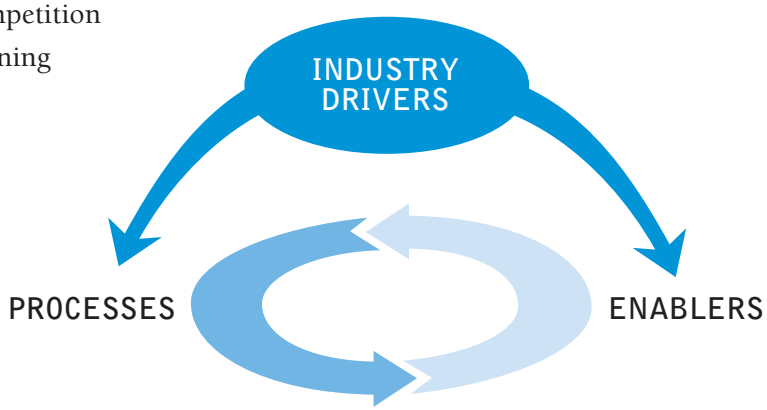
"Many construction-related skills were at one point considered arts. Due to many social issues, cultural priorities have changed and the majority of the individuals replacing these artists simply work for the money. While some may have pride in their performance, most do not put their hearts into it."

INDUSTRY DRIVERS

In Sebastian Junger's book, *The Perfect Storm*, three weather systems collide in the North Atlantic to produce a unique and unexpected event. This disruptive event was not foreseen, making response and survival far more challenging. The construction industry faces a similar situation today.

Seven drivers cited by owners during the eighth annual owner's survey are bearing down on the construction industry. These drivers will produce unique and unexpected results and include:

- Aging infrastructure
- Aging workforce in all aspects of the industry
- Struggle to attract Generation Y, and retain Generation X and baby boomers
- Accelerated schedules, increased globally distributed operations, and increased construction complexity
- Imperative to learn alternative delivery and financing systems
- Pressure to meet increased global competition
- Needed investment in purposeful training



Industry Drivers influence owners' choices of business processes and technology enablers. However, these choices are further influenced by the relationship between the processes and enablers, independent of industry drivers.

These drivers represent long-term trends that are largely uncontrollable by any one owner, and yet, owners must react to these drivers in order to ensure their survival. W. Edwards Deming[1] may have said it best: "It is not necessary to change. Survival is not mandatory." Understanding the underlying drivers impacting the industry is critical to future success.

Owner response is expressed in a) the refining of processes and b) the search for and implementation of enabling technologies. However, the choice of processes and technology enablers is further complicated by the additional influence they have on each other, independent of industry drivers. While this dynamic is challenging to reconcile, it is certainly not insurmountable. This year's survey results indicate that owners are adapting to these challenges.

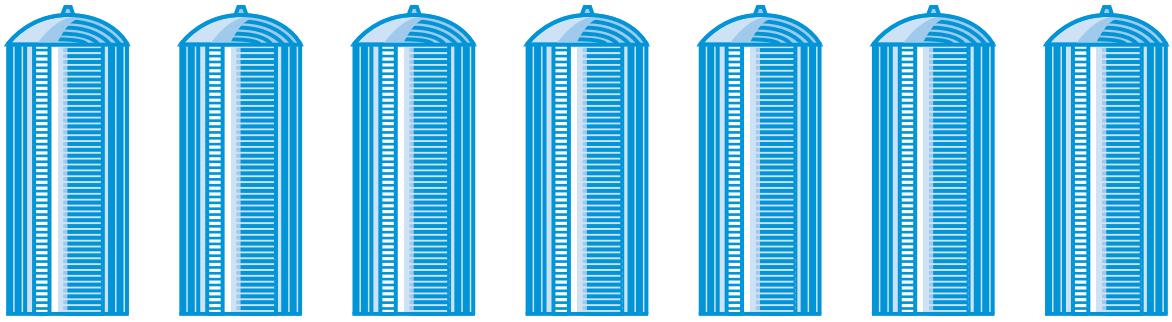
[1] William Edwards Deming (October 14, 1900–December 20, 1993) was an American statistician, college professor, author, lecturer, and consultant. Deming is widely credited with improving production in the United States during World War II, although he is perhaps best known for his work in Japan. There, from 1950 onward, he taught top management how to improve design (and thus service), product quality, testing, and sales (the last through global markets) through various methods, including the application of statistical methods such as analysis of variance (ANOVA) and hypothesis testing. Deming made a significant contribution to Japan becoming renowned for producing innovative high-quality products and becoming an economic power. He is regarded as having had more impact upon Japanese manufacturing and business than any other individual not of Japanese heritage. Despite being considered something of a hero in Japan, he was only beginning to win widespread recognition in the United States at the time of his death.

PROCESSES:
Construction Management

THE PAST.

The shift from the ancient master builder[2] concept to segregation between design and construction functions occurred slowly. In the United States, this shift was predominately a result of 19th century transitions. It was reinforced artificially through legislation and other means that further segregated design and construction functions. The resulting dynamic was a set of self-contained functions, illustrated as silos in **Exhibit 1**.

EXHIBIT 1 **Functional Silos with Minimal Integration**



The silo mentality and artificial separation was reinforced by federal, state, and municipal legislation that required separate contracts for design and construction services. In addition, these services were procured on a separate basis, again reinforcing segregation. Accredited educational institutions reinforced the artificial segregation through separate degree programs in architecture, engineering, construction management etc. Industry associations reinforced the artificial segregation by restricting membership to individuals with specific degrees or certifications, or employment with certain types of firms. The precedent associated with contract laws reinforced the artificial segregation by raising the perception of risk. In this environment, change inched forward.

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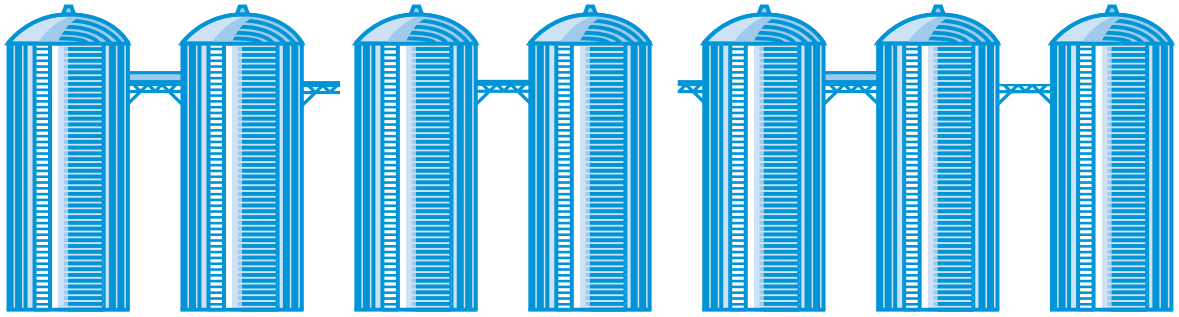
2 The origin of the term is ancient. The word "architecture" comes from Latin describing a master builder. In ancient Mesopotamia, the Code of Hammurabi fixed absolute accountability upon master builders for both design and construction until completion. Architectural documents during this time were typically uncomplicated, using drawing with limited written specifications and verbal instructions. In the 19th century United States, the master builders lost their singular authority on building projects with separate contractual documents and responsibilities segregated between design and construction functions.

THE PRESENT.

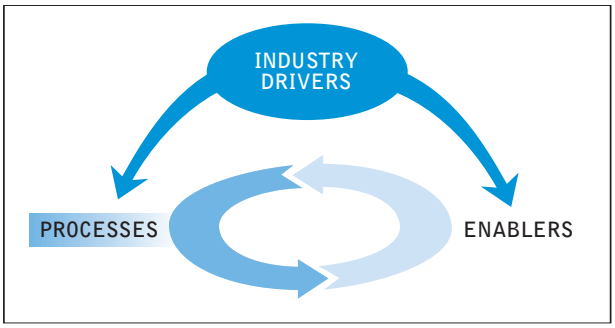
Bridging the gap between functional silos through the use of design/build and program management techniques is occurring. **Exhibit 2** demonstrates the bridging of the functional silos and movement toward more integrated and collaborative business processes is accelerating based upon feedback from this eighth annual owner's survey. Artificial barriers are beginning to fall as state governments approve legislation allowing alternative-delivery-systems use to widen and increase. Leaders of educational institutions are designing joint-degree programs to reflect and respond to industry drivers. Industry associations, like CMAA, are making no distinction between educational experience or employment type, and focusing on recognizing professionalism and accomplishment in the construction industry. Perhaps the best example of this narrowing gap is owner increased use of integrated and collaborative project delivery systems.

EXHIBIT 2 **Functional Silos with Partial Integration**



Project Delivery System Selection

Project delivery system selection is one of the most critical decisions any owner will make since its implications for construction performance are so wide-reaching. Both FMI and CMAA believe there are three tactical factors to consider when determining and evaluating a project delivery approach for architectural/engineering/construction services. The first area to consider is the delivery method that will be used to construct the job, which ranges from design/bid/build to design/build. FMI defines "pure" design/build as any situation where an owner contracts with a single entity or a joint-venture entity for both design and construction management. The second area of consideration is the process used to manage or oversee design and construction activities. Owner options range from acting as the general contractor and managing internal crews or subcontractors directly (multi-prime management) to using a program manager to outsource management of the entire effort. The final tactical question involves how to contract with the service providers. Opportunities range from a public bid-opening, to pre-qualification of a small, select group of firms from which bids are solicited, to a negotiated balancing of risk between the parties.



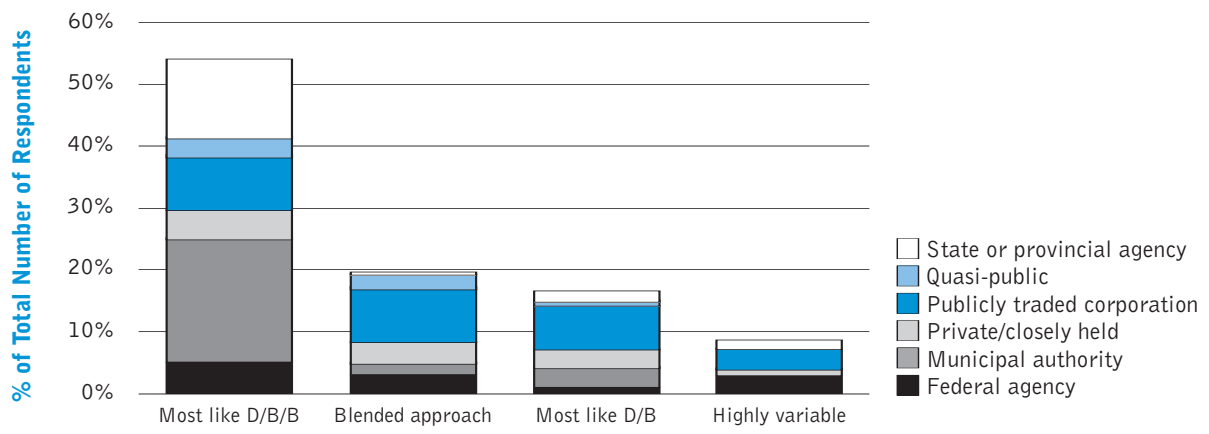
Survey participants responded to three, separate questions:

- On the majority of your capital construction projects, use the 1 to 10 scale provided to portray your approach to construction execution[3] ranging from design/bid/build to design/build.
- Estimate the frequency with which you used the methods or services below to manage the process of construction on individual projects.
    - **a)** Acting as your own construction manager
    - **b)** Hiring a general contractor
    - **c)** Hiring a firm in a CM-at-risk capacity
    - **d)** Hiring a firm in a CM-agency capacity
    - **e)** Hiring a program manager (over multiple projects or entire program).
- Estimate the frequency with which you used these selection methods to procure capital construction services in 2006.
    - **a)** Low bid (provider selected solely based on bid price)
    - **b)** Select bid (pre-qualified firms with selection based upon price)
    - **c)** Negotiated (qualification-based with negotiation of risk placement and final price).

Construction Execution Tactics

Exhibit 3 presents an assessment of owners' method of construction. We grouped ratings of 1 to 3 as "most like design/bid/build." Ratings from 4 to 7, in the middle of the spectrum, were grouped and referred to as "blended" construction methods. Those responses ranging from 8 to 10 were grouped and described as "most like design/build." Another answer option, referred to as "highly variable," was selected by owners not using one approach consistently. Fifty-four percent of owners indicated that they use design/bid/build as the predominant construction method. An additional 20% of owner

EXHIBIT 3 **Construction Execution Approach by Owner Type**



[3] For the purposes of this question, FMI requested respondents rate on a 1 to 10 scale the degree that their projects' approach to construction resembled design/bid/build or design/build. Definitions were provided to set the end-points of the scale and help respondents describe their response. The definitions included the following: "design/bid/build: 100% construction drawings prepared in advance with no expectation for change orders or unforeseen conditions," and "design/build: conceptual or low percentage design drawings with expectation of more detailed design and construction drawings only slightly preceding construction phases."

respondents use a blended approach, while 17% use a design/build approach. Only 9% of owners use a highly variable approach.

In 2005, we asked a similar question that resulted in 66% of the respondents stating they primarily use design/bid/build.[4] In this same survey, owners responded they use design/build less than 10% of the time.[5] This year's findings show an observed shift in owners' selection of various project delivery tactics with greater use of non-traditional approaches.

State and municipal agencies are the most likely to use design/bid/build approaches while publicly traded firms and private firms are the most likely to use design/build. This result was observed also in 2005 when a similar question was asked. It is notable that state and municipal agencies are now using design/build at a slightly higher rate than in 2005, indicating continued loosening of legislation, allowing greater use of alternative delivery systems.

Transportation agencies and organizations, office and professional facility owners, and education owners are the most frequent users of design/bid/build. Interestingly, transportation agencies and organizations, energy firms, and manufacturing firms are the largest users of design/build.

"Less complex, lower commercial/regulatory risk projects are sometimes delivered using a design/build approach. More complex projects are design/bid/build — either with single GC approach or multiple-trade contract packages."

— Large Pharmaceutical Firm

"[Our] project delivery method is highly dependent on project funding. i.e. if design funding is two years before construction, we typically use design/bid/build, but we often attempt design/build or bridging if design and construction are funded closer together."

— Large Public Agency

"Design/bid/build is used primarily on unique facilities. We must give a viable reason if not using design/build."

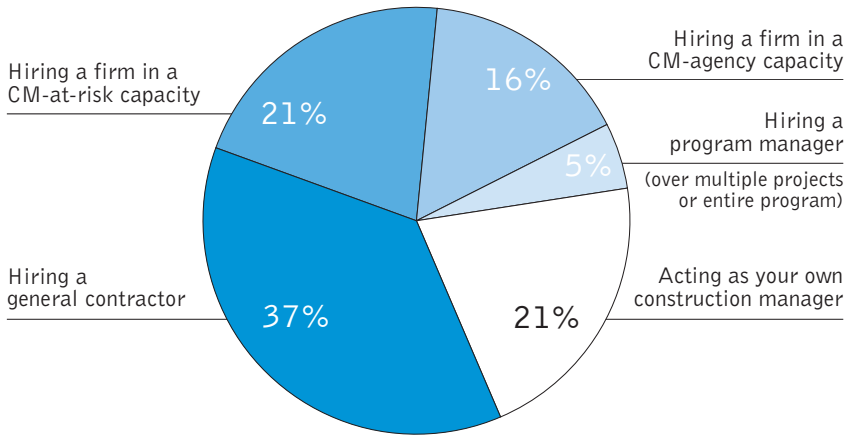
— Large Public Agency

Management Process of Construction Tactics

Owners describing the management process for design and construction indicated the vast majority (79%) are hiring a firm to provide services and support. Twenty-one percent report acting as their own construction manager. Upon further investigation, nearly two-thirds of this figure is made up by four, large owners with highly sophisticated internal staff who are managing the process of construction in this way. The remainder is a large number of firms that happen to perform a small to medium amount of work on their own in this fashion. Thirty-seven percent report hiring a general contractor, which is the most popular selection. This is followed by 21% hiring a construction manager in a CM-at-risk capacity. In 2005, CM-at-risk was selected 19% of the time, indicating an expanded use of this alternative delivery approach.[6] Owners use CM-agency for 16% of their spending and program management for 5%. **(See Exhibit 4)**

[4] FMI Corporation, "*FMI/CMAA Sixth Annual Survey of Owners*", fall 2005, pg. 2.
[5] Ibid. pg. 8.
[6] Ibid. pg. 8.

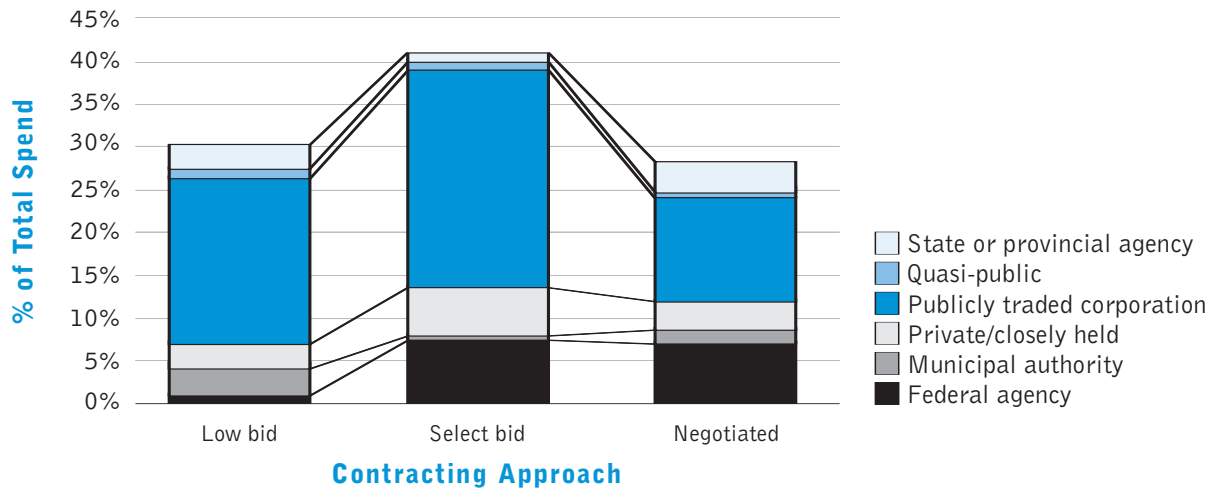
EXHIBIT 4 **Managing Process of Construction by Spending**



Contracting and Pricing Method Tactics

Exhibit 5 details the contracting approaches used most frequently by owners. The results demonstrate that the majority of owner spending is contracted using a select-bid approach (42%). Both CMAA and FMI define this approach as "pre-qualified firms with selection based upon price." The select-bid approach was followed by low-bid (30%) and negotiated (28%) techniques splitting the remaining owner-use nearly equally. Federal owners are using a mixture of select-bid and negotiated contracting predominately. A negotiated approach is defined as "qualification-based with negotiation of risk placement and final price." Municipal owners are primarily using low-bid. Private and closely held owners are primarily using select-bid. Publicly traded owners are the greatest users of negotiated techniques, even though they most frequently use select-bid as a method to contract and determine pricing.

EXHIBIT 5 **Contracting Approach by Spend and Owner Type**

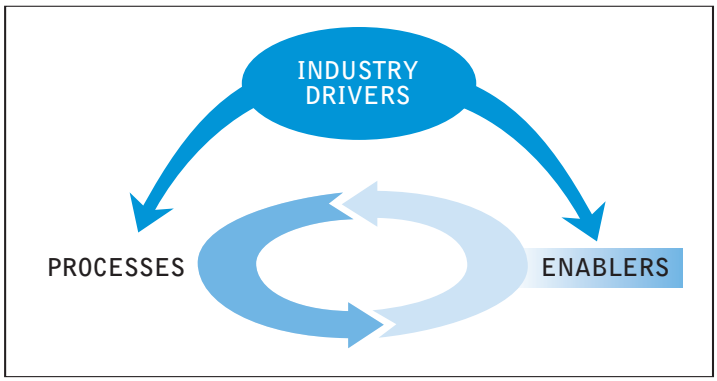


ENABLERS:
Technology

THE PAST.

The construction industry has been responsible for bringing some of the most fantastic innovations and ideas to life. However, the industry has lagged in recognizing and responding to industry drivers. Its embrace of enabling technology, in comparison to other industries, has been much slower. Over the years, silo construction-management approaches, owner's demands for schedule compression, a reduction in the detail and quality of design documents,[7] and an increase in the complexity of structures began to defy the traditional manual methods of monitoring and managing the construction process.

New software tools were applied to automate manual processes, yet innovation in these processes was not frequent or pervasive. At its core, the application of information technology (IT) enabled automation — not management — of the industry's additional complexity.



THE PRESENT.

Today, IT enablers are advancing not only within specialties, but most notably across them to enable the complex multi-faceted communication required for more collaborative construction management processes. What are these tools, and how are owners using them?

We posed a series of questions to better understand the nature and use of enabling technologies. The considerations reviewed include IT spending to support achieving project objectives; requirements for electronic documents used between owners and service providers; and feedback on software solutions considered of highest value and use. As an industry, construction spends among the least on enabling technologies. In its report on IT spending and staffing, the Gartner Group places the construction industry's 2006 IT spend of $11 billion annually at the bottom of all industries with agriculture and mining.

Project Level IT Spending

This year's survey results offer little improvement and indicate a continued lack of investment in IT. Owners are infrequently observing or measuring the impact that technology applications generate. Nearly 25% of owners do not know how much IT spending takes place to support project objectives. The largest segment of owners (44%) indicated their budget for job-related IT spending was only

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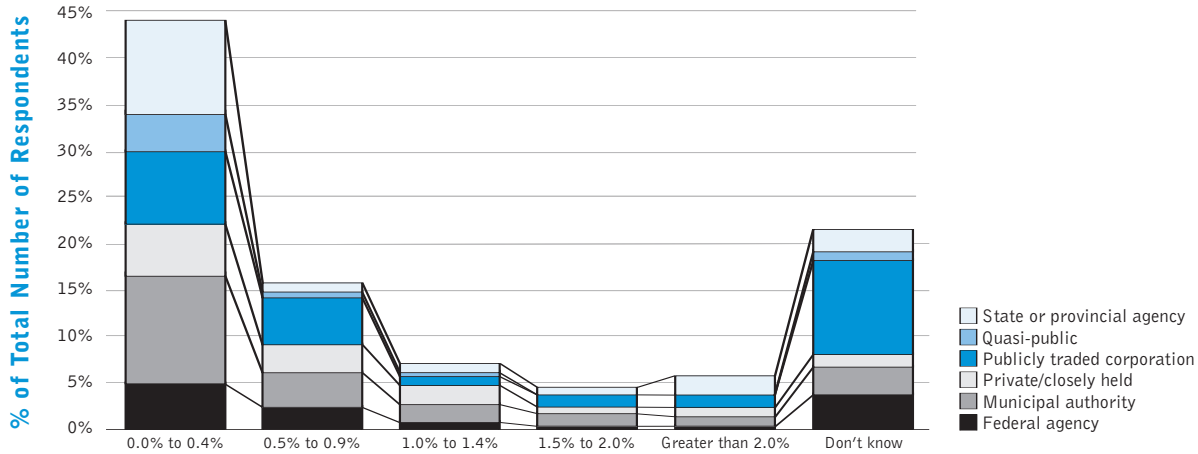
[7] FMI Corporation, "FMI/CMAA Fifth Annual Survey of Owners", Fall 2004, pg. 7.

between 0% and 0.4% of their construction budget. (**See Exhibit 6.**) These responses are understandable, given the fact that owner representatives typically don't have the IT spending data available to make such a correlation. Job-related IT spending may not be visible to owners since it is lumped into project overhead.

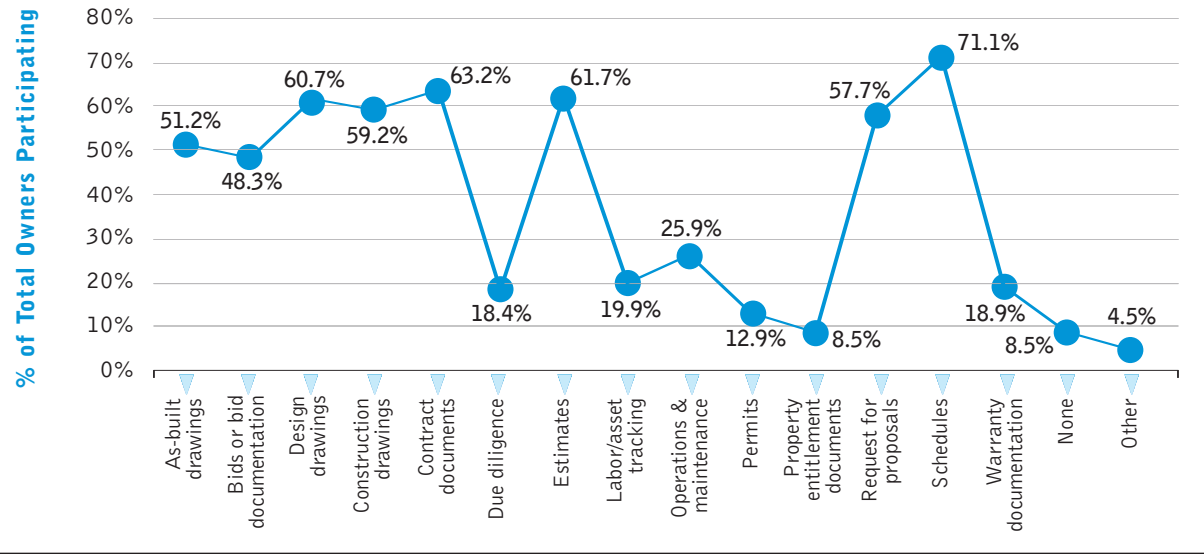
EXHIBIT 6 IT Spend by Owner Type



Electronic Document Use

A lack of knowledge building remains a problem among owners, given that nearly 10% report they make no use of electronic documents throughout the entire construction process. (**See Exhibit 7.**) The electronic documentation demanded most frequently by owners includes schedules, contract documents, estimates, and design drawings. Documents used least frequently in this electronic form are property entitlement documents, permit documentation, labor/asset tracking, warranty documentation, and due diligence.

EXHIBIT 7 Electronic Document Use



Critical Software Tools

Among all the top five responses, owners most frequently cited (29%) applications used to perform project management and scheduling. Twelve percent of owners identified spreadsheet applications as the software they use most frequently. Incidentally, MicroSoft Excel was the number one software mentioned 16% of the time as the most important. Another 7% use applications that enable collaboration. These priorities may be a reflection of the construction management approaches employed. With design/bid/build as a dominating approach, project orchestration becomes the principle way for owners to manage project costs and risk. (**See Exhibit 8.**)

Challenges abound on how best to engage technology. Owners responding to the *Eighth Annual Survey of Owners* reported lack of expertise and lack of industry standards as two of the greatest hurdles to pairing enabling technologies with collaborative construction processes. However, when these hurdles are overcome and the pairing occurs, the benefits described by these owners are significant. Improved communication and collaboration among all project participants becomes routine.

EXHIBIT 8 **Software Function Use Frequency** (top five)

What are the five most important software applications used to perform last year's capital construction projects?	Number of Mentions	% of Total
Project management & scheduling	130	29%
Spreadsheet	52	12%
Design & Drawing	36	8%
Collaboration, communication... General-purpose	32	7%
Financial... General-purpose	30	7%

"Constructors develop models to enhance their coordination practices and product documentation, which are incorporated into a building database and ultimately used and cherished by the building manager in helping to maintain the facility at the lowest possible cost to the owner. In the end, we should see better quality, plus increase[s] in productivity and profitability."

— *Large Public Owner*

The Public Face of BIM

U.S. GENERAL SERVICES ADMINISTRATION'S BIM INITIATIVE

Charles Hardy, AIA, CCM, is a deputy director with GSA's Office of Property Development and is among the agency's BIM champions across the country. In an interview conducted in August 2007, he shared insights into the agency's BIM initiative.

FMI: ***What prompted GSA to pursue BIM?***

Hardy: Efficiency was a key reason. BIM has the potential to provide us with a far more efficient operation, not only as part of design and construction but also in operations and maintenance. Accuracy is another reason. BIM appears to offer greater accuracy than what our current practices produce. We initially established the National 3D-4D BIM Program in the Public Building Services Office of the Chief Architect in 2003. Calvin Kam Ph.D. was selected to serve as our National 3D-4D BIM Program Manager, and he helped drive BIM use in the GSA. In 2006, GSA mandated that all major projects receiving design funding in fiscal year 2007 and beyond were required to use BIM modeling and more specifically, spatial program BIMs. (Spatial program or space planning lay out the interior structure and use of space within a facility.) We have seen the industry move toward integrated practices between owner, contractor, and designer, and our own plans for greater BIM implementation fit this direction.

FMI: ***How do you encourage your suppliers to use BIM?***

Hardy: We educate them and facilitate their buy-in to the process of integrated practice and the use of BIM technology as an enabler. GSA mandates BIM use, but we understand there's a cost and learning curve associated with that and are willing to cover a portion of that learning curve. We evaluate additional compensation on a case-by-case basis. In the end, there has to be a strong business case, focused on ROI and value added, for all parties involved, to commit to BIM use.

FMI: ***What construction execution approaches seems best suited for BIM — for instance design/build, design/bid/build or management techniques like CM-at-risk?***

Hardy: We think all are well-suited to BIM use. I'm not sure there is a best choice at this point. It comes down to the team you've got. Integrated practice and alliance partnerships appear to be ideal structures as all participants play their role at the appropriate times. You need to get the subcontractors on board, but you still need to ensure competition. It can be quite a procurement challenge. Also, it depends on project constraints and requires BIM-savvy participants. In some ways, design/bid/build seems to be the least collaborative of the processes, but it's not prohibitive to BIM use. There are some owners who are required to use design/bid/build, and they can make it work, though it might be a little tougher to do.

FMI: ***Is there a lesson that you can share from your BIM mandate?***

Hardy: Two things in particular come to mind. First, take care not to underestimate the need for broad internal evangelism. When the mandates and processes were coming out at GSA, there were a limited number of folks who understood BIM and virtual design and construction and were strong advocates. We could have done a better job of educating our employees to get internal buy-in. So a good internal education program on BIM is something I would recommend.

The second lesson lies in the value of experience. Try it; experiment with it. Find what fits. Do not force it, but do not back away from its challenges. Find the right mix for your operations. We have learned one size does not fit all. BIM has to be tailored and adapted to your particular projects. At the same time, do not try to "boil the ocean."

I have encountered no one using BIM who has said it is the wrong way to go. I am not sure if BIM is just too young in its adoption cycle or if negative impacts are being kept quiet, but the companies I know implementing BIM are all doing well. Some owners might be concerned about the technology or implementation process risk. We do not see these as insurmountable issues. We continue to document our implementation through pilot projects and are developing metrics around BIM usage and further refining the business case to support implementation.

FMI: *Where can we learn more about GSA's BIM program?*

Hardy: GSA supports a very extensive web site related to our 3D-4D BIM effort. The link for it is:
http://www.gsa.gov/Portal/gsa/ep/channelView.do?pageTypeId=8195&channelPage=%2Fep%2Fchannel%2FgsaOverview.jsp&channelId=-18161

Chuck Hardy can be contacted at charles.hardy@gsa.gov

ABOUT GSA

The U.S. General Services Administration manages more than 1,500 federal buildings. The agency's 2007 budget for construction, acquisition, repair, and alterations was $2.4 billion. In November 2006, the General Services Administration mandated new buildings designed through its Public Buildings Service use building information modeling in the design stage.

BIM USE & PRACTICE[8]

Much confusion and inconsistency still surrounds BIM. The Associated General Contractors (AGC) and the National BIM Standards (NBIMS) are two organizations that offer different definitions. For the purposes of this study, FMI worked with CMAA's Emerging Technology committee to develop a preferred definition that includes both technology and process aspects.

> ***Building Information Modeling (BIM)*** *refers to the creation and coordinated use of a collection of digital information about a building project. The information can include cost, schedule, fabrication, maintenance, energy, and 3D models. The information is used for design decision-making, production of high-quality construction documents, predicting performance, cost estimating, and construction planning, and eventually, for managing and operating the facility.*

In trying to understand the use of this enabling process and technology, we focused on understanding the business cases for an owner to adopt it, including the point at which an owner first decided to use BIM, the source of introduction to BIM, their willingness to recommend BIM use to other owners, and their perspectives on observed benefits and hurdles.

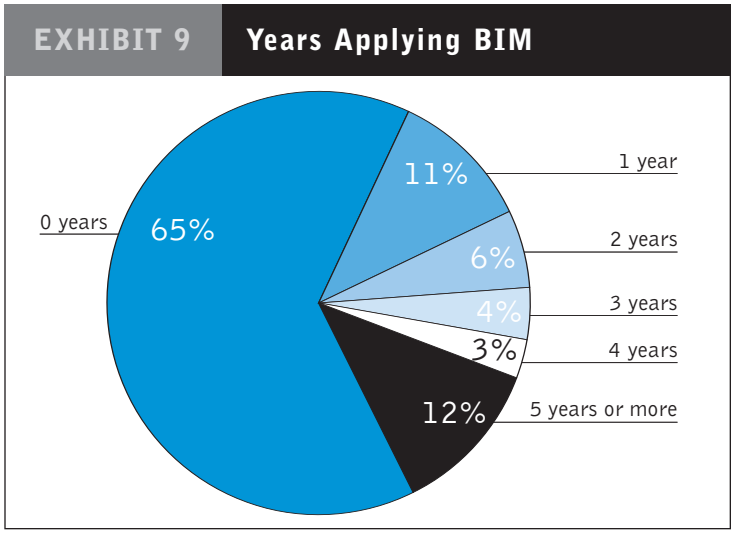
"[A benefit of BIM is the] ability for non-technical owner representatives to understand the project and the effect of their decisions"

— *Airport Authority*

BIM Experience

Thirty-five percent of all owners responding to the survey have used BIM processes and technology on one or more projects. The frequency of BIM use compared to total spend is likely much lower and likely below 5% in FMI's opinion, although owners were not specifically asked this question. What, when, and how are these owners applying this technology is of critical importance to others that may consider use of its techniques. The number of new users annually has trended up from 3% in 2003, 4% in 2004, 6% in 2005, and 11% in 2006. (**See Exhibit 9.**)

EXHIBIT 9 **Years Applying BIM**



[8] Readers looking for additional feedback and a more comprehensive treatment of BIM use and impact to the design and construction industry can review the following study: Hoover, Sabine, and Schubert, Nick, "BIM Changes the Culture of Design and Construction," *FMI Quarterly 2007*, Issue 4, Raleigh, NC, pg 104-115.

The Private Face of BIM

CRATE AND BARREL

John Moebes, AIA, with Crate and Barrel since 1998 and Director of Construction since 2006, is leading a program charged with commissioning 11 new stores annually in the United States and Canada. The use of BIM is among the key techniques relied upon to successfully complete this program on time and on budget. Moebes offered his perspectives on five years of BIM use in an August 2007 interview.

FMI: ***What was the tipping point that drove Crate and Barrel to investigate the use of BIM?***

Moebes: When 2002 brought a 34% increase in the price of recycled steel, we had to step up to meet and overcome this new force affecting our bottom line. Traditional construction industry responses proved inadequate — I could not secure cheaper labor, cheaper materials, and I could not find less expensive land. I turned to a process refinement effort enabled by technology, and BIM in particular, to produce bottom-line impact by streamlining our design and construction efforts. We have successfully increased labor productivity, thereby lowering its net cost, changed or reduced the amount of materials used and wasted on a job site to lower their net cost, and modeled construction costs more accurately to the point that some of the more expensive site options available became financially viable.

FMI: ***What has changed today for Crate and Barrel relative to the use of BIM?***

Moebes: Today, Crate and Barrel's capital program is more intense than ever. At the same time, my operation is successfully delivering capital facilities with fewer staff. Measurable efficiencies originate from lessons learned; my team is using BIM to learn from mistakes in order to prevent repeating them. The models are continually updated to reflect project-related adjustments and improvements in real-time, contributed by the entire Crate and Barrel construction community — construction managers, subcontractors, suppliers etc. We reuse accumulated intelligence to build a more reliable forecasting, design, and building process that moves at our store-opening speed. Our team is so committed to the use of this tool that long-time suppliers who were not or could not get onboard and demonstrate their readiness to use BIM were replaced in favor of new allies.

FMI: ***What are the practical aspects of using BIM in your fast-paced and hectic environment?***

Moebes: Though enthusiastic about BIM, my team and I are pragmatic about when to apply it in capital project management. We learned two lessons that we encourage anyone getting started with BIM to take to heart. First, think in terms of crawling before you walk and walking before you run. But do expect to run eventually. Second, recognize that having BIM capabilities does not eliminate the need for you to judge the right tool for the job. Don't leap to the conclusion that BIM techniques are always the best answer for every project or every aspect of construction.

FMI: ***Any final thoughts for owners who might consider the use of BIM?***

Moebes: I would say that expectation-setting is an important success factor for organizations undertaking BIM processes and technologies. BIM is in a growth mode. Capabilities of the technology and communities of practice are still expanding and maturing.

John Moebes can be contacted at jmoebes@crateandbarrel.com

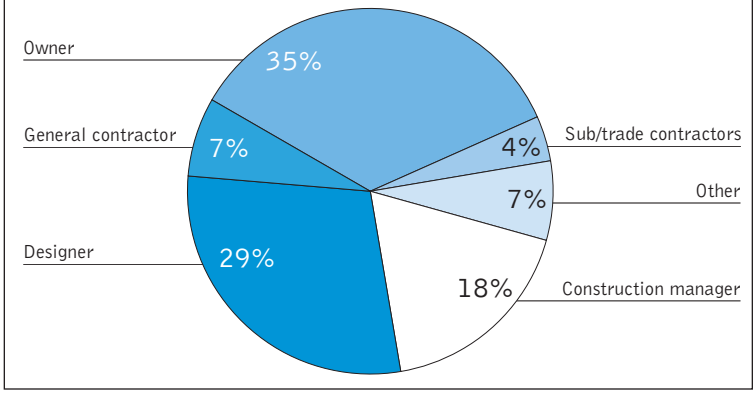
ABOUT CRATE & BARREL

The Crate and Barrel family has grown to 150 stores and more than 7,000 associates nationwide and is still growing. While the company is proud of its growth and achievements, it attributes the company's fresh and invigorated vision and product to the 3Ps: its people, product, and presentation.

Path to BIM

Owner organizations using BIM came to it from several routes, the most frequent of which was their own investigation (35% of the time). Designers and construction managers are the second and third most frequent source. (**See Exhibit 10.**)

EXHIBIT 10 Who Recommends BIM to Owners?



Willingness to Recommend BIM

Seventy-four percent of BIM users are likely or extremely likely to recommend BIM to other owners. Only 11% said they would not likely recommend BIM use.
(**See Exhibit 11.**)

EXHIBIT 11 Willingness to Recommend BIM

How likely are you to recommend the use of BIM solutions to others who have the same types of projects as you?	BIM Users
Extremely Likely	**53%**
Likely	**21%**
Neutral	**14%**
Unlikely	**7%**
Not at all likely	**4%**

BIM Benefits and Hurdles

Rating and ranking of benefits and hurdles associated with BIM use is critical to understanding perceptions that stand in the way of its adoption as well as the development of business cases to speed integration and widespread use. Tying the benefits to measurable and observable results is critical to allow the next group of adopters to justify catching the wave. Owners identified several key benefits. (**See Exhibit 12.**) Segregating non-BIM users from BIM users results in only a slightly different ranking of these benefits. We believe this stems from these organizations reading the same material — and buying into the logical concepts describing how BIM use can drive process and performance improvement in the face of a disruptive and changing industry. The scoring of these benefits is much higher by BIM users, indicating they are more certain they are receiving or will receive these benefits. Highest ranked by both groups is improved communication followed by higher quality project execution and decision-making. Only two benefits showed any significant difference in ranking: greater productivity from labor and assets ranked seventh by non-users and 10th by users. Broader strategic perspective and innovation was ranked 13th by non-users and eighth by users, with a significant scoring differential.

Hurdles identified by respondents reflect a largely similar ranking by non-users and users. A lack of executive buy-in is ranked as a more significant hurdle by non-users, whereas BIM users place a higher ranking on hurdles that arise from different needs across different stakeholders. The scoring of all hurdles is much lower by BIM users, indicating they are much more confident they can or will be overcome. Both groups view security risks and legal/contractual concerns as only limited hurdles. (**See Exhibit 13.**)

EXHIBIT 12 BIM Benefits

Rate benefits that BIM solutions provide on capital construction projects (Scale: 1=strongly disagree; 5=strongly agree)	**All Responses**		**Non-BIM Users**		**BIM Users**	
	Score	Rank	Score	Rank	Score	Rank
Improved Communication and Collaboration Among Project Participants	4.22	**1**	4.02	**1**	4.42	**1**
Higher Quality Project Execution and Decision-Making	4.09	**2**	3.97	**2**	4.19	**2**
Greater Assurance of Project Archival	3.98	**3**	3.87	**3**	4.08	**4**
More Comprehensive Planning and Scheduling	3.97	**4**	3.83	**4**	4.09	**3**
Higher Quality Construction Results	3.90	**5**	3.79	**5**	4.00	**6**
Easier to Achieve Process Standardization	3.89	**6**	3.71	**6**	4.06	**5**
More Reliable Compliance with Specification and Regulations	3.73	**7**	3.60	**8**	3.85	**7**
Greater Productivity from Labor and Assets	3.71	**8**	3.62	**7**	3.79	**10**
More Consistent Performance Against Project Budget	3.68	**9**	3.47	**10**	3.84	**9**
Significantly Reduced Change Orders/Claims	3.64	**10**	3.56	**9**	3.71	**11**
Broader Strategic Perspective and Innovation	3.63	**11**	3.38	**13**	3.85	**8**
Decreased Labor Costs	3.52	**12**	3.41	**12**	3.62	**12**
Measurably Reduced Contingencies	3.49	**13**	3.44	**11**	3.52	**13**
Improved Safety Performance	3.27	**14**	3.22	**14**	3.32	**14**
Competitive Advantage in Recruiting and Staffing	3.21	**15**	3.13	**15**	3.27	**15**

EXHIBIT 13 BIM Hurdles

Rate hurdles that slow or prevent adoption of BIM solutions on capital construction projects (Scale: 1=strongly disagree; 5=strongly agree)	**All Responses**		**Non-BIM Users**		**BIM Users**	
	Score	Rank	Score	Rank	Score	Rank
Lack of Expertise	4.09	**1**	4.29	**1**	3.82	**1**
Greater System Complexity	3.92	**2**	4.01	**3**	3.81	**2**
Lack of Industry Standards	3.92	**3**	4.07	**2**	3.74	**3**
Poor Integration with Existing Systems	3.79	**4**	3.91	**4**	3.67	**4**
Different Needs Across Stakeholders	3.72	**5**	3.79	**8**	3.63	**5**
Training Burden	3.66	**6**	3.82	**6**	3.46	**6**
Unclear Business Value and ROI	3.62	**7**	3.82	**7**	3.38	**7**
Lack of Executive Buy-in	3.57	**8**	3.88	**5**	3.20	**8**
Vague Cost Estimates	3.32	**9**	3.43	**10**	3.20	**9**
Legal / Contractual Concerns	3.23	**10**	3.43	**9**	3.02	**10**
Security Risks	3.03	**11**	3.20	**11**	2.84	**11**

BIM Resources and Contacts

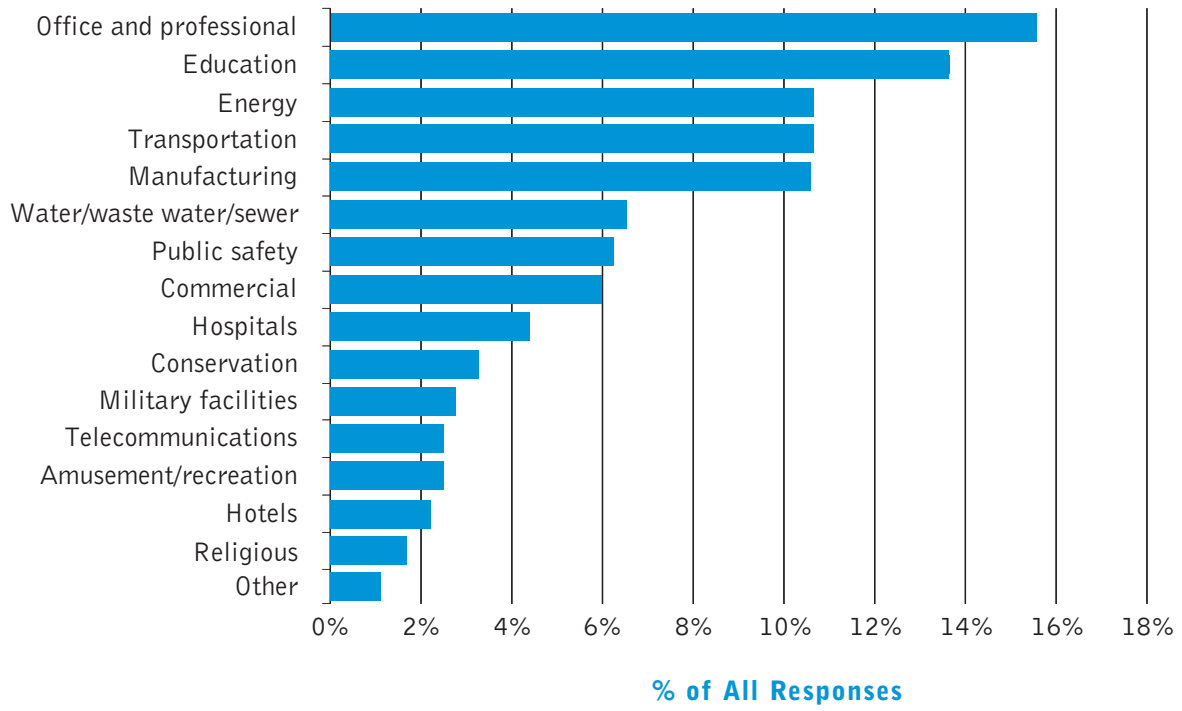
Additional resources and research on the use and practices associated with BIM can be found in the following locations:

- **American Institute of Architects (AIA)** (www.aia.org)
- **Construction Management Association of America (CMAA)** (www.cmaanet.org)
- **National BIM Standards (NBIMS)** is a subcommittee of the National Institute for Building Sciences (NIBS) Facility Information Council (FIC) (www.facilityinformationcouncil.org/bim/index.php)
- **Stanford University, Center for Integrated Facility Engineering**, (www.stanford.edu/group/CIFE)
- **The Associated General Contractors of America (AGC).** *The Contractors Guide To BIM*. Edition 1, 2006. (www.agc.org)

SURVEY DEMOGRAPHICS

The 200 responses to the *Eighth Annual Survey of Owners* came from owners representing a wide variety of size, construction type, and industry segments. Office and professional buildings represented the largest construction type with 14.5% of respondents. (**See Exhibit 14.**) Education (13.4%), energy (10.7%), transportation (10.4%), and manufacturing (10.4%) rounded out the top five industry sectors served. Thirty percent of the owner respondents build in at least two segments with several universities constructing in nine or more of these segments. These owners are essentially self-contained cities requiring all types of construction. The segregation of owner spending in **Exhibit 14** is roughly in proportion with 2008 non-residential spending in FMI's *2007 U.S. Markets Construction Overview*.

EXHIBIT 14 **Owner Response by Industry Sector**



All types of owners participated, including publicly traded stock corporations (28%), municipalities (23%), and state or provincial agencies (17%), making up the majority of respondents by owner type. (**See Exhibit 15.**)

EXHIBIT 15 Survey Respondents by Owner Type

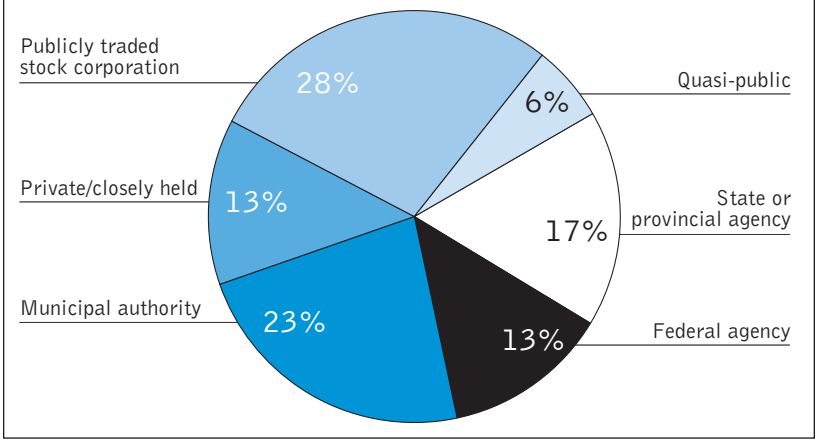
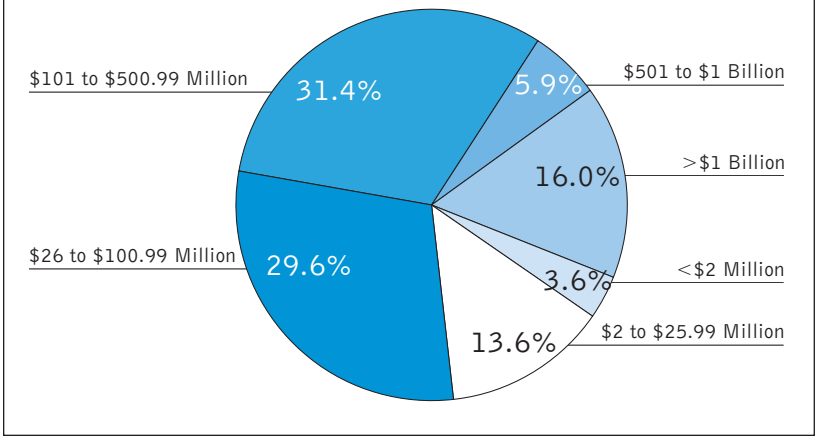


EXHIBIT 16 Annual Construction Capital Spending

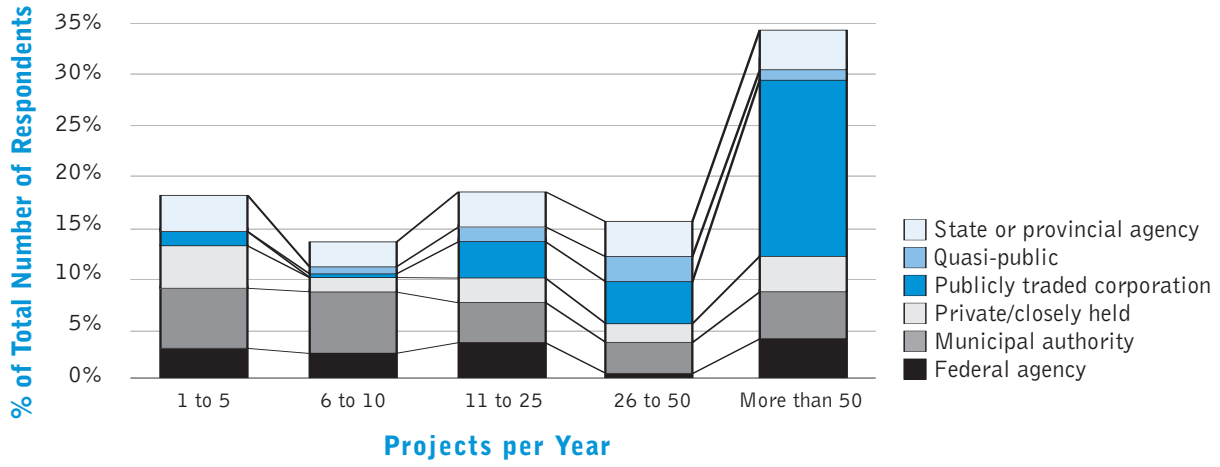


Some of the largest owners in the world responded with total capital spending of $115 billion around the globe. Twenty-seven owners reported capital construction programs over $1 billion, with the largest single construction program reported at nearly $9 billion. The U.S.-specific spending represents nearly 10% of the $600 billion in non-residential construction taking place annually in the United States. The remaining $65 billion is spread throughout the globe. Fifty-three percent of survey respondents reported capital budgets in excess of $100 million with the remainder of owner respondents spending smaller amounts. (**See Exhibit 16.**)

Activity level as measured by the number of projects per year demonstrates that more than 35% of all owners surveyed complete more than 50 projects annually. Fifteen percent undertook 25 to 50 projects, and the remaining 50% of firms completed fewer than 25. (**See Exhibit 17.**)

Publicly traded corporations dominated the category consisting of owners completing more than 50 projects annually. Private and closely held businesses tended either to have very small or very large work programs. Municipal authorities tended to have the smallest programs of all the owner types. Educational institutions, energy firms, manufacturing firms, and office and professional firms dominated the "more than 50 projects" group. Interestingly, the "1 to 5 projects" group was also dominated by the office and professional, and education groups. Other major contributors to the 1 to 5 project group included transportation and commercial.

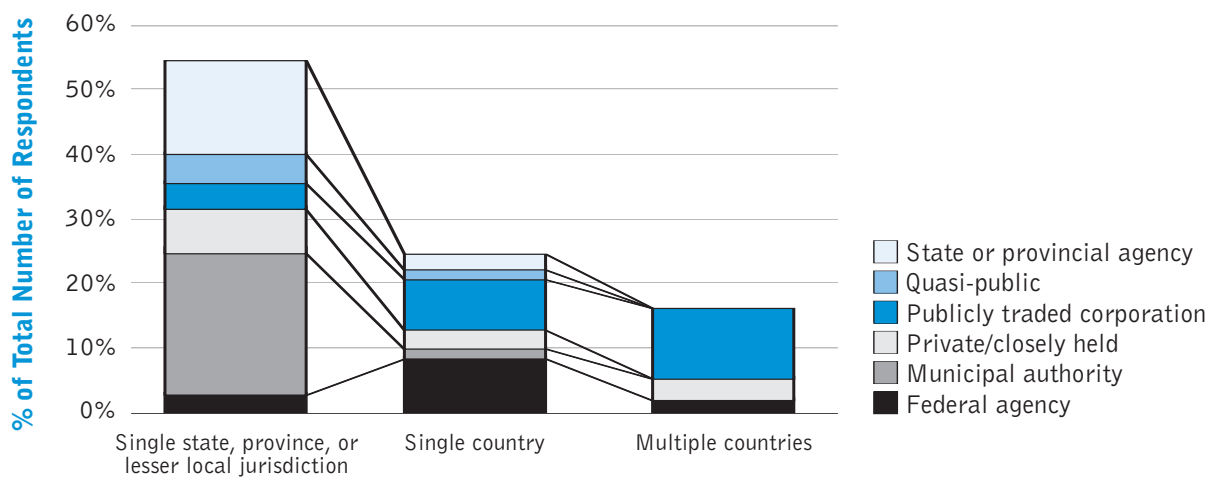
EXHIBIT 17 **Number of Projects Constructed Annually, by Owner Type**



"Escalating construction costs will increase pressure to drive out waste and inefficiency. Many capital investment opportunities will be compromised or lost because efficient design and delivery systems and methods have not become mainstream."

Geographically, the majority of owners responding to the survey were involved in projects in a single state, province, or local jurisdiction (55%), or a single country (25%). A significant number of owners produced projects dispersed over multiple countries (20%), reinforcing the global nature of the response to the survey. Privately held organizations reported strong participation in both single regions and globally, indicating that meeting their business objectives takes precedence over any fears about performing work globally. Publicly traded firms — that tend to be the largest and exhibit the greatest ability to manage global risk — dominated the types of firms working globally. (**See Exhibit 18.**)

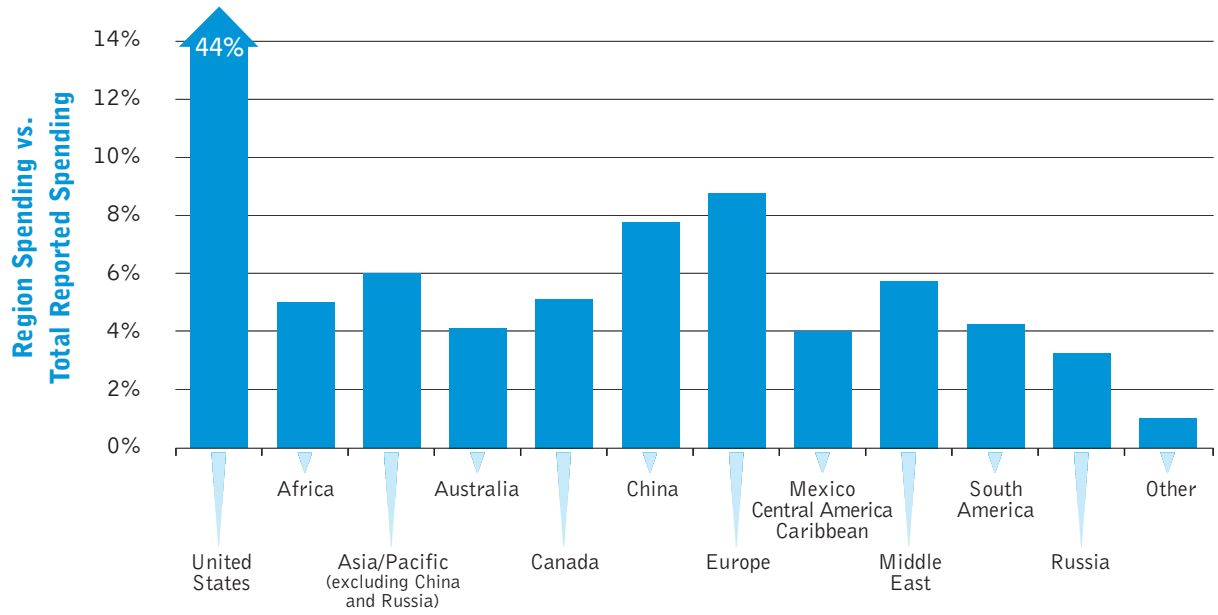
EXHIBIT 18 Owner Work Locations, by Owner Type



"The most dangerous issues we face are those that have the potential to erode our core ability to perform. These include the lack of qualified engineers, experienced managers, and skilled labor. As an industry, we must switch our fundamental approach to talent acquisition from buying talent to building talent."

FMI and CMAA asked survey respondents to estimate more specifically the location of their global spending. Nearly half of the $115 billion in spending reported by participants is taking place in the United States with the remainder spread around the globe. Participants reported the highest figures in Europe and China with the remainder in Asia/Pacific following closely. (**See Exhibit 19.**)

EXHIBIT 19 **Worldwide Capital Construction Spending, by Region**



CONCLUDING THOUGHTS

The seven trends described in this FMI/CMAA *Eighth Annual Survey of Owners* are gaining speed and on course to brew the "perfect storm" for the construction industry. Made up by the seven winds of change — aging infrastructure; aging workforce; attraction and retention struggles; accelerated schedules, globally distributed operations, and construction complexity; alternative delivery and financing systems; increased global competition; needed training investment — the perfect storm will seek out vulnerable owners.

Owners preparing now for this impending storm represent our industry's innovators. They are refining necessary processes and tools. Enabling processes and technologies like BIM represent a major tool these owners will use to survive and thrive. Other tools these leading owners are using to lay the foundation for innovation include:

- Applying alternative project delivery systems
- Using construction and program managers to augment their experience and expertise
- Relying on electronic documentation through all construction phases to drive efficiency
- Observing broader strategic perspective and innovation on their projects
- Improving communication and collaboration among project participants
- Meeting or beating project budgets consistently
- Achieving faster and easier process standardization

Together, these methods will support a needed change in philosophy, process, and approach, and enable innovators to turn the tide of the impending storm from their construction area. We will likely see a wide range of responses to the identified industry challenges. While our industry's innovators will be defined by their propensity for risk and knowledge of new processes, others will fall behind.

The storm is coming. Will we heed the call and change direction, or sail into the storm unaware?

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ABOUT FMI

Founded in 1953 by Dr. Emol A. Fails, FMI provides management consulting and investment banking for the worldwide building and construction industry.

FMI delivers innovative, customized solutions to facility owners; contractors; construction materials producers; manufacturers and suppliers of building materials and construction equipment; property managers and developers; engineers and architects; surety companies; and industry trade associations.

FMI's experienced professionals assist owners with the development of sourcing strategy, assessing design and construction unit perfor¬mance and support for management skill development. Services provided to other construction industry businesses include strategic planning, leader and organizational development, business development, research, mergers and acquisitions, peer groups, private equity placement, project execution, and training.

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