

# **Quarterly**

2007 ISSUE 4

## TECH TIME

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# This Quarter: Tech Time

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## Dear Reader:

We hope that your year has been a great one and that *FMI Quarterly* has been helpful in achieving those results. It is hard to believe that this is the 25th issue of *FMI Quarterly*, but we plan to be around for a few hundred more so perhaps this is no big deal.

The articles this issue focus on *Technology*. While technology stimulates some of us, it has the ability to outperform Thanksgiving turkey in putting others to sleep. But I don't think you will get the turkey effect from the writers in this issue. Give a few of the many articles in this issue close attention, and I think you will be hooked into reading the rest.

Gayle Sheppard, a long-time friend, has perspective on a new type of software that will quickly capture the imagination of early adopters. Glenn Matteson has rejoined FMI after a 10-year absence. Not only are we happy to have his equipment management experience back in our skill set, we're also happy to have his well-written article on technology impacting field productivity and management. Christian Burger, a former FMI team member, contributes "Software Systems and the Construction Organization," which explores how companies can get more value from their IT investment by changing the way IT is managed within their organization. New to FMI and new to *FMI Quarterly* is Marisé Mikulis. She teams up with Kathryn Robinson to offer an article on reconsidering IT assumptions in order to accelerate its benefits within the construction organization. From our Denver, Colo., office, contributors Sabine Hoover and Nick Schubert provide a thoughtful piece on Building Information Modeling and its ability to push the industry forward. Also from Denver, Ken Roper and Layne Newton pen a piece for us on Intelligent Buildings and related market opportunities for contractors.

Tampa-based, regular contributor Gregg Schoppman delves into the people side of technology, illustrating how contractors can benefit from successful implementation and training.

Also in this issue, we include our leadership team of Vanessa Winzenburg, Tim Tokarczyk, and Willie Hepworth's feature article on trust and its ability to connect people and organizations. Mark Bridgers and Kathryn Robinson collaborate to give us, "Practice Makes Perfect: Best Practices Between Utility Owners and Contractors." Kelley Chisholm provides her annual review of FMI's 2007 *U.S. Construction Industry Talent Development Report* in "Reach for the Stars." Finally, Stuart Phoenix details a number of changes for baby boomers that are making ownership transition more complex.

Some of you are aware of my change in status. For those who aren't, I am following Doc Fails' lead in curtailing much of my travel and client work conjunctive with my 65th birthday. It has been an incredible 39-year experience with a terrific group of clients and FMI associates. For better or worse, however, I will still be at the helm of *FMI Quarterly* for as long as it works for FMI and me. I continue to be fascinated by this great industry of construction, and my editorial role is one way of keeping my hand in the game.

Let us know of topics in which you have keen interest or would like to contribute. We will be dealing with capital innovation, environmental stewardship, globalization, and change management during 2008.

Sincerely,

A handwritten signature in black ink, appearing to read "Jerry Jackson", with a large, stylized loop at the beginning.

Jerry Jackson  
*FMI Quarterly* Publisher and Senior Editor

# Departments

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## LEADER AND ORGANIZATIONAL DEVELOPMENT

### Plus/Delta Feedback: A Powerful Tool for Developing People

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Remember the first time you heard your voice on tape? If you are like most people, you were surprised to hear how you sounded. It is often a shock to learn that how we come across to others is not what we thought. Derek, a senior project executive for a prominent construction-management firm, discovered the power of feedback firsthand when he participated in a 360-degree feedback assessment as part of a leader-development program. He was pleasantly surprised to learn that he had gained the highest respect from his co-workers in his technical knowledge, business savvy, and ability to deliver on established goals. He also learned that his style of relating to others had room for improvement. His hard-driving, type “A” personality pushed others away, and he was viewed as arrogant, critical, and resistant to change. He realized that if he wanted to take on more leadership responsibilities within the organization, he would need to grow in his ability to connect with and influence others.

Receiving feedback can be hard to hear, especially if you aren’t used to it. At FMI, we often ask the construction leaders we work with, “How many of you receive too much positive feedback at work?” “How about on areas you can improve?” No one ever answers affirmatively to these questions. It seems many of us are not used to receiving or giving feedback. What about you? What about the people you lead? How would they answer these same questions?

Productivity studies have shown that feedback (positive and constructive) is a key ingredient in improving performance. It is also a powerful motivator for people. In environments where feedback is rare, people are operating in the dark, almost as if they were blindfolded. Many of us have experienced that at some point in our careers — that is, where either the person or the willingness was not there to give us guidance, teaching, and direction. While we may be able to make it through that experience, that’s not the kind of workplace where we perform our best, and it is definitely not the fastest way to learn. Giving feedback is how leaders can turn on the lights for their people and remove the blinders.

Positive feedback remains one of the simplest, cheapest, and most effective ways to reward and motivate people. Saying “thanks” and recognizing efforts goes a long way toward letting people know they are appreciated. Even more important is being specific about what people have done well. Without specific

feedback about what we are doing that is working, we only hit the goal by accident, and we cannot repeat the performance with any predictability. This is what we call “plus” feedback: letting people know, specifically, what behaviors will help them reach the goal. “Plus” feedback (knowing what to continue or do more of) is just as useful as feedback about behaviors that cause the person to miss the goal (things to stop doing).

The other type of feedback involves how to improve performance. What is getting in the way of hitting the goal? We all need to know how we can perform even better, and in this time of

increasing competition, a person or a company that does not know where to improve will fail to learn and will quickly be left behind. We call this “delta” feedback, from the Greek symbol for change. Feedback, whether about behaviors to change or things to continue doing, is essential for any person or company that wants to grow, learn, and succeed. If we assume most people are doing the best they can, then the only way they can improve is to change something based on feedback. Remember the

feedback that Derek received about being critical and resistant to change? With a little coaching, he learned to solicit ideas from others on his team, thank them for those ideas, and to take the time to think through how those ideas might affect the operations of his organization, rather than discouraging innovation by immediately analyzing an idea and explaining why they would not work. Not only did he reap the benefits of having his co-workers begin to see him as more open to change, but he also discovered that they had a lot of useful ideas.

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**We all need to be  
recognized for what  
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#### **BALANCED FEEDBACK**

Feedback that is always “delta” becomes discouraging and unproductive. We all need to be recognized for what we do well and to learn how we can improve. At the other extreme, if we only receive “plus” feedback, we will never learn how

to improve. Furthermore, if the “plus” feedback we receive is shallow or just “warm fuzzies,” it does not really improve performance or motivate people.

If our message is going to resonate with the person receiving the feedback, we need to make sure we are specific about what we observe and the impact that the words or behaviors are having. Mark, a senior vice president at a large construction management firm

gave his boss, Erik, specific feedback after observing a pattern of behavior. “Erik, I think you could be even more effective in our management meetings if you leaned forward in your chair and communicated interest by sharing your ideas and asking questions. Although I’m sure this is not the impact you are intending, leaning back in your chair and remaining silent can be

interpreted as being disinterested in the conversation.” Mark’s feedback is specific, behaviorally focused, and informs Erik on how others interpret his actions.

### APPLICATION

Think about yourself as a leader.

- Do you give enough “plus” feedback?
- If not, why not?
- What prevents you from doing so?
- Do any of these reasons sound familiar to you?

“If I give ‘plus’ feedback ...”

- People might relax and give less effort.
- Maybe they’ll ask for more money.
- Their paycheck is their positive feedback.
- Maybe the person will be uncomfortable hearing it.

“If I give ‘delta’ feedback (what needs to change) ...”

- People might get upset.
- It will just start an argument.
- I don’t have time to tell other people how to do their jobs.
- I am not good at giving “delta” feedback.
- They might criticize me.

To reap the most benefit from delta/plus feedback, you should:

1. Provide a balance of “plus” and “delta” feedback, and
2. Be specific in order to motivate people and to gain an increase in performance.

These feedback reminders will help you get the results you want:

- Ask permission.
- Care — be tough on issues, easy on people.
- Have a positive attitude.
- Offer alternatives and suggestions.
- Talk about the behavior, not the person.
- Use “I” statements, not “You” statements.
- Use good timing.



- Consider your location.
- Use simple, direct statements.

Try giving more feedback at work, “plus” and “delta.” You will see an increase in motivation, performance, and learning for yourself. You can also help people be receptive to your feedback by being open and receptive to any feedback you receive. As you give and receive more feedback, you, your team, and your company will all reap the benefits of this high-performance technique. ■

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## MERGERS AND ACQUISITIONS

### ABCs

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Most entrepreneurs work their entire career to grow the value of their company. While they often earn a great living, a significant portion of their net worth is tied up in the business. One method of accessing that wealth is to sell all or part of their company.

Since selling a business is usually a once-in-a-lifetime event, entrepreneurs tend to have many questions about the process. Although every company is unique, there are common themes and frequently asked questions, which are summarized in this article.

#### IS THIS A GOOD TIME TO SELL?

The most important timing decision involves a seller's personal goals. If you are not ready to sell the business, the external environment is irrelevant. Once you have decided that both your financial and personal lifestyle goals point towards selling the company, then it is time to investigate the market environment.

Companies generally sell at a premium, if the previous few years have exhibited growth and the business is still strong. It is much more difficult to achieve a strong sales price if financial results have been declining or erratic.

The economy, in general, will influence cyclical industries like construction, and sales prices generally rise in good times and fall when the economy performs poorly. Buyers are more likely to pay strong prices for acquisitions when their profits are good and their stock price is up.

A long-term plan will ensure you are prepared to market the company in a time of strength, not weakness. Selling a business generally takes nine to 12 months, from the first meeting with your investment banker until the proceeds

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of sale are wired into your account. You want to be prepared to pull the trigger when the company is in growth mode, and the sector and economy are doing well.

#### **HOW DO I PREPARE MY BUSINESS TO MAXIMIZE VALUE?**

Thoughtful preparation and planning are key to maximizing the value of your business. Any weaknesses in the business should be addressed well in advance of the sales process.

If you think you will want to sell the business in three to five years, start preparing now. The terms “value drivers” and “value detractors” indicate the characteristics of your business that will be viewed as

strengths and weaknesses by potential buyers. In general, they are the same characteristics that you look for in a strong business with a long-term focus. Value is enhanced by traits such as:

- Revenue and profitability growth
- Plans to address shifting markets and competitive pressures
- Technology and finance infrastructure
- Customer diversification
- Management depth
- Good working capital management
- Proprietary products or technologies
- Brand awareness/name recognition
- Up-to-date equipment and facilities that can accommodate growth

Conversely, negative results on these traits will detract from the value of the transaction.

External value drivers are those that are completely outside of the company's realm of influence but will still affect the value of the business enterprise such as:

- Market trends
- General economy
- Industry consolidation

Sophisticated buyers will ask the right questions to understand the true state of your company. If the value drivers/detractors are ignored by the business owner, they will surely be a focus of the potential buyer. The buyer will have to address your company's weaknesses by spending their own cash, which will affect the purchase price. If you are already a strong organization that is prepared for growth, you will be a better investment and command a higher price.

**WHAT IS “PRIVATE EQUITY?” WOULD  
A FINANCIAL (PRIVATE EQUITY)  
BUYER/INVESTOR BE A GOOD FIT FOR  
MY COMPANY?**

Private equity firms manage pools of invested money from private individuals, pension funds, insurance companies, endowments, and other investors. Private equity firms invest in companies using financial leverage, with the goal of growing the company, paying off its debt, and realizing a return far in excess of what traditional investments generate.

Private equity has grown immensely in popularity as an investment vehicle in the past five years. Due to the amount of funds available for investment (estimated at more than \$100 billion), there is a great deal of competition for acquisitions of middle-market companies. In this unique environment, private equity purchasers are paying prices that are competitive with strategic (industry) buyers, and often pushing prices higher than would be possible, if only those strategic buyers were interested.

Private equity firms generally purchase majority stakes in companies, ranging from 51% to 100% of the equity. In general, private equity buyers want active management to remain with the company for at least two to three years after the transaction. The more active others are in running your company, the less emphasis will be put on you to remain with the company post-transaction. In

general, the seller/owner will receive administrative and planning support from the private equity partner, which allows him or her to devote more time to the part of the business that he or she enjoys.

Many entrepreneurs choose the opportunity to sell a large portion of the company to diversify their wealth, but still retain a significant percentage of equity so that they can participate in the upside as the company's success continues. Private equity buyers generally prefer to structure deals in this manner. When the company is sold for the second time (typically three to seven years later, and hopefully at a much higher value), the remaining equity is cashed-out in what is commonly referred to as “the second bite of the apple.”

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### IF I WANT TO STAY, WILL THERE BE A PLACE FOR ME AT THE COMPANY AFTER A SALE? WHAT WILL MY LIFE BE LIKE WITH A “BOSS?”

The spectrum of buyers will range from large companies that have managers cued up to run the company after a transition period, to investors that want you to stay for three to five more years and continue to grow the company. Ideally, you will attract interest from a buyer whose post-transaction expectations match yours. However, flexibility on your part is always the best tool to secure the strongest financial deal. You can often maximize value by compromising your ideal transition.

Many entrepreneurs dread the idea of having a boss. After many years of controlling your own destiny, it is difficult to play second fiddle. Creating a new position, expanding into a new geography or purchasing a major piece of equipment may have been your unilateral decision before sale of your business. While you may have similar authority delegated from your new boss, it is more likely that some new rules will be put in place. With a strategic acquirer, you will likely be part of a large company and have to play by their rules and accept their corporate

culture. The flip side is that you always have the freedom to move on, if you are not happy. With a private equity buyer, you will likely have a great degree of autonomy as long as things are going well. However, if sales and profits are suffering, you will certainly know that you have controlling shareholders to answer to.

It is always wise to speak with former business owners that have been acquired by your buyer. They will have excellent insight into what your life will be like as part of the organization post-close. Many

entrepreneurs find long-term happiness partnering with their acquirers, but some need complete control to be happy. You should learn as much as you can about your acquirer, and be as honest as you can about yourself and your need and desire for control.

### WILL MY CUSTOMERS AND COMPETITORS FIND OUT THAT MY BUSINESS IS FOR SALE?

The construction industry is a small world and many of the participants know each other. For this reason, most of our clients are concerned about confidentiality during the sales process.

There are certain measures that your investment banker should take to protect confidential information, including the identity of your company. First, your investment banker should not contact anyone without your approval. Second, your banker should have potential buyers sign confidentiality agreements before learning your identity or any significant details about your business.

However, there is always some risk that others will learn of your impending sale. While it can be minimized, risk of disclosure is one that you must unfortunately take in order to sell your company.

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**The construction industry is a small world and many of the participants know each other.**

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## WHEN SHOULD I TELL MY EMPLOYEES? WILL MY EMPLOYEES LEAVE, IF THEY FIND OUT MY BUSINESS IS FOR SALE?

You can decide when to give employees knowledge of the transaction. Some sellers tell their top managers before the process even begins, and others wait until after the final sales agreements are signed. Business owners are seldom comfortable in making a pending transaction public. However, sometimes the downside of telling key employees is less problematic than the difficulty of completing the sale process without their knowledge. Often, key employees will be included in the process early, but other employees will not have any knowledge until late in the process or until after close.

By nature, most people are uncomfortable with change. Word of a pending sale does create an uncertainty for employees that will make many of them nervous about their future. However, in most cases, good employees will have greater opportunities after a sale as part of a larger organization. Also, in the case of a financial buyer, your employees will be valued since they helped create the success of the company. At an appropriate time, you can communicate to your key employees this fact. You can also emphasize that they will likely benefit from greater career opportunities as a result of the sale. Be as specific as possible without making guarantees that you are in no position to make.

Entrepreneurs spend many years building a business. Mistakes are made along the way. Lessons are learned, and eventually, business owners have an excellent grasp of their capabilities and their markets. Selling a business is typically a one-time event, with many facets to consider. It can seem a daunting event by even the most optimistic business people since it is a completely new endeavor and often outside their comfort zone. However, it has been done thousands of times, and countless entrepreneurs have dealt with the same difficult issues. At the conclusion, they reap the reward for decades of hard work building their business. ■

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**Selling a business is typically a one-time event, with many facets to consider.**

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## MERGERS AND AQUISITIONS

### Exit Options for Owners: A Checklist for Selling Your Company Internally

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The recent strength of the U.S. commercial and institutional construction marketplace has provided a boost to the coffers of many contractors. Flush with these strong profits and record backlogs, many owners have begun to consider the next logical step — exiting their business through a sale or transfer. While the flurry of strategic and financial buyers who have emerged for construction

companies in recent years has created mergers and acquisitions opportunities in our industry, the fact remains that the overwhelming majority of contractors (six out of 10) still cash out of their businesses through an internal sale to key employees or family. Whether you are contemplating an immediate internal transfer of your business or have the luxury of time to plan for such succession, this article lays out the key items to examine when considering a sale to key employees or family.

#### **Align future ownership with future management responsibility.**

The most successful internal sales occur between owners and those individuals who have a direct impact on the day-to-day operations and profitability of your firm. As an owner, you understand the direct correlation between ownership

and accountability within a closely held firm — your plan should create and harness this powerful link for application to others.

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**Internal sales are much more likely to succeed when shared goals drive the process and transaction structure, rather than the other way around.**

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#### **Goals and objectives come before structure and price.**

Shared goals that are openly communicated among participating parties are critical. Ensure that the future owners of your business each have similar objectives with regard to managing operations, building equity, and distributing earnings. Once this foundation has been laid, your advisor can assist in selecting the right structure (ESOP, subchapter-S buyout, permanent joint venture etc.) to meet these needs. Do not try and fit your internal transfer process

into an existing structure just because that is the method you are most familiar with. Internal sales are much more likely to succeed when shared goals drive the process and transaction structure, rather than the other way around.

#### **Prepare for that which cannot be anticipated.**

Just like in constructing any project, internal sale plans invariably encounter unanticipated bumps in the road — both bad and good. Bad jobs, bonding constraints, unforeseen market opportunities — none of these can be planned for but will likely occur during the course of your ownership transfer. Build flexibility into your plan to accommodate the necessary course corrections.

#### **Profitability is critical.**

Your employees likely do not have the financial resources available to purchase your company so most of the money will come from the future profits of the business. If your company is profitable, almost any internal transfer technique will work. If your company does not make money, ownership transition will not take place unless you are willing to give your company away.

**Align strategic and ownership transition objectives.**

Cautiously approach strategic initiatives with an eye towards your long-term ownership transition goals. A timely ownership transition will likely impose cash-flow constraints on your business that can limit strategic objectives. Before your transition plan begins, ensure that your strategic objectives align with your ownership transition objectives.

**Company value is based on earnings and your exit timeframe.**

The earnings capability of the business and your timeframe for exiting are far more important than any theoretical value of your business. You may value your company at \$1 million, but this valuation is meaningless if there are not interested outside buyers and your employees are only able to pay you \$500,000 over the timeframe you have set for the buyout.

**Internal buyouts extend the length of your payments.**

Financially, the difference between selling your company to a third party or selling to key employees is often a matter of the timing of the payments — internal buyouts take longer to achieve the same value. However, while value can be roughly equivalent between the two transactions, it is important to recognize that the extended timeframe associated with an internal sale also extends your personal liability as it relates to the company. Depending on your financial goals and the profitability of your company, a smooth internal transfer will likely take seven to 10 years.

Owners who choose to sell their companies to key employees or family have personal motives, which are frequently as compelling as their financial objectives. They may take pride in seeing their names remain on the door, giving their children or loyal employees a chance to own what they do, or in providing continuity of a unique corporate culture. The attractiveness of the internal sale process is that it offers owners a great deal of flexibility with regard to roles, responsibilities, compensation, and other deal components.

An internal sale to key employees or family can be a rewarding alternative for all parties. With the strength of the current construction economy, the climate has never been better for developing an internal ownership plan. ■

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## **ZURICH CONSTRUCTION**

### **BIM Technology Benefits Outweigh the Risks**

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As the latest technological advance to hit the architectural, engineering, and construction industries, building information modeling (BIM) is expected to become the design tool of the 21st century, completely changing the way business is done.

A departure from the computer-aided drafting (CAD) methods in common use for the past 20 years, BIM gives users the ability to demonstrate the entire building lifecycle, bringing an unprecedented collaborative approach to the

process. Using data provided by virtually every member of the project team, BIM uses 3-Dimensional digital representation that allows computers to “virtually build” the project — from viewing, testing, and revision, to generating reports and views for purchasing, fabrication, and assembly operations — avoiding paper altogether, in most cases.

Users believe BIM’s main advantage is error reduction, along with increased construction productivity and shorter construction time, all of which directly contribute to cost savings. Specifically, BIM can reduce errors through computer visualization of a building’s components in relation to the whole project, giving team members the opportunity to detect and fix conflicts before construction begins.

This early detection can translate to big savings for the industry. According to the American Institute of Architects, it costs \$100 billion to fix and administer construction errors vs. \$24 billion to design the original projects. Much of this waste or rework is due to inaccurate drawings, miscommunication among stakeholders, and inefficient and inconsistent design analyses, according to the National Institute of Standards and Technology (NIST).<sup>1</sup>

Like any tool still in the developmental stages, BIM is far from perfected. Because the technology itself is still evolving, team members frequently end up using a variety of versions and applications, most of which don’t interface with each other. Others are reluctant to make the transition from CAD to

BIM systems.

Another concern is how BIM will change the face of construction contracts and legal liability. Because so many different users are directly inputting data into the system, the gatekeeper role is still unclear, which is a serious concern when the input and handling of so much data is at stake.

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**Like any tool still  
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#### FROM CAD TO BIM

Twenty years ago, the design and construction industry began moving from drafting tables and blueprints to CAD technology, which

automated the drafting process. CAD computer applications are based on traditional 2-Dimensional representations, using lines, arcs, and symbols. Because personal computers were just becoming universally accepted, the timing was perfect for the emergence of CAD in the industry.

The later development of 3-D and object-oriented CAD (OOCAD) systems



eventually replaced 2-D symbols with objects representing the behavior of common building elements, all displayed in multiple views.

BIM technology, which began taking hold in the United States around 2000, traces its roots to OOCAD and is actually the latest generation of CAD technology. The big difference is that BIM bridges the information loss associated with a traditional building project by enabling users to input all the elements that combine to make up a building design into one “project database” or “virtual building” — a single, consistent source of information associated with that building.

BIM involves collaboration by everyone in a construction project — from the design team (architects, surveyors, civil engineers, structural engineers, mechanical engineers, and electrical engineers) to the construction team (contractors and subcontractors) and building owners/operators — allowing each group to add to and reference back to all existing information. Users say that it is this collaboration that makes BIM so beneficial.

Leading BIM software products include Vertex BD from Argos Systems Inc.; ArchiCad from Graphisoft; Bentley Architecture from Bentley Systems; Revit Architecture from Autodesk, which recently purchased competitor NavisWorks; and SketchUp from Google.

#### EMBRACING THE NEW

Many larger design and construction businesses impressed by BIM’s capabilities have embraced the technology over the past several years.

“Seeing a project in 3D was a huge first step in the right direction,” said Michael LeFevre, AIA director, planning, and design support service for Holder Construction in Atlanta, which has been using various BIM formats since 2003. “Everyone being able to see it together was another huge benefit in gaining a better understanding of the building and of each other. Finally, having all the data in one place, current, and being able to extract intelligence from it is another bonus.”

Firms like Holder are so sold on BIM that they have designated specialists to oversee its implementation. An example is Karie Johnson, director of virtual construction at Adolfsen & Peterson Construction in Minneapolis, which began using BIM technology about a year ago. Johnson’s job is to integrate BIM into her company’s processes by introducing the technology to all offices nationwide, overseeing training and product purchases, and working with team members to determine which construction projects warrant the application of BIM and to what degree (the company only uses BIM for more complex projects that lend themselves to partner collaboration).

“BIM is revolutionizing the way we work together,” Johnson said. “Since it changes the way we interact with each other, it requires a level of trust due to

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**Many larger design and construction businesses impressed by BIM’s capabilities have embraced the technology over the past several years.**

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current contracts and liability issues.” An architect by training, Johnson lauds BIM for its reduction of rework, waste, and expense, and its increased accuracy, productivity, overall project understanding, and advanced safety.

Companies already using 3D CAD technology find the transition to BIM a relatively natural progression. “Right now, we’re going through the same thing with BIM that we did with CAD in the mid-1980s,” said Dan Russell, simulated construction department manager at Sundt Construction based in Tempe, Ariz., a BIM user for about 18 months. “The biggest issue is getting people up to speed with training and struggling through a temporary loss in productivity as they get used to a new system. But the benefits far outweigh the upfront costs.”

#### REAL-LIFE EXAMPLES

For Michael LeFevre of Holder, BIM has proved invaluable by producing 3D models for partial use on buildings in a matter of hours or days, compared to a year or more with a traditional CAD system. Model creation and maintenance costs associated with BIM use range from hundreds of dollars to six figures, with an immediate return in direct collision detection cost avoidance anywhere from two to 10 times the model’s cost. “This estimate doesn’t even begin to measure indirect savings such as shorter schedules, reduced conditions costs, avoided cost escalation, owner and construction team rework, contingency management, and claims reduction,” LeFevre added.

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**Companies already using 3D CAD technology find the transition to BIM a relatively natural progression.**

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Holder recently invested \$40,000 to model a downtown Atlanta project on a tight urban site. The firm realized cost savings of \$200,000 by using BIM technology, LeFevre said. The savings came in the form of avoided building conflicts, such as mechanical, electrical, and structural problems — beams colliding with ductwork — that did not show up in 2D.

Another recent BIM-modeled Holder project in Arizona resulted in no mechanical collisions — a rarity in the traditional design and construction process. “We’re human, and only as good as our minds and flat paper,” LeFevre said. “While this tool still requires good experienced professionals, the use of 3D conflict detection tools makes us much smarter — and smarter together.”

Karie Johnson recently used BIM technology for a 3M film-processing plant

in Greenville, S.C., a \$45 million job. Using BIM allowed the team to show subcontractors what the building was going to look like, giving them a clearer understanding of the scope of the project, and lowering bids. The technology also made it much easier for the Minneapolis team to work with equipment manufacturers in Germany.

For Sundt, BIM has already saved the firm big money by avoiding building collisions, said Dan Russell. While modeling a wastewater treatment plant, the firm found areas where the building's underground piping was hitting the electrical duct bank. The project team made changes to the duct banks before starting construction, resulting in savings totaling \$250,000 in hard costs.

On another project modeled using BIM, Sundt spotted problems with a mechanical room that was too small to accommodate heat exchangers and other large equipment. An option was to lower the floor, which wasn't an issue because the problem was detected before construction began. However, the project's mechanical engineers wanted to know why the heat exchangers were so large. By using BIM, the team was able to see the issues and the mechanical engineers recalculated the requirements. They then specified smaller heat exchangers before starting procurement, which meant they were able to fit everything in the mechanical room without lowering the floor.

#### POTENTIAL FLIES IN THE OINTMENT

With all these benefits, it would seem there are no drawbacks to using BIM technology. However, a few areas of concern do exist.

First is the cost of such systems. "Like any technology investment, a significant initial outlay is required to get up to speed," Johnson said. "A system to implement BIM can run upwards of \$10,000 to \$20,000 for one user, plus training costs. However, if a person has an aptitude for computer technology and 2D skills, it is not too difficult to make the leap into 3D."

Lack of systems compatibility is another issue for users. In 2004, the NIST estimated that the U.S. capital facilities industry loses \$15.8 billion annually from inadequate interoperability (the exchange of modeling information between various disciplines).

According to the National BIM Standards Project Committee (NBIMS), the fragmented nature of the industry is the result of the old artisan hierarchies, and later trade union practices, which were eventually codified in legal and ethical separations between designers, construction, vendors, and end-users. Even when the industry began using CAD technology, business practices were still compartmentalized.<sup>2</sup>

However, NBIMS, along with other industry groups and the federal government, are currently developing BIM national standards. The industry is currently commenting on *National BIM Standard Version 1, Part 1*, with Part 2 estimated for publication at the end of 2007.

## THE IMPACT OF LIABILITY

The other major area of concern surrounding BIM use is how the construction contract will respond to the technology — specifically, how the industry will adapt to a 3D model as a contract document and how it will affect liability exposure.

Currently, a construction project's architectural drawings represent the construction contract, which has remained virtually unchanged for many years, said Jim Bedrick, vice president of virtual building and design for Webcor Builders Inc., San Mateo, Calif. "While there is no doubt that 3D models do a much better job of representing work than 2D drawings, the question is how to make the 3D model into a legal definition of the contract requirements," he said.

"What we are currently seeing with BIM is the typical signoff document language we saw when AutoCAD was first introduced," added Karie Johnson. "Information is shared but with a disclaimer."

Much will depend on interpretation, with the need to make a distinction between simple project information and actual contractual requirements, Bedrick added.

A related question that must be answered is: Who is ultimately responsible for the information going into the BIM model? "Because BIM has enabled a more collaborative process, various organizations are looking very hard at the whole design and construction process, which should be, and now could be, much more integrated," Bedrick said. "Organizations like Associated General

Contractors, American Institute of Architects, and the Construction Users Round Table are looking into what contracts will look like when we have an integrated delivery process."

Integrated agreements are nothing new in Europe and abroad. For example, Australians have used project alliances with legal contracts for years, with 35 to 40 major infrastructure projects built under these agreements in the last several years, Bedrick said. However, this is still somewhat of a revolutionary process in the United States.

One of northern California's largest healthcare providers, Sutter Health, recently used integrated agreements.

The company is embracing a new construction philosophy to execute approximately \$6 billion in capital projects over the next several years. Sutter is using Lean Project Management, which is noted for greater planning and communication, better workflow, fewer change orders, and prompt material handling.

The downside of such collaborative projects is a blurring of liabilities, which can result in confusion around project insurance, Bedrick noted. Traditionally, all contracts are written by compartmentalizing risk, which made it easily insurable. Under this process, architects and engineers carry errors and omissions insurance, while the contractor does not. Under a collaborative system, this distinction is not as clear.

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**A related question that must be answered is: Who is ultimately responsible for the information going into the BIM model?**

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However, risk management is much improved through collaboration, making it more attractive to insurers, Bedrick noted. "If you have a designer and builder working together, you have a much better chance of controlling the risk on a project," he said.

While all of these factors may cause users to give BIM technology a second thought, it would not be a good idea to stay off the BIM bandwagon, said Sundt's Dan Russell.

"Experts are predicting that BIM will be the industry standard within the next five years," he said. "Two years ago, maybe 10% or 20% of architects were thinking about it. Today, in larger firms, about 80% are using it in some fashion. Even the AIA has said that, if you're not using BIM in the next five years, you'll be close to being out of business." ■

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<sup>1</sup> Julie Fraser, Executive brief: Leveraging the value chain in construction — Building Information Modeling (BIM) [http://64.233.169.104/search?q=cache:7qGf174mDsJ:https://www304.ibm.com/jct03004c/businesscenter/smb/us/en/contenttemplate/!!/gcl\\_xmliid%3D41848/\\*American+Institute+of+Architects+%24100+billion+construction+errors+%2424+billion&hl=en&ct=clnk&cd=1&gl=us](http://64.233.169.104/search?q=cache:7qGf174mDsJ:https://www304.ibm.com/jct03004c/businesscenter/smb/us/en/contenttemplate/!!/gcl_xmliid%3D41848/*American+Institute+of+Architects+%24100+billion+construction+errors+%2424+billion&hl=en&ct=clnk&cd=1&gl=us)

<sup>2</sup> NBIMS Publications and Resources <http://www.facilityinformationcouncil.org/bim/publications.php>

# Laptop Meets Bulldozer

Implementation and successful training on a single strategically viable tool connected with a fundamental business process creates brawn that will create the engineering marvels of tomorrow.

*By Gregg Schoppman*



any of the engineering and architectural marvels in the world are attributed to construction brawn and muscle. Mighty pieces of iron moving mountains of earth and enormous tower cranes silhouetted on the horizon serve as visual reminders of the enormity of the construction process. Innovations in equipment and building materials have enabled improved efficiency in every facet of the business world as well as made feasible some of the greatest feats within the construction industry.

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However, truly improving productivity in operations requires more than a sophisticated scraper, bulldozer, or drill. Technological innovations on a smaller scale, from laptops to GPS, often have the greatest impact. The challenge for construction firms, small and large, is introducing a culture of technology to people that don't perceive its need or embrace it. The construction industry remains late to the starting block in the technology race, encumbered by complex issues and poorly equipped users.

Software firms abound with solutions to construction's ever-increasing list of demands. Document control, scheduling, collections, and even grade control are a short list of management functions reduced to mere keystrokes and dashboards, all with the intent of improving productivity and increasing efficiency. The main

challenges lie in human elements. The greatest systems are useless in the hands of the neophyte. Capitalizing on technological assets not only enables market differentiators but also increases efficiency at many levels within the organization. Yet, “I don’t know even where the ‘ON’ button is,” is a common retort among many field managers who have dedicated their lives to moving dirt or installing drywall, but place little regard on a 10-pound paperweight (i.e., laptop computer) and the myriad of programs that exist inside. Even with the most experienced user, technology is diminished if it serves as a reactive mechanism to a problem or challenge. Simply increasing functionality of technology will not produce the greatest gains. The long-term solution involves creating a culture of proactive communication and planning rather than speeding up reactive e-mails or lowering the cost of hand-held, two-way radio chirps signaling another firefighting episode. Best-of-class contractors gain maximum efficiency from their teams through a comprehensive and detailed strategy for deployment of technology, no different than introducing a new safety or quality control program. These same contractors understand the value of training and how to integrate these new systems into their operations with maximum effect.

#### A STRATEGIC PERSPECTIVE

Countless numbers of contractors invest large sums in their information technology purchases, yet experience buyer’s remorse when the promised solutions to the project challenges remain elusive. They believe they have been over-promised and underserved. Contractors often brand themselves “early adopters” because they are quick to own the latest and greatest gadgets, yet they have little regard for or knowledge of how to use them effectively. Technology decisions are no different than fleet decisions or tool-crib decisions. Purchasing tools and equipment requires judicious care to ensure they meet the buyer’s desire, form, and function. For example, you wouldn’t buy a rotary drill when a circular saw will do. Further, expensive fleet purchases require even more care to ensure effective and productive long-term utilization. One major challenge with information technology purchases lies in the fact that owners must determine what will successfully integrate and link their legacy

systems while creating a new platform to deal with the current and future challenges. Salvaging an excavator is relatively easy. Salvaging an antiquated document control system requires much more effort to protect the integrity of the information warehouse. Can the new system mirror the old way while providing sufficient innovation for future operations?

Contractors labor over the “biggest and best” systems, hoping to find a fully-integrated solution to suit

their needs that doesn’t require any adjustment of input or output. Alternatively, the cobbled-together systems that support operations seldom operate seamlessly — scheduling by Brand X, cost control by Brand Y, and document control via a complex series of spreadsheets and databases. Even with this “patchwork quilt” approach to

information technology solutions, the technology is often under-utilized. In many cases, the technology available vastly surpasses many contractors’ needs. To arrive at the best solution, consider the strategy of the organization. What does the vision of the organization say about the size, complexity, delivery methodology etc. of the projects to be served by the technology? The tools needed to support operations will vastly differ if the firm is dedicated to mass earthwork projects vs. multi-story condominium projects. While the software and platforms may be similar, the utilization of the tools will be drastically different. There is no “one size fits all” perspective. Force-feeding a system or tool on operations people who fail to understand and support that system will only lead to discontent and an underutilized investment.

One of the best techniques for determining the correct system is a focus group of managers and superintendents. This group understands their own needs and what will improve the planning, communication, and efficiency for the type of construction projects the firm undertakes. Their perspectives and early involvement are vastly superior to a decision-making team largely populated by information technology or accounting staff. Exhibit 1 shows how the areas of focus addressed by the typical focus group can vary by type of work.

Exhibit 1  
**Two Perspectives of an Operations Technology Evaluation**

**Sitework/Utilities Specialty Contractor**  
Customer type: Private, negotiated  
Project type: Large scale, earthwork residential subdivision

Operations Area	Level of Sophistication	Areas of Focus
Scheduling	Medium	System needs to focus heavily on manpower and equipment utilization (resources)
Document Control	Low	Simple tool to manage surveys and reports to the customer
Feedback and Cost Control	High	Imperative to receive daily production and unit-cost information; graphical feedback preferred

**Commercial General Contractor**  
Customer type: Public, hard-bid  
Project type: Large scale, complex school/municipal projects

Operations Area	Level of Sophistication	Areas of Focus
Scheduling	High	System should allow detailed task-work breakdowns as well as reporting functions for project status; resources will be mainly subcontractors; project task lists anticipated to be 300+ for any given project
Document Control	High	Heavy reliance on written communication (i.e., requests for information, change order proposals etc.) with tracking functions; management dashboard a plus
Feedback and Cost Control	Medium	Impetus is less on daily production (subcontracted) and more on cash flow; heavy importance on change order management (with customers, with subcontractors)



Buy-in to the system begins in the focus group. Without consensus, support, and reinforcement of standards through compliance audits, managers and superintendents gravitate towards their own ad-hoc systems. Instead of using scheduling software to

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## Identify the right team with which to begin implementation, and begin with a new project.

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aid in managing complex activity streams, superintendents use whiteboards and spreadsheets to illustrate a progress schedule. In lieu of GPS systems for grade control, costly survey crews roam the project site. Without pervasive use of the technology, the return on investment never occurs. Furthermore, as operations personnel rely on their own systems, data and project-critical information becomes fragmented and inconsistent. Additionally, important project metrics such as change order approvals, schedule performance, and

status of receivables lack integrity and credibility. Gain a better understanding of how to maximize the system's implementation by examining technology challenges from user perspectives.

### FOCUS ON THE CHAMPIONS

Even with needs clearly identified, implementation requires patience and careful selection of first-users. Many firms have failed at this stage because senior management doesn't effectively roll out the system and provide real-life demonstration of its benefits to their team. The "buy it and they will use it" strategy only caters to a small percentage of early adopters who need little motivation to use new technology. Early adopters are important, however, as the "champion group" that will help endorse and sell the system to the rest of the organization.

Identify the right team with which to begin implementation, and begin with a new project. Before beginning the project, develop the project infrastructure with the team. The "pilot study" enables the firm to examine the most efficient methodology moving forward by providing a test case for file trees and budgets. For example, the list below identifies some project components and aims to surface corresponding logic through team development:

- **Documents:**

- Requests for Information*

- Numbering system for quick reference
    - Field generated vs. office generated?

- Letters*

- File by issue vs. file by entity (i.e., subcontractor, customer etc.)
    - System generated or word processing program?

- Submittals*

- Numbering system
    - Appropriate dashboard for submittal status

- **Schedules:**

- Typical Work Breakdown*

- By phase, location etc.
    - Level of detail?

- Resources*

- Master resource list vs. independent resource list?

- Cash Flow*

- Task revenue, task costs, both?

- **Job Cost Feedback:**

- Budget Set-Up*

- Logical sequence of coding?
    - Appropriate number of codes?

- Tracking and Feedback*

- How will status be reported?
    - How will performance be communicated?

While many of these questions may seem intuitive, pilot groups help create continuity as new project teams adopt the new systems. Debugging the system continues long after the software leaves the factory. Customizing reports and project infrastructure early at the project level creates a stable foundation for future projects. More importantly, this provides a “grown here” feel rather than the generic, one-size-fits-all quick fix.

The momentum generated by this group of champions helps sell the next group as well as dissuade dissent from would-be system saboteurs. While information technology is largely a hard science, successful use of technology relies, in part, on the psychology of thwarting those who would derail the implementation. Reasons for non-acceptance range from lack of training to simply a general ignorance of system benefits. When champions extol a system’s virtues and celebrate early successes, fence-riders can be recruited to the enthusiastic user-side. Associates visualize the benefits of a system rather than view it as a hindrance. Thus, arguments of the assassins and saboteurs lose credibility.

## MENTORING AND TRAINING

The next challenge is to deal with novices, potential naysayers, and assassins. Companies routinely invest in basic computer training. These courses offer a fundamental knowledge of how to turn on the computer and access the Internet. Long after the course ends, many questions still linger. Admitting defeat to a nine-pound laptop is almost non-existent in the macho and ego-driven world of the contractor. Instead, the laptop sits in the trailer or on the passenger seat of the truck, unused. The loss associated with the cost of a wasted computer pales in comparison to the losses in productivity whether it is from the job-cost feedback system or

simply in the communication bottleneck this non-use creates.

As companies deal with these technological issues, their organizations get older. Across the country, companies struggle to meet industry demands because of a lack of skilled labor brought about by the aging workforce. A great divide exists — younger project managers and engineers are married with older field managers and superintendents. These odd-couple teams are enlisted to complete complicated projects with significantly different perspectives and skill sets. How does an organization create synergy and a productive environment with a team that sees the project from two different extremes? Senior management's challenge lies in bridging the gap between a group that embraces technology and a group that views technology as an impediment to building. Mentoring is one technique for creating a proactive training environment that allows both groups to benefit.

As older members of the team retire, companies not only lose an employee but a knowledge asset that is difficult to replace. Capturing that knowledge is paramount. Further, another source of pain in many organizations stems from younger managers and engineers who lack the necessary field knowledge to make educated and informed decisions about their projects. Great companies insert new associates directly in the field. Rather than learning office skills first, they begin by learning critical field and constructability lessons from the field manager. It is here that a symbiotic relationship can develop. Most of the younger associates flourish in a technology environment, stemming from their education and upbringing. By imparting their skills and supporting the field, both people learn and the project's performance increases as well. Careful explanation of the benefits of such a pairing needs to take place early on in the process. Pairing the right individuals together is equally important. Thrusting a

young engineer or assistant onto the site of a lone-wolf, curmudgeon will frustrate both parties and provide limited educational opportunity. A structured process and proactive communication help create a strong farm system of future producers as well as a means of teaching the old dogs some new tricks.

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**Most of the younger associates flourish in a technology environment, stemming from their education and upbringing.**

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#### OVER-RELIANCE ON TECHNOLOGY

Web-based this, hand-held that. Cell phones now receive e-mail, voice mail, and basic cable television. The capabilities of some scheduling software surpass the needs of many contractors who simply

want to create a bar chart. Technology offers many opportunities, but without strong fundamentals, it will never be the panacea construction executives desire.

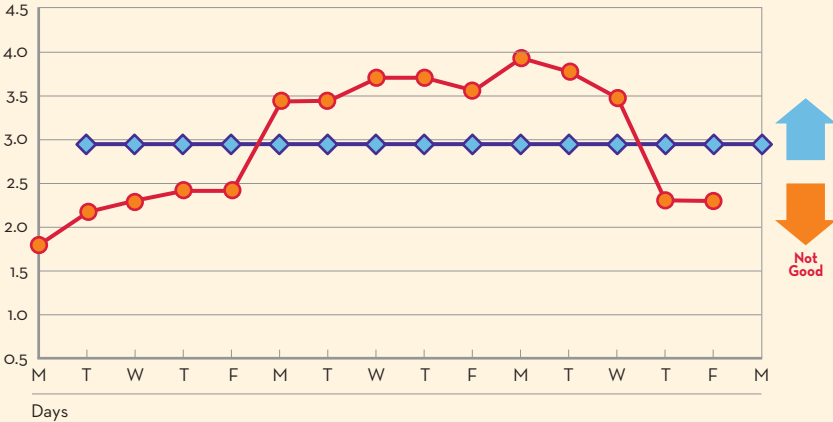
For example, wallpapering trailers with grandiose Gantt charts is no substitute for good quality planning. A computer will never download the thought process of a project estimate or the best strategy with which to construct a project. A schedule is a piece of paper. Planning requires thought and interaction. Without fail, ask a project manager or superintendent about their plan, and you will be handed a bar chart. Efficiency and productivity increase not because of the bandwidth or an Internet

Exhibit 2  
**Performance Feedback: A Graphical Perspective**

Average Daily Production

◆ Estimated daily production  
 ● SQS/man day

Production (SQS/Man Day)



connection or number of tasks on a Gantt chart, but rather because teams have engaged in the appropriate level of planning before, during, and after a project.

Voluminous cost reports teaming with columns of data never serve their role if they are neither shared nor understood by the intended audience. Green bar sheets often litter the landscape of a trailer with critical production information going unread. Knowing the score provides the field critical information about their performance so they can take corrective action. Management needs to be sure the information distributed speaks to its audience. Provide meaningful graphical feedback on performance. Pictures sell the information better than a tabular matrix and communicate to multiple audiences. Colorful, graphical output is not just eye-candy; it is extraordinarily valuable in its ability to make important points in very little time. Sharing this information with the crew involves the team in the project goals and can drive the right behavior to achieve those goals. Exhibit 2 illustrates this type of performance feedback.

The construction industry relies heavily on the human element. Many industries benefit from such technological innovations as robotics and automation. The integration of man and machine in construction is slowly becoming a distinct competitive advantage for some firms. Those who have found a way to distinguish themselves from the competition by incorporating a technology-now strategy with an effective implementation plan not only eliminate their competition but also enhance their operations through the efficiencies of their system. Technology, from GPS to laptops, need not be limited to the technologically strong manager and superintendents. Nor does technology only have to serve the large organizations. Implementation and successful training on a single strategically viable tool connected with a fundamental business process creates the brawn that will create the engineering marvels of tomorrow. ■

# Leadership 2.0: Building Trust, the Forgotten Application

Trust is the fundamental tool leaders must use to increase the connection with their people, inspire them, and to achieve remarkable business results.

*By Vanessa Winzenburg,  
Tim Tokarczyk, and Willie Hepworth*

**T**he advent of new technologies in the late 20th and early 21st centuries has transformed the landscape of human interaction. The world is smaller now than ever before, and people are more connected than at any previous point in human history. Globalization, for example, has enabled us to outsource non-essential business functions overseas, or to share resources within multinational corporations across borders. The proliferation of cell phones has connected us; workers can now communicate with each other almost instantaneously around the world at the click of a button.

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Further, social networking sites like MySpace and Facebook have brought together millions of people into centralized locations, where access to their lives is open to all. These advances in technology have changed the way businesses operate, which provides both additional tools for leaders, as well as newfound obstacles to developing trust with their people. To truly increase the speed and efficiency of their organizations, leaders must be careful not to overuse technology, but instead, to develop a trusting culture.

## VIRTUAL CONNECTIVITY

With technology improving and increasing exponentially, we are living in times unlike any before. The world will only continue to grow smaller as technology becomes more powerful, cheaper, and more readily accessible to the billions of people living in the Third World. In fact, the wireless communications industry grossed over \$115B in 2006, with just 9% of that revenue attributable to North American users. Eighty-five percent of cell phone users currently reside in Asia, Europe, the Middle East, and Africa.

Technology has dramatically increased the quality of life around the world. The Internet, along with e-mail and instant messaging services, enable citizens of countries around the world to become citizens of a global community. Advances in medical technology have greatly improved the quality and length of life for millions of people around the world. Faster and easier access to a wealth of information has transformed education as people have more options and resources for learning. All of

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**The Internet, along with e-mail and instant messaging services, enable citizens of countries around the world to become citizens of a global community.**

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this communication comes at little cost today. Internet-based telephones have allowed people separated by thousands of miles to stay in touch at virtually no cost. Social networking sites have provided a forum for many people to reconnect and to build connections with people they would not have met otherwise. Technology has provided an economic boom to countries like India and China, opening opportunities for education and commerce, and greatly increasing the economic fortunes of many of these countries' citizens.

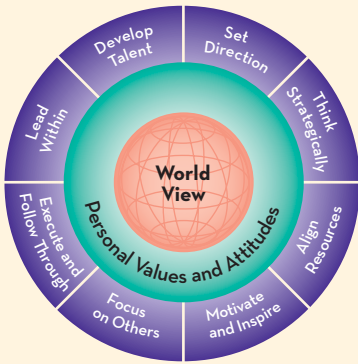
Paradoxically, at the very point when humanity is more connected than ever before, people around the world are feeling more isolated and alone.

In the United States, depression is on the rise, affecting almost 19 million Americans (or 10% of the adult population) each year. This disorder costs U.S. businesses as much as \$51B in absenteeism and lost productivity. Within the U.S. construction industry, companies will replace at least one in four employees annually as a result of employees' failure to bond with the company and its leaders.

The quality of the connection that technology has provided requires further examination. Face-to-face conversations have been replaced by expressionless and often ambiguous e-mail. More conversations take place on cell phones than in person. Three billion telephone calls are made every day, and over 60 billion e-mails are sent worldwide every day. Text messaging has severed that connection even further, allowing short messages to be sent in text, rather than communicated verbally or in longer, more formal e-mail communication. Amazingly, the number of text messages sent and received every day exceeds Earth's population.

The rise of newer and faster technological breakthroughs has both proponents

Exhibit 1

**Peak Leaders**

and critics. It would be foolish to believe that technology has not vastly improved the lives of billions of people around the globe. However, it is similarly foolhardy to believe that technology is a panacea to solve mankind's troubles. The proper place of technology comes up in many places in our society, but its role in leadership is often overlooked. Can technology be used to improve the quality of leadership, or is it a barrier, preventing peak leadership within an organization?

While technology's focus is increasing speed and connection in

the business world, leadership is fundamentally about connecting with people. (See Exhibit 1.) Leaders who function at their peak level of effectiveness are driven by a strong set of values and beliefs and are skilled at many of the things you hear and read about in the press today — articulating a compelling vision of the future, setting clear strategy, getting the right people into the right roles within the organization, ensuring organizational goals are established and achieved, inspiring people to reach their potential and building the skill and competence of the next generation of workers. Each of these leadership tasks can be enhanced through the appropriate use of technology. However, while leaders should harness the benefits of technological advancement, especially in communications, they should also consider critical issues that arise in today's high-tech/low-touch business environment. While e-mail and Blackberries are great tools for enhancing a leader's accessibility — increasing frequency of communication between leaders and followers and expanding a leader's access to information — they are frequently overused. We view this technology like a hammer, and therefore most issues, concerns, or items on task lists appear like nails, or things that can be resolved with this trusty sidekick and thick thumbs.

While technology can increase speed and connection in business, there is a fundamentally different tool that leaders must use to increase speed and connection with their people, to inspire them to reach their full potential, and to achieve remarkable business results. That tool is trust.

**TRUST**

Trust, simply put, is about confidence and credibility. Trusting someone comes from faith and a belief in that person. A credible person inspires confidence as someone that can be

depended on, even in a pinch. Jack Welch once said, “I could give you a dictionary definition, but trust is something that ... you know it when you see it.”

Trust is often thought of as a social virtue and something of a soft skill that may be nice to have, but that isn’t an economic engine. Trust does have considerable economic impact. Consider the purchase of McLane, a Wal-Mart subsidiary, by Warren Buffet and Berkshire Hathaway. After only two hours of meetings between the parties, a deal was reached. Buffet and Wal-Mart’s representatives shook hands, and two weeks later the transaction was completed. There was no due diligence in the \$23B deal. This deal closed quickly because Warren Buffet’s word is his bond, and Buffet trusted Wal-Mart representatives to uphold their promises. Stephen M.R. Covey has coined a term for this expediency as operating with the “speed of trust.” On the flip side of this coin,

when trust is low, speed goes down and costs go up. For example, in the aftermath of the 9/11 tragedy, trust in the airlines was lost due to terrorism. The speed of transportation went down, and travelers must now wait in long security lines to reach their departing gate. Costs increased, and travelers now pay for the upgraded security in order to make traveling by air safer.

Similar situations happen on construction projects. When a contractor submits a second dubious change order within a short time, the project owner may begin to lose trust in the contractor and hire a construction manager to keep an eye on his or her interests. The owner and design team will likely now ask for verification on all pricing. The contractor begins documenting everything in preparation for claims and litigation. At this point on, whenever there is a bump in the road, the process will be filled with conflict, negotiation, and disputes. Over time, unless trust is restored, it will become increasingly difficult for this particular project to be brought in on-schedule and within budget. How might the situation be different if the owner, design team, and contractor were all on the same boat and rowing in the same direction due to mutual trust?

Research by Watson Wyatt<sup>1</sup> indicates that total shareholder return in high-trust organizations is almost three times higher than the rate of return in low-trust organizations. According to the 2007 *Great Places to Work* survey, conducted by the Great Places to Work Institute in partnership with *Fortune Magazine*, trust between managers and employees is the No. 1 defining characteristic of the best workplaces.

A key ingredient for building organizational loyalty among the best employees is a trustworthy leadership team. Enron, Martha Stewart, WorldCom, and *The New York Times* scandals are a few of the recent events that have chipped away at society’s trust in institutions, organizations, and leaders. In a recent survey, only 54% of consumers in the United States trusted businesses, and only 39% trusted government to do the right thing. The construction industry also has its trust issues. In a recent survey, contractors were third from the bottom on a list of the most trustworthy



occupations, surpassing only used-car salesmen and television evangelists. This is as much a perception problem as anything else since the term “contractor” is used to describe disparate enterprises from remodelers working out of the back of pick-up trucks to global firms building infrastructure. But in the end, it is up to each individual leader to build the relationships necessary to ensure that they are cultivating trust on their teams, in their organizations, and in their communities. Understanding how to build trust is one of the most valuable skills a leader can possess.

## BUILDING TRUST

Trust is a key competency for construction leaders in the new era of globalization. Construction companies are facing greater competition and opportunities from overseas firms. The speed of business is increasing due to these factors, and leaders that have built trusting relationships in their organizations will be better suited to adapt to the rapidly changing times. The core elements of trust are character, competence, and consistency. Most people consider themselves to be of strong character, highly competent, and consistent. This is because people generally hope others will judge them based on their intentions. Unfortunately, trust is not built through intentions, but rather through behaviors and actions.

Five specific behavioral attributes play the strongest role in a leader's ability to build and maintain trust: honesty, integrity, accountability, tenacity, and authenticity.

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These attributes do not imply that a person simply doesn't lie and tries to do the right thing; they require much greater dedication and discipline.

Honesty means consistently telling the complete truth, and it involves communicating the facts clearly in order to be understood and leave the right impression. It is often easier to avoid telling the whole story, hoping that the individuals involved will come to their own conclusion or that the situation will resolve itself and no more disclosure will be necessary. Yet, these situations often backfire and erode trust. People that feel (or know) information was withheld, positioned, or postured will be much more suspect of future information they receive. Building trust requires complete honesty, even when it is painful for one or both parties of

the communication. Over-communication is preferable; the more people feel they understand the facts and motives, the more readily they will trust.

Integrity, the second behavioral attribute, involves people doing what they said they would do. Making a commitment builds hope. Further, agreeing to a request either implicitly or explicitly connotes a promise. Therefore, it is critical that leaders make commitments explicit so there is no confusion or misunderstanding regarding

what has been promised. Then, leaders must fulfill those promises. Doing so builds trust and models the behavior they expect to see in others. If employees sense the leader allows, accepts, or values behaviors other than those requested, they will begin to doubt his or her sincerity and lose trust. Again, it is not merely intentions that will be judged but the ability to deliver. So it is better to promise the report by Friday and deliver on Thursday than to promise Thursday and miss the deadline. Over-promising is a leading killer of trust. People will not trust others they feel cannot deliver, especially if the individual has failed to deliver in the past.

Tenacity involves determination and perseverance even in difficult situations. This attribute is a key component of consistency (one of the core elements of trust). People trust leaders who behave predictably. Tenacity requires that leaders prioritize their commitments and meet them, regardless of other emergencies that arise. It is not always possible to maintain every commitment, so a good rule of thumb is to ask: Which commitment, if broken, will have the greatest long-term impact on relationships and trust? Often the last-minute owner or client request, if unmet, will do less to erode trust than failing to deliver on a long-ago promised dinner with a spouse. In fact, when individuals say they can't promise x, y, or z because of a prior commitment, it builds trust. The other person sees this as evidence of the person's character and tenacity about fulfilling commitments.

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**People make mistakes. That's life. What is important is the response.**

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Accountability means taking responsibility for any unkept promises. Renegotiate any deadlines as soon as possible — before missing it. This requires honesty and candor about the situation, rather than hopefulness. It also requires courage for the person to admit he or she is unable to meet

expectations. However, this will help to clarify priorities by distinguishing which projects the person can extend. Still, the most important piece of being accountable is not the renegotiation. It is apologizing for failing to fulfill the commitment and taking responsibility to “right” the situation and rebuild trust with the offended party.

## REPAIRING TRUST

Regardless of an individual's diligence and dedication, there are probably times when that person has failed to fulfill commitments, been caught in a “white lie,” or has otherwise damaged trust in a relationship. People make mistakes. That's life. What is important is the response. All types of relationships are built and nourished

by trust. The key to rebuilding trust is to start with accountability and honesty. Admit the mistake. Take appropriate responsibility, and commit to righting the wrong. Clearly explain what is intended to remedy the situation. Follow this with integrity and tenacity. Follow through on those promises, no matter what. The more frequent and/or severe the violation, the longer it will take to restore trust. Trust is not restored or repaired often through a single “right” act, but typically requires demonstrating a pattern of trustworthiness and over-delivery on promises. Despite the effort, it is almost always worth the investment to restore trust. It is critical for maintaining trust in other relationships (word travels fast), and for generating speed and efficiency in the workplace.

The concept of a united owner-designer-contractor team all dedicated to the common purpose of a successful project is essential in today’s construction environment, and the foundation of all real teamwork is trust. Absence of trust is the failure on the part of team members to understand and open up to one another. It stems from not admitting mistakes, weaknesses, and concerns for fear of reprisal and is evidenced by a lack of healthy debate within the team.

People view technology often as the solution to the majority of problems businesses face daily. Technology can bring people together, but it also leaves them feeling more disconnected and isolated. While technology is an important tool for leaders, over-reliance and misuse can be costly. In the current rapidly changing business environment, “softer” skills like trust carry even greater importance. True credibility and confidence cannot be created through e-mails or text messages. Character, competence, and consistency reveal themselves in the every day, face-to-face interactions between people. To build truly powerful and trusting relationships, leaders must focus their energy less on their BlackBerry and laptop and more on developing deep personal relationships with their followers. The majority of communication occurs through nonverbal means, and relying too heavily on technology to communicate can create miscommunications, lead to procrastination, and create a disconnect between the message sent and the message received. If leaders wish their interactions to be truly fast and efficient, building trusting relationships will be far more effective than relying on technology alone. ■

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**True credibility and confidence cannot be created through e-mails or text messages.**

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<sup>1</sup> Watson Wyatt is a global consulting firm focused on providing solutions to organizations about people and financial issues.

# Intelligent Buildings: A Win-Win for Stakeholders

Market opportunities continue to develop for the IB environment, and yet, confusion still exists about contractors' roles in this market segment.

*By Ken Roper and Layne Newton*

**W**alking through the door of a small lecture room in a large public university, the lights automatically turn on. Speakers hang from the wall, as well as a projection television that the computer at the helm of the class operates. The class begins, the professor writes on the sensitive computer screen, and the lights instinctively dim to reduce glare. The professor's notes are automatically captured and e-mailed to the students once class finishes.

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Further, the professor's lecture is streamlined in real-time so students unable to attend class can login via the Internet and phone and participate in the lesson. We always knew people in universities were smart, but when did the buildings get that way?

Paralleling the growing demand for intelligent and sophisticated people is the demand for intelligent and sophisticated buildings — buildings that not only hold intelligent beings but also are intelligent themselves. An "intelligent building" (IB) is one that provides a productive and cost-effective environment through optimization of its four basic elements. These four elements include the building systems, structure, services, and management. For all of these elements, the key objective is to maximize solutions for the occupant's needs. IBs help building owners, property managers, and occupants to realize their goals in the areas of cost, comfort, convenience, safety, the environment, long-term flexibility, and marketability. Successfully implementing an

IB environment creates increased occupant productivity and satisfaction.

Market opportunities continue to develop for the IB environment, and yet, confusion still exists about contractors' roles in this market segment. Clearly, this emerging market will continue to evolve. Those choosing to participate will experience

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**IBs offer a balanced approach to all project stakeholders, including owners, managers, users, and the local and global communities.**

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a competitive advantage. Traditionally, too much emphasis is placed on the initial cost of a building project vs. the value of the final product as determined by occupant satisfaction and total life-cycle costs. IBs offer a balanced approach to all project stakeholders, including owners, managers, users, and the local and global communities.

#### **BUILDING OCCUPANTS**

The primary purpose for any commercial building is occupancy. An IB improves on that deliverable by providing easy access, comfort, an environmentally friendly and safe setting, and services that contribute to

productivity. What's more, it minimizes environmental disruption from the building and ensures the building's long-term functionality. Desirable characteristics for occupant objectives include:

- Comfort and air quality
- Occupant-based HVAC
- Individual occupant lighting control and energy feedback
- Automatic system optimization and performance verification
- Appropriate materials use
- Environmentally safe (LEED Certified)
- Connection to outside services.

IBs connect the building's IT system with the building automation systems (BAS), which provides good thermal and visual comfort to all occupants. Rather than uniform lighting, temperature control, and ventilation, control is site-specific to the location of the occupants. Occupants control these conditions, and the building systems automatically adjust to the occupants and integrate with all building systems to meet the building performance objectives. While people are in an IB office, they can control their climate, making them comfortable and more productive. Alternatively, when they are out of the office, the temperature adjusts and the lights are turned off, saving energy and money.

To enhance buildings' efficiency, connectivity with the outside environment is fundamental. Off-site monitoring, fault detection, and remote

maintenance are integral parts of the IB’s network systems. For example, on average, 28 deficiencies require correction upon a building’s commissioning.<sup>1</sup> Commissioning ensures that each building system is working optimally and remedies any disparities prior to occupancy. The initial commissioning carries less than a five-year ROI.<sup>2</sup> With an IB, owners can maintain building efficiency and avoid any additional disparities. Remote maintenance of the BAS ensures the building continues to work optimally, which, in turn, continues energy, time, and money savings.

Energy cost, maintenance, productivity enhancement, lower life cycle costs, and increased occupant satisfaction translate to higher rents and increased resale values for IBs. Economic analysis reveals a different focus for the IB building process. (See Exhibit 1.) Whereas construction cost is typically a major part of a buyer’s mentality, with an IB, this becomes secondary.

Exhibit 1

Economic Analysis of an Intelligent Building

		(30,000 SF) Extension of Costs
Construction cost	\$150/SF	\$4,500,000
Energy costs	\$1.57/SF	\$47,100
Maintenance and operations	\$8 SF	\$240,000
Market rate rent	\$25 SF	\$750,000
Space per occupant	250 SF per occupant	120 Occupants
Average employee costs (salary \$40,000 plus average benefits \$12,000)	\$52,000/year	\$52,000/year
Employee cost impact per SF	(\$52,000 x 120)/30,000	\$208.00
Investment for intelligence	\$15 SF	\$450,000
Category	Estimated Benefit	Benefits (per SF/Year)
Energy savings	12.00%	\$0.19
Operational savings	10.00%	\$0.80
Employee productivity	1.00%	\$2.08
Rental rate over market	4.00%	\$1.00
Occupancy improvement	4.00%	\$1.00

Economic Benefit Analysis		
Initial investment in intelligence		\$(450,000)
Annual benefits		
Energy and operational savings		\$30,000
Employee productivity		\$62,400
Rental rate over market		\$30,000
Occupancy improvement		\$30,000
Total annual benefits		\$152,400
Net investment year one		\$(297,600)
Payback years based on investment		2.95
Return on investment over five years		20.58%

ROI Calculation	
YR 0	-450,000
YR 1	152,400
YR 2	152,400
YR 3	152,400
YR 4	152,400
YR 5	152,400
ROI	20.58%

Source: Ehrlich, P. (2006). Why your next project should be an intelligent building. AutomatedBuildings.com. Retrieved 6/22/07 from www.automatedbuildings.com

## BUILDING OWNERS

Most developers and owners are not convinced that the IB system design and customization will justify their investment. Securing the low bidder is still important to owners on most projects. Systems integrators and suppliers will need to demonstrate the ROI and will play key roles in future IB projects. The economics of these future projects will focus more on total life-cycle costs. Cisco Systems and other suppliers

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**The importance of combining sustainability and building intelligence allows for building flexibility, which will only become more important in the future.**

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see a significant opportunity for their products in this emerging market. While contractors will install the required systems, systems designers, engineers, and suppliers will play major roles in project development. The retrofit market is ripe for these technology innovations since limited internal structural changes are required.

The current trend for LEED certification fits perfectly with the IB process. On average, Americans spend 90 percent of their time indoors.<sup>3</sup> This fact, coupled with growing concerns and knowledge about the environment, indoor air quality, day lighting advantages, energy consumption, and reusable materials, makes these projects

more attractive and mutually beneficial to owners. The importance of combining sustainability and building intelligence allows for building flexibility, which will only become more important in the future.

Higher occupant satisfaction translates to higher rents and lower vacancy rates. Personnel costs can exceed 100 times annual energy costs.<sup>4</sup> For these reasons, it makes economic sense to satisfy occupants. Most owners rely solely on complaints or casual communication to evaluate occupant satisfaction. However, IBs could potentially be networked to help owners determine occupant satisfaction in an effort to maintain high levels. Higher occupancy satisfaction and lower vacancy rates are key in projects' economic analysis. Combined with higher resale values, higher investment in front-end construction costs is justifiable. IBs represent an exciting opportunity for the owners and contractors engaged in the process.

## CONTRACTORS

The opportunity for contractors is enormous. Sites, materials, design, installations, structure, systems integration (see Exhibit 2), building maintenance, and economic analysis

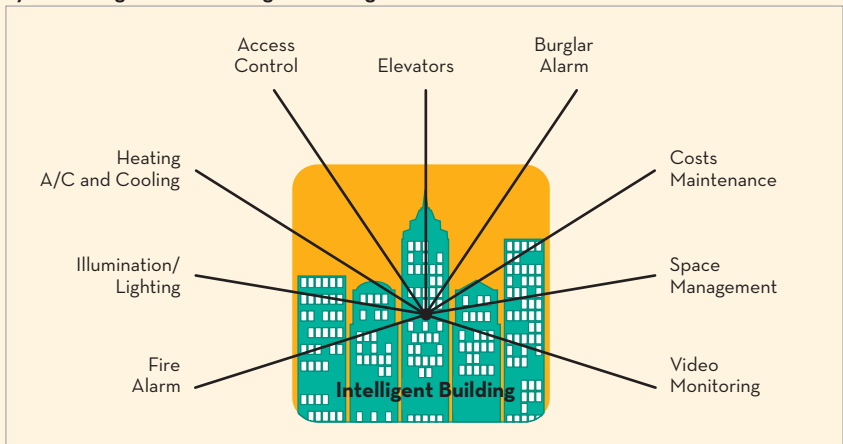
Exhibit 2

**Systems Integration: A Metaphor Between Working Environment  
And Human Senses, and the Senses of an Intelligent Building\***

**Systems Integration: Working Environment and Human Senses**



**Systems Integration: An Intelligent Building**



\* Huhtanen, 2000

Source: Himanen, M. (2003). *The Intelligence of Intelligent Buildings: The Feasibility of the Intelligent Building Concept in Office Buildings*. Technical Research Center of Finland

will all change. Contractors embracing the concepts and proactively moving into a position of competency will be market leaders. Some example IB projects illustrate a few of the possibilities. An airport has many distinct systems that operate lighting, HVAC, security, fire detection, and other airport services. Imagine a scenario in which all these disparate systems are manipulated with a single control. As a flight taxis to a gate, the systems anticipate the arrival and activate the air conditioning and lighting at the gate. As the luggage begins to enter the baggage claim areas, the lighting and air conditioning systems activate. Health care centers act in the same way. Computers housed in patients' rooms makes physicians' orders clear, lessening any chance of misdiagnosis. Also, rooms can transform from a patient's room with space for the family, to a surgical area, to a triage center. With its high demand for space, IBs are a natural progression for health care construction and development.

IB construction takes on a different sequencing and execution. The current method involves a carpenter hanging the doorframe and then installing the hinges, lock, and hardware. With IBs, the door may contain an electromagnet and an electrical hinge, a panic bar, and an access control system, requiring an access card and an electronic strike. All of these system components require proper sequencing



and installation. Coordination and collaboration is paramount with systems designers and engineers in addition to all the other project parties. Lack of coordination typically ends up in finger-pointing and a non-productive outcome.

Furthermore, for the contractor, there is a significant opportunity in outsourcing the operations of the IB. For the owner who does not outsource, a major predicament will be personnel turnover among building operators who know how to manage and maintain the IB. All the capital investment will

be moot, if three years down the pike, a replacement operator only knows how to cut things off and on, rather than use the sophisticated, delicate controls available. This means a continuous training opportunity for contractors (for pay) or simply providing the skilled operators themselves.

Contractors involved with green and LEED building already have a step up in IBs. Six credit categories are considered in LEED buildings, two of which strongly correlate to IB: energy efficiency and indoor environmental quality. Contractors who are shifting roles to understand the synergistic interactions of combining the shell, glazing, HVAC, and electric systems, in addition to cost and constructability feedback, assessment and measurement will have the advantage in both IB and green building projects.

## OPPORTUNITY

A significant challenge equals a substantial opportunity. Most people are in business to bring value to the public while making money. IBs represent an opportunity to develop and construct valuable buildings that are efficient economically and environmentally and that are enduring. Contractors wanting to take advantage of this opportunity should begin thinking about their company's skills and unique value proposition for owners. Develop an understanding and knowledge base for the information technology involved. For example, an electrical contractor will need to know how power metering and monitoring will tie into the network. For a lighting contractor, the required knowledge will be understanding how wireless, mesh networking fits into the system. Begin to develop relationships with building

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**IBs represent an opportunity to develop and construct valuable buildings that are efficient economically and environmentally and that are enduring.**

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owners and collaborate on what future industrial, commercial, and residential occupants will need in the space.

IB core competencies involve understanding all the economics of life-cycle costing; this knowledge alone presents a persuasive argument that sells the value of the IB project. Occupant productivity gains, reduced operating costs, and future impacts on resale value are implied benefits of the process, but owners will need to be convinced these are attainable. A design and contractor team must prove technical competency for the design and installation process. Building a resumé in the process will take time and involve a learning curve as the teams build this competency.

Building value for owners is a contractor's goal and responsibility. IB offers a unique way to do this, and getting there first offers a strong competitive advantage to those that are qualified and capable of delivering. ■

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<sup>1</sup> Commissioning LEED for New Construction Projects, 2005 U.S. Green Building Council. <http://eetd.lbl.gov/emills/PUBS/Cx-Costs-Benefits.html>

<sup>2</sup> Mills, E., Friedman, H., Powell, T., Et AL., (2004). *The Cost-Effectiveness of Commercial-Buildings Commissioning: A Meta-Analysis of Energy and Non-Energy Impacts in Existing Buildings and New Construction in the United States*. Retrieved 6/22/07. <http://eetd.lbl.gov/Emills/PUBS/Cx-Costs-Benefits.html>

<sup>3</sup> The Total Exposure Assessment Methodology (TEAM) Study. EPA 600/S6-87/002. U.S. Environmental Protection Agency. 1987. <http://www.epa.gov/ncepihom/>.

<sup>4</sup> Higgins, C. (2004) *Benefits Guide: A design Professional's Guide to High Performance Office Building Benefits*. New Building Institute. P. 31

# Why Construction Has Technology Turtles

The construction industry remains a laggard in the world of technology adoption. Despite this, some remarkable applications have hit the industry recently.

**By Glenn Matteson**

**C**hange does not always come easy for the construction industry. Contractor focus is on the present, given pressing schedules, daily or hourly production targets, unpredictable working conditions, ambiguous design documents etc. The resulting slower technology adoption rate is worsened by the limited education and training of the rank and file in the industry. Where else do you still find the daily hours for a piece of equipment written in the dust on the cab's window for the mechanic or person fueling the equipment to record? Or, where else would you hear a foreman respond, "line one or line two?" when asked if he ever "goes on line" to research a problem.

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Despite this, some remarkable applications have hit the industry in recent years. Compared to other industries such as communication, consumer electronics, data processing, manufacturing, and most service industries, however, construction remains the laggard. The technologies exist today, but the challenge lies in understanding how to apply them effectively. Design and project delivery tools have arguably made the greatest advances through technology in the industry today. BIM, collaboration

software, and design sharing all are having major impacts. However, one area could produce the greatest economic gains from technology's progress, and yet it is undoubtedly the most ignored — field productivity and field management.

Construction is the largest employer in the country, and most of the industry's employees are in the field. Labor is quickly becoming the chokepoint for successful project delivery in all segments. Skilled labor, whether in a trade or supervision, is an even more precious resource and one that has been recognized as critically important

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**Construction is the largest employer in the country, and most of the industry's employees are in the field. Labor is quickly becoming the chokepoint for successful project delivery in all segments.**

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for the industry and the economy as a whole. Needed infrastructure development and replacement can be postponed or, worse, be hit with unacceptable quality as labor scarcity looms. The trade press is filled with articles and promotions directed at increasing the quantity and quality of the American construction labor force. Here is where technology can have its most significant impact. During the 1990s, technology was a driving force that propelled world productivity beyond levels ever seen. The decentralized personal computer engaged powerful software tools that allowed industries, institutions, governments, services, and individuals to produce more goods and services faster, with less effort, and with better quality. Economists also attribute this dramatic gain in productivity as a causal factor in helping to tame

inflation. Consumers could consume more. Goods and services avoided the upward price pressure derived from increased demand. Supply could keep up with demand without increasing unit costs ... the power of productivity. Given the labor shortage, this powerful means of increasing productivity is one of the most valuable applications in construction today. Let's examine two specific areas where technology is just beginning to contribute to productivity increases in major ways.

First, equipment productivity is an extension of labor productivity. Granted, bigger, stronger machines can improve output, but they also require greater capital outlay and higher operating costs. Leveraging equipment productivity simply through larger machines may not be the complete answer. Applying those machines in a smarter way can be even better. Most heavy/highway and civil contractors today know very little about how their equipment actually behaves on the job site day to day, hour by hour. They do not know how much fuel is wasted through idling engines. They generally do not have the time or manpower to deal with the long-term consequences of weak maintenance programs or ineffectual equipment management practices. Productivity slips away in small, incremental pieces that are hard to notice because these pieces are of little or no consequence at 40-cent fuel rates and are nearly impossible to capture in metrics.

Today's "GPS" (global positioning system) solutions, as they are generically and erroneously called, were originally technologies in search of an application. Many in construction still share that view today: "Our equipment management is pretty good. We've been successful for 50 years without any black boxes tattling on the operators." Interestingly enough, similar comments were heard 20 years

ago about cell phones, 50 years ago about hydraulics, and even 100 years ago about internal combustion engines! Granted, most suppliers of "GPS" or telematic systems originally did not understand the construction industry. Meanwhile, wireless carriers and the automotive and transportation industries such as truckers and rental-car or used-car companies used this technology quite effectively for logistics management and security. Extrapolating and modifying the hardware into construction was not difficult; the difficulties lay in understanding construction's needs and applications because the construction industry itself does not know or have a consistent knowledge of equipment management and production management. It is often still just "grind-it-out" by field supervision and sometimes by clever crisis management. All the effort is manual, the knowledge tacit. The combination is, therefore, difficult to replicate or pass from one manager to another. Not until enough people from construction studied telematics and asked the appropriate questions about features and capabilities did this technology become a true aid to productivity. It took some knowledge of how to apply the technology, not just knowledge of its availability or how to create the technology.

Accurate cycle times, logistical planning of material movement, quantity measurements, and a disciplined management approach to the technology measures are having a tremendous impact on field productivity and management. Six Sigma teams using telematic technology have documented incredible successes. The "black box" originally designed to supply hours and locations can now be set to measure "events." Initially, events meant warnings about machine health, such as an engine overheating or excessive hydraulic pressure. Very quickly it became obvious that other "events" could be captured precisely in time and location. They could be recorded, communicated in real-time, and consequently acted upon to improve production results. Load counts, material quantities, and dump or load times are measured; engine idling time is identified; and maintenance/fueling procedures are optimized. Certain telematic solutions now offer the ability to automatically report the fuel consumed on any diesel engine as well as the rate of consumption over the course of the day. Such data can help identify

when the machine was idling and when it was working. The aggregated fuel use can more accurately indicate when service intervals are needed. Without any additional administration, this technology can also drive compliance with emissions requirements many states are now implementing. Fuel costs can be decreased significantly.

All of these results are positively affecting the users of heavy equipment, and subsequently, their customers are receiving faster, less costly projects. Daily feedback to the crews is accurate and automated, providing a better incentive to manage more effectively. Automatic job cost integration of equipment's actual hours can help control idling time, improve estimating rates, and reduce owning and operating costs. Raw data and hours can be fed into a job-cost system with or without cost codes. This eliminates the field's hoarding, "gamemanship," or just guessing as they manually record equipment time. An industry first, downtime, can now be definitively measured, allowing a real comparison between equipment brands, models, job sites, and operators. Production can increase on every job. The equipment hours are automatically sent each morning to the respective foreman or superintendent where they can be cost-coded via error-proof touch screens and communicated automatically back into cost accounting systems and master scheduling programs. Even the long-term aspects of managing the fleet are greatly enhanced with accurate utilization data. Hourly owning and operating costs become a truer picture, allowing much more empirical analysis on repair vs. replace decisions and overall fleet size, composition by make/model, owned, rented, leased etc. The value of all these equipment management and equipment productivity improvements are compounded when the overarching labor crisis confronting the industry is considered. More can be done with fewer or less-skilled people when it comes to equipment management and improving its productivity.

Exhibit 1 shows a hauling application for a 70-ton rigid frame truck. It works two shifts (purple and orange) and clearly shows a difference in production and fuel consumption. The graphed lines indicate the gallons per hour (vertical axis) being

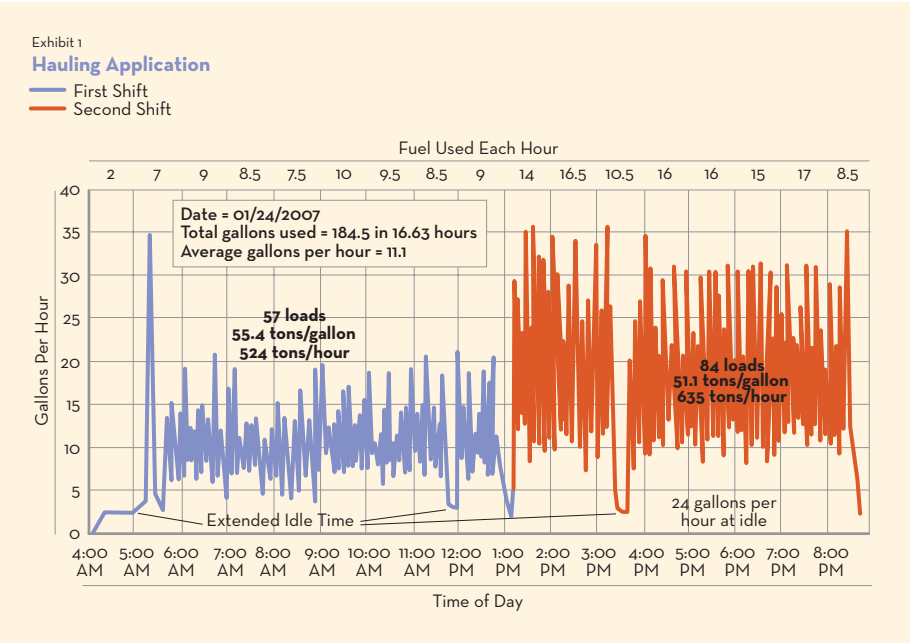
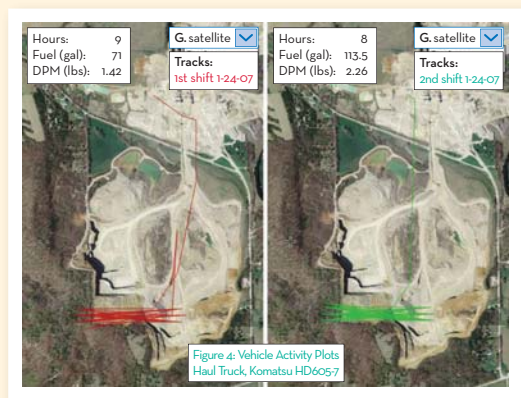


Exhibit 2  
Quarry Operator's Satellite View



consumed at the time of day (horizontal axis). The rise and fall in consumption rates are due to the cycle of loading, running, dumping, and returning.

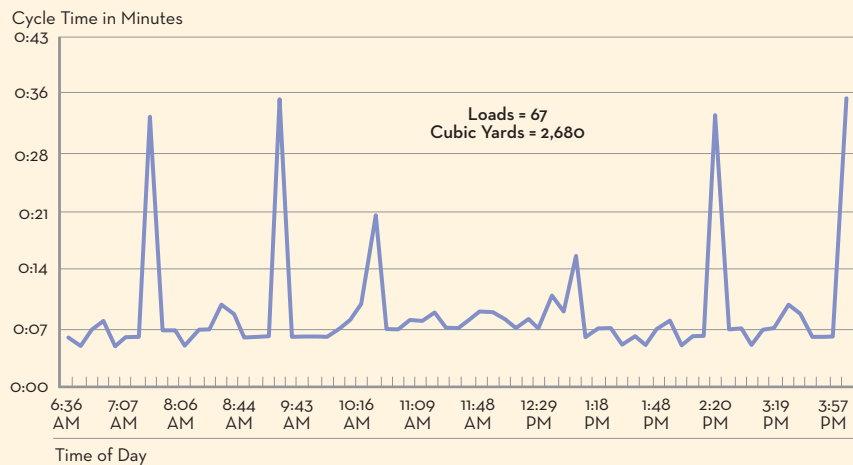
The telematic device counts the loads with a proximity switch on the dump bed, and a probe in the intake manifold measures the fuel consumption. All the data is reported once or twice per day. This quarry operator chose a satellite view (see

Exhibit 2) that clearly shows the truck was working the same area, doing the same task for both shifts. Why the difference in production and fuel burn then? Another report showed the loader was a smaller size in the first shift and took almost twice the time to load the haul truck than a larger loader used in the second shift. The second-shift truck operator was able to run faster, produce more, and not wait to be loaded. The first-shift truck operator lowered his speed and burned less fuel, but moved less material, avoiding a wait to be loaded by the smaller loader working another truck.

This technology is applicable to almost any production application — asphalt paving, mass excavation, grading, concrete placement etc. The fuel totals can be compiled into any type report or database as needed. Hard data can verify production rates used by estimating or in quantifying force account work.

Cycle times can be measured directly. (See Exhibit 3.) The spikes represent delays the truck faced over the course of the day. The telematic device can transmit this

Exhibit 3  
Production Measurement  
Production Cycle Times and Load Count on Truck No. 1162 — May 22, 2006



information at midday to spot-check the morning's production, and managers can make adjustments as needed.

Jobs, supervisors, or operators can be compared and recognized for their achievements. Some contractors simply post these production charts in the field trailer or shop, and the behavioral change is practically automatic. Again, the technology designed for equipment reinforces the results expected from labor.

The second piece of technology we'll discuss directly impacts all labor. When you distill this industry down to what makes a project successful, there are really only a few elements: strong estimating with clever or innovative means and methods, solid project execution, and good luck! Since the last item is more a function of the first two, let's start by looking at project execution. After all, effective execution will provide the strong estimating and means and methods for the future. The obvious

technology play for project execution resides with the project manager's communication and analysis tools. A less obvious technology, which can overshadow even the best PMs and the whiz-bang gadgets at their disposal, directly aides labor. Almost any job description for a superintendent or foreman includes the words planning and scheduling. Projects have varying degrees of complexity, but all contain risk elements related to unknown or changing conditions. The planning and scheduling are intended to mitigate that risk. While it sounds good in theory, in practice, the majority of field managers are overwhelmed by surprises, the enemy of planning and scheduling. The reasons for surprises are numerous and widely known, but difficult to correct. They can begin with the drawings, plans, and specifications. They can be unforeseen as in literally underground or behind a wall. They can be humanly manufactured by assumptions, indifference, ignorance, improper motives etc. The list goes on, and the surprises multiply. They are worsening, too, as projects grow more complex with increased oversight, regulations, cost escalations, litigious attitudes, and generally confrontational mindsets working a zero-sum game. Pair these features with a shrinking manpower base that knows how to deal

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with it, and it's easy to get discouraged. Technology can help with the planning and scheduling in the field. A pair of critical challenges faces the field supervisor: having the ability to accurately communicate the nature of the surprise and then dealing with the subsequent delay in receiving answers. Push-to-talk voice communication has helped, but in some circles it is regarded now as a hindrance with garbled "streaming consciousness" and irritating chirps flooding the airwaves. Construction labor and supervision are generally visual in their approach to problem solving. Construction is a three-dimensional, tangible world in which the visually attuned can excel.

Continuous feedback and communication reduce the time delays between questions and answers, but the physical separation

among field, construction management, designer, and owner, and lack of visual support for assumptions have hampered effective communication ... until now.

Paperwork can be the bane of field managers, but it's the primary conduit of communication between the groups just listed that can overcome the surprises. Errors, incompleteness, and time lapses in paperwork hinder this communication form. Tediousness, obsolescence, superfluous requests, and outdated process flows can compound the ineffectiveness of paperwork. Technology today can use dynamic forms, coupled with wireless communication, to eliminate most of these problems. Photographs, voice recognition, text-to-speech, database, and server flexibility can all be tied together to improve one of the most valuable resources in construction. Today, it is feasible for the on-site field manager, armed with this technology, to solve a surprise within minutes instead of hours or days. Not only is the speed of the solution increased by an order of magnitude, but also the accuracy of communication is digitally perfect, and the parties involved have precise documentation. A typical solution like this is a "tablet" computer coupled with wireless communication and a simple built-in camera. Tablets differ from laptops in that a keyboard is not needed. Handwriting and selecting with drop-downs using a stylus or even a finger are not necessarily new, but when combined with a custom, dynamic form built specifically for that company's processes, the results can be amazing. Other sources of data input include barcode scanning, RFID (radio frequency identification), IR (infrared), GPS, Ethernet cables etc. Telepathic brain waves are not quite there yet, but just give it a little more time!

Input can be controlled programmatically, avoiding erroneous or data-entry errors. The forms can be changed in the field by authorized managers. Forms or RFIs with photos and real-time annotations from the field can be distributed immediately as an e-mail to all concerned. Answers with photos, drawings, revised plans, authorizations,

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**Construction labor and supervision are generally visual in their approach to problem solving. Construction is a three-dimensional, tangible world in which the visually attuned can excel.**

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directions, explanations, change orders etc., are sent back in real-time. Field managers can then focus on what they do best — building things. Electronic documentation provides substantiation of the project's progress and all the aspects derived from that documentation. Imagine a job without delays or confusion because of surprises!

Could old-fashioned, improved planning and scheduling reduce surprises and consequently the flying of bits and bytes to and from electronic tablets? Remember that one of the more pressing issues facing the industry is the shortage of skilled labor and management. This technology can improve a mediocre or less-experienced field manager and help to develop the next generation of field managers as it “removes the pain of paperwork.” This technology can even translate between Spanish, English, and most of the world's languages and provide feedback about the field's performance in real-time.

It is well-known that field managers are motivated to complete their paperwork by seeing the benefits of that paperwork, or the results of their labor. It's human nature to want to know, “How am I doing?” This technology can communicate in reverse to the field, providing that feedback. Job-cost reports, production targets, schedule milestones, personnel issues, and any written communiqué can be dynamically created and instantly shared. Another interesting trend from this is the rise of the “surrogate PM or scheduler.” A key tool for the field manager is the short-interval planner. A detailed outline of tasks, their expected durations, and required inputs are spelled out for a one- to two-week period. It often resembles a small, simple CPM. Traditionally, the typical field manager will complete the initial form as required by the job, but will not use it. The form will be neglected because of the work required to update it and the fact that the schedule changes before it can be updated. Drop-down boxes and touch screens allow the field manager to update activities on the tablet. An off-site manager can receive the inputs, review the impact, and

make necessary changes, reminders, notifications, or corrections. Again, as the dearth of qualified field people hits our industry, a single skilled manager can assist or even oversee multiple projects simultaneously with appropriate technology.

Other applications in construction are enhanced or even re-invented using technology. Estimators and design professionals

get real-time feedback on their means, methods, production calculations, and assumptions about job-site conditions. Site inspections are visual, universally shared, and logged. Owners are updated. Vendors are brought closer to the job and can partner with the contractor. Material management, lay down, layout, and fabrication become easier. Safety is controlled and, more importantly, better implemented. Dangerous conditions and practices can be dealt with faster. Contract control is

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## Real-time wireless documentation and data that help control labor and equipment productivity are just two of the emerging technologies applicable to the construction industry.

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managed effectively when combined with PDF formats that prevent any changes to or copying of the electronic document without cited controls or notes. Any contractor with a service department has a whole new dispatch and control system. Imagine a service-tech armed with a tablet that can be dispatched immediately to the next job. The tech can complete all material requisitions, check multiple parts inventories, review customer and equipment histories, access technical manuals or parts books, generate invoices, get live technical help, and document existing conditions with photos; the list goes on and on. The efficiency gains are only limited by the imagination. Heavy equipment mechanics realize all these same benefits. Repair time is cut and, more importantly, downtime is reduced.

Real-time wireless documentation and data that help control labor and equipment productivity are just two of the emerging technologies applicable to the construction industry. They may not be the high-profile tools used by designers who model entire structures or developments, but they impact the largest number of people in the industry. Labor and equipment account for the greatest risk to productivity, and any tool that helps manage that risk is important. The adoption of these two kinds of technology will happen rapidly once the early success stories spread. The field people using this technology will start demanding it wherever they apply for work. The contractors not prepared to provide it will lose out on not only the benefits of the technology, but also, perhaps more importantly, will lose the people who expect to use it on the job. The technology, as often is the case, originated in other industries, but as we better understand its features, the better we will become at reaping its benefits. ■

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# Practice Makes Perfect

Contractors that figure out how to help improve the performance of their utility owner clients become invaluable to these same clients.

*By Mark Bridgers and Kathryn Robinson*

**W**hat are the most successful business strategies? The ones that are mutual and repeated. B.C. Forbes,<sup>1</sup> founder of Forbes Magazine and father of Malcolm Forbes, said it best: “Any business arrangement that is not profitable to the other person will in the end prove unprofitable for you. The bargain that yields mutual satisfaction is the only one that is apt to be repeated.”

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Said another way, contractors that figure out how to help improve the performance of their utility owner clients become invaluable to these same clients. FMI’s experience mirrors this sentiment and is borne out in a recent nationwide best practices study. Undertaken in 2006 by FMI’s utility vertical-market team, this study worked directly with the 20 largest natural gas utilities in the United States. These utilities use a mixture of internal and external (contractor) crews to perform construction, and FMI surveyed and interviewed these field resources to establish the production impact. The study goal was to establish a statistical link between an underground utility firm’s capital construction performance and the construction management and field management activities utilized. The following items were observed:

- When field crews exhibited frequent use of 21 critical management practices, productivity was the highest and cost the lowest.

- Owners that concentrate outsourcing with the fewest service providers, or perform the majority of these functions internally (another form of concentration), lower total capital cost.
- Owners that collaborate and/or integrate with this smaller number of service providers demonstrate the lowest overall capital construction cost.
- Contractors that demonstrate frequent use of critical field practices and choose to work with owners that concentrate and collaborate, generated the total highest revenue growth and profit margins.

While the results of our study are specific to utility owners and contractors, the gains available to both owners and contractors are applicable across all industry segments. In an unrelated study conducted through the support of the Construction Management Association of America (CMAA), owners achieved a 30% lower

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**While the results of our study are specific to utility owners and contractors, the gains available to both owners and contractors are applicable across all industry segments.**

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management cost.<sup>2</sup> This was achieved through the combination of pursuing high-value relationships with service providers and focused outsourcing of non-core activities, or through the purchase of holistic program management services.

Utility owners who integrated specific applications in the following seven best practice areas achieved superior productivity and low capital costs. For example, owners that worked directly with union representatives or external contractors to jointly implement the 21 critical management practices achieved significant improvement in performance. In the case of the owner, this shows up as a faster schedule or lower cost performance while the contractor has the opportunity to increase margins.

These best practices are highly controllable and each owner can choose to implement them, and contractors can choose to work for owners that exhibit them. In combination, these seven areas were the source of observed capital construction cost differences in the owner companies that participated in the study. Contractors who focus on helping their client improve any of these seven areas will reap the benefits of an improved owner-contractor relationship and simultaneously increase both their own as well as their client's profitability — creating a mutually beneficial relationship and one likely to be repeated in the future.

#### SEVEN BEST PRACTICE AREAS

- **Use of Contractors** — Use of third-party contractor crew resources on specific types of construction to achieve greater productivity
- **Use of Internal Crews** — Use of internal construction crew resources on specific types of construction to achieve greater productivity

- **Overhead Containment and Management** — Owner use of overhead cost resources to produce greatest output
- **Relationship and Approach to Third-Party Contracts** — The contractual, organizational, and cultural fit characteristics related to the use of third-party contractors for completion of projects
- **Internal Coordination** — Effective interaction between market fulfillment, design, construction, and material distribution/logistics management
- **Culture** — The customary beliefs, social forms, and material traits that help define how individuals tend to behave and respond in the work environment, resulting in efficient and effective organization as measured by output and financial performance
- **Field Management** — Use of field management practices to produce the greatest output

While all of these best practice areas help owners reduce their overall capital cost, they are also potential profit opportunities for contractors. Contractors that can help an owner lower the capital spend yet achieve the same output become indispensable. Perhaps the most immediate benefits can be achieved in the area of field management practices. Our study revealed that this area creates significant opportunity for contractors to improve both their own performance and the performance of their utility clients. This best practice area revolves around how contractors, and more specifically, how field labor/management is applied to put capital construction in place.

## FIELD MANAGEMENT

Our assessment of the effective use and implementation of 21 critical field management practices delineated those utilities that demonstrated superior performance and those that did not. The differences in performance related directly to the frequency of use of the 21 critical field practices.

In addition, we segregated responses from internal crews used by utilities and contractor crews in order to compare and contrast their feedback and relationship to performance. Historically, many utilities used internal crews to perform significant portions of their capital construction program. Today, outsourcing for capital construction is much more frequent, and internal crew skills on necessary capital construction are weaker today due to reliance on contractors. It is much more likely that internal crews are handling traditional operations and maintenance functions within the utility. When we compared both contractor and internal utility crews and contrasted their answers to the following questions, we found fascinating differences.

- Are there productivity differences between contractor and internal utility crews?
- What field management practices offer the greatest impact to overall construction performance?

- What efforts should utilities undertake to improve field performance with their internal crews?
- What efforts should contractors undertake to improve field performance with their crews?

Overall, the analysis demonstrated significantly higher productivity levels for utilities using contractor crews. FMI measured footages installed over a fixed time period and used a cost per foot measure calculated as the amount spent on field crews divided by the total feet installed. Exhibit 1 compares the best performing utilities and the poorest performing utilities based on how frequently they use contractor crews vs. internal crews. The poorer performing utilities use internal crews more frequently and install approximately 50% of the footage achieved by the higher performing utilities. The resulting cost per foot demonstrates a differential of \$6.46 or an improvement potential of 40% for these poorer performing utilities.

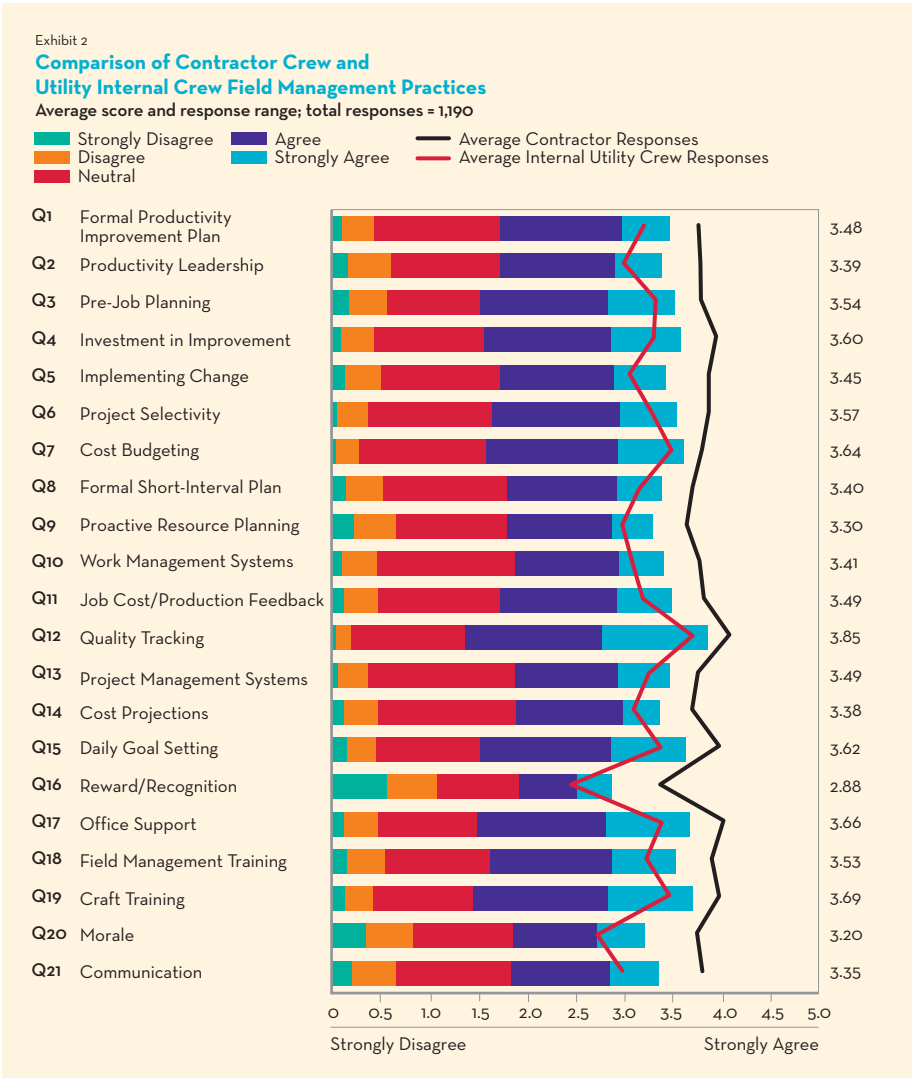
What management and labor practices allow the best performing utilities and their contractors to achieve the nearly 50% improvement in feet installed? Contractor and utility crew field management, crew leader(s), and crew members were interviewed, observed, and asked to respond to a standard survey instrument. Each individual rated their personal use and perceived effectiveness of 21 field management practices using a five-point Likert<sup>3</sup> scale. Exhibit 2 demonstrates the differences in practice use. Of the 21 questions from the survey, 20 of them demonstrate a relationship to performance. Our broader analysis that segregated utility employees from construction employees is more remarkable. The bars in Exhibit 2 represent the results of the over 1,000 survey responses. The black line represents the average contractor-supplied responses from approximately 500 crews, while the red line represents an additional 500 responses exclusively from the internal utility-crews performing capital construction.

The results demonstrate a 0.5 to 1.0 rating-point differential, where contractor responses are rated higher and demonstrate a strong relationship to the higher productivity observed. In no case did the contractor responses yield results below 3.0 or neutral, while the internal utility crews rated five questions below 3.0, indicating disagreement with the statement. Ultimately, the study demonstrated that as the perception (field crews, crew leaders, and supervisory staff) of field management practice improves, capital construction costs decrease, and productivity increases, which makes more effective and efficient field forces.

Exhibit 1  
Utility Field Productivity

Combined Productivity	Contracted Value	Owner Crew Value	Total Construction Value	Feet Installed	Combined Productivity
Top 50 Average	\$38,561,699	\$10,324,297	\$48,885,997	\$5,106,507	\$9.57
Bottom 50 Average	\$30,787,480	\$10,469,537	\$41,257,018	\$2,573,199	\$16.03

Note: Top 50 Average represents the half of the utility study participants who demonstrated the lowest capital cost vs. the Bottom 50 Average representing the half of the utility study participants who demonstrated the highest capital cost.



Of all the processes studied, three demonstrate the strongest connection to driving lower construction costs and higher productivity:

- **Project Selectivity** focused on understanding which work was best suited to the crews available to perform it.
- **Quality Tracking** focused on ensuring that work put in place was installed correctly the first time.
- **Craft Training** focused on ensuring field forces were highly skilled in both technical and, more importantly, crew management techniques.

Exhibit 3 demonstrates the responses separating contractor and internal crew perceptions. The differences in observed performance and perceptions indicate that there are different opportunities for improvement depending on if field forces are supplied by a contractor or employed by the utility. Contractors that understand these differences can better position their services to add the greatest value in support of utilities attempting to drive capital cost lower. The greatest opportunities for



Exhibit 3

**Contractor vs. Internal Utility Crew  
Performance Improvement Opportunity**

Contractor Crew Opportunities		Internal Utility Crew Opportunities	
Q7	Cost Budgeting	Q2	Productivity Leadership
Q9	Proactive Resource Planning	Q5	Implementing Change
Q14	Cost Projections	Q8	Short-Interval Planning
Q19	Craft Training	Q9	Proactive Resource Planning
		Q10	Work Mangement Systems
		Q20	Morale

*Note: See Exhibit 2 for contractor and utility crew response differences to each question listed above.*

improvements in field productivity for both contractor crews and internal utility crews are detailed in Exhibit 3.

Utilities and contractors alike share most of these areas of opportunity since each requires the other to make the changes needed to achieve the resulting productivity and bottom-line benefits. For example, utilities that share work and labor resource need forecasts with contractors enable these same contractors to drive performance and productivity improvement among their crews by improving the cost budgeting and proactive resource planning processes. Without this utility information, this improvement opportunity becomes much harder to achieve, making mutual satisfaction elusive.

Deals that yield mutual satisfaction are the only ones that will be repeated and the only ones that can drive long-term relationships, boosting contractor growth and margin achievement. FMI's 54 years of experience has witnessed contractors' ability to build high-value relationships that result in significant financial performance

improvement. In the case of contractors, we have seen an ability to absorb short-term growth rates greater than 15% with no deterioration in net margin, in combination with driving improvement in labor productivity of greater than 10% through integration with key clients. The ability to absorb and digest this change is a challenge for contractors and has been the source of many contractor failures over time.

A general belief exists that 10% improvement in productivity is far too large to be achieved. As a frame of reference, in an eight-hour day, eliminating 9.6 minutes of wasted time equates to a 2% improvement in labor productivity, and capturing 48 minutes yields a 10% improvement. This is well within reach for nearly all contractors, and something as simple as getting crews to the job site by 7:00 a.m. vs. 7:30 a.m. can bring forth this improvement. Recapture of this time goes directly to the contractor's bottom line

Exhibit 4  
Contractor Performance Improvement Results

	Original		10% Labor Productivity Improvement and 15% Revenue Growth	
	Dollar	Percent	Dollar	Percent
Sales	30,000,000	100.00	34,500,000	100.00
DIRECT COSTS				
Labor	6,369,000	21.23	6,687,450	19.38
Materials	10,938,000	36.46	12,578,700	36.46
Subcontracts	7,176,000	23.92	8,252,400	23.92
Equipment	2,493,000	8.31	2,866,950	8.31
Total Direct Costs	26,976,000	89.92	30,385,500	88.07
GROSS PROFIT	3,024,000	10.08	4,114,500	11.93
Overhead	2,313,000	7.71	2,313,000	6.70
NET PROFIT BEFORE TAXES	711,000	2.37	1,801,500	5.22
Variance From Original Budget Dollars	—		1,090,500	
Variance From Original Budget Percent		0.00		153.38

and can yield a 3% improvement in net margin, in effect doubling the average operating profit margin of 3% that is consistently observed across the entirety of the construction industry. Exhibit 4 demonstrates these potential gains showing a 15% increase in revenue tied to a 10% improvement in labor productivity. The impact is significant for the firms able to implement these strategies.

What is this worth for utility owners? As described previously, a 30% improvement in management cost, improvement in field productivity, and lower overall capital spend are all available. The academic definition of a win/win outcome is achieving something that neither party could achieve on their own. In this case, it means combining a doubling of contractor profit while lowering overall capital spend for the owner. ■

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<sup>1</sup> Bertie Charles Forbes (May 14, 1880–May 6, 1954) was a financial journalist and author who founded Forbes Magazine. B.C. Forbes was born in New Deer, Aberdeenshire, in Scotland. In 1897, after studying at the University of Dundee in Scotland, Forbes worked as a reporter and editorial writer with a local Dundee newspaper until 1901 when he moved to Johannesburg, South Africa, where he started up the “Rand Daily Mail.” He immigrated to New York City in the United States in 1904 where he was employed as a writer and financial editor at the Journal of Commerce before joining the Hearst chain of newspapers as a syndicated columnist in 1911. He left Hearst after two years to become the business and financial editor at the New York American where he remained until 1916. He founded *Forbes* magazine in 1917 and remained Editor-in-Chief until his death in New York City in 1954, though assisted in his later years by Bruce Charles Forbes (1916–1964<sup>1</sup>) and Malcolm Stevenson Forbes (1917–1990), his two oldest sons.

<sup>2</sup> Management cost is defined in the survey as the combination of internal construction management and oversight costs in addition to external, or outsourced, program management, construction management, and oversight costs.

<sup>3</sup> A Likert scale is a type of psychometric response scale measuring either positive or negative response to a statement and is often used in questionnaires. It is the most widely used scale in survey research. When responding to a Likert questionnaire item, respondents specify their level of agreement to a statement; traditionally a five-point scale is used ranging from strongly disagree to strongly agree. A typical test item in a Likert scale is a statement where the respondent is asked to indicate their degree of agreement. Likert scales may be subject to distortion from several causes. Respondents may avoid using extreme response categories (*central tendency bias*), agree with statements as presented (*acquiescence response bias*), or try to portray themselves or their organization in a more favorable light (*social desirability bias*).

# Reach for the Stars

FMI's 2007 *U.S. Construction Industry Talent Development Report* reveals several of the issues and challenges companies are facing in the ongoing war for talent.

**By Kelley Chisholm**

Is it possible to create and maintain a talent-focused culture while building employee commitment? The answer is yes, but not without hard work, a clear vision, and supporting strategies.

For more than 15 years, FMI has surveyed construction firms nationwide in order to identify current training and development practices, challenges, and trends that are influencing the industry.

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This year, the report was expanded to take a critical look at talent development in a broader context. While many of the training and development questions from previous surveys were included, *FMI's 2006-2007 U.S. Construction Industry Talent Development Report* examined several of the issues and challenges companies are facing in the ongoing war for talent, including recruitment, performance management, succession planning, and retirement concerns.

## **SURVEY RESPONDENTS/ROLES**

Nearly half (48%) of the survey respondents were general contractors, followed by heavy/highway/utility (17%), mechanical/plumbing (13%), electrical (7%), specialty trade (4%), residential (2%), construction managers (2%), and others, such as specialty contractors and residential production builders (7%). (See Exhibit 1.) Forty-three percent reported annual revenues of \$100 to \$499 million, followed by 37% in the \$50 to \$99 million range. Over half of the respondents (57%) were

Exhibit 1

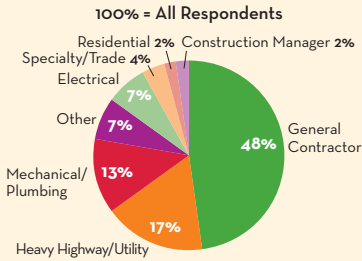
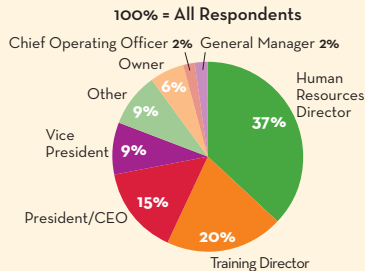
**Primary Type of Work**

Exhibit 2

**Role of Respondents**

training or human resource directors, who fully understand the urgent need for talent development and the challenges with successfully attracting, recruiting, training, and retaining their most important asset — their people. (See Exhibit 2.)

**BUDGETS AND EXPENDITURES**

Eighty-two percent of respondents indicated that they prepare a yearly budget for training activities. This number has steadily increased to 74%, the number of respondents who were budgeting for training last year, from just 54% in 2003. According to the American Society of Training and Development's (ASTD) 2005 *State of Industry Report*, companies spent 2.6%, which is consistent with other U.S. companies.<sup>1</sup> In the ASTD report, training expenditures were presented for three groups: respondents to their survey (BMS), large Fortune 500

companies (BMF), and organizations from their Best Awards Program (BEST). As Exhibit 3 illustrates, ASTD projected companies would spend between 2.25% and 3.16% of their payroll on training in 2005. These figures match FMI's survey findings.

**RECRUITING RESOURCES AND TOOLS**

To stay ahead in the talent wars, successful recruitment strategies require aggressive tactics. Sourcing qualified candidates can be demanding and time consuming, taking time away from other dollar-producing activities. Being recognized as an employer of choice is one way to attract talent, and this may be achieved by branding and marketing the company's image in targeted media outlets, web sites etc. The faster good candidates are identified and hired, the less money the company will spend on advertising, interviewing, and selecting an individual for the position.

Over three-quarters of those surveyed used internships or co-op programs as a recruitment tool. (See Exhibit 4.) Internships are usually a win-win situation, as they allow employers and the interns to use actual on-the-job performance as a real measurement for future success and fit. Advantages to hiring former interns included increased retention rates of new employees and reduced training times.

Internal employee referral programs were also very popular, with 73% percent of respondents saying they used them. Research indicates that these programs yield high-quality hires while decreasing the amount of time spent on hiring. Current employees know the company's culture, and are likely to recommend candidates they believe will be a good fit for the organization. Since first-rate referrals reflect well on the referring employee, they will strive to identify top candidates and avoid poor performers.

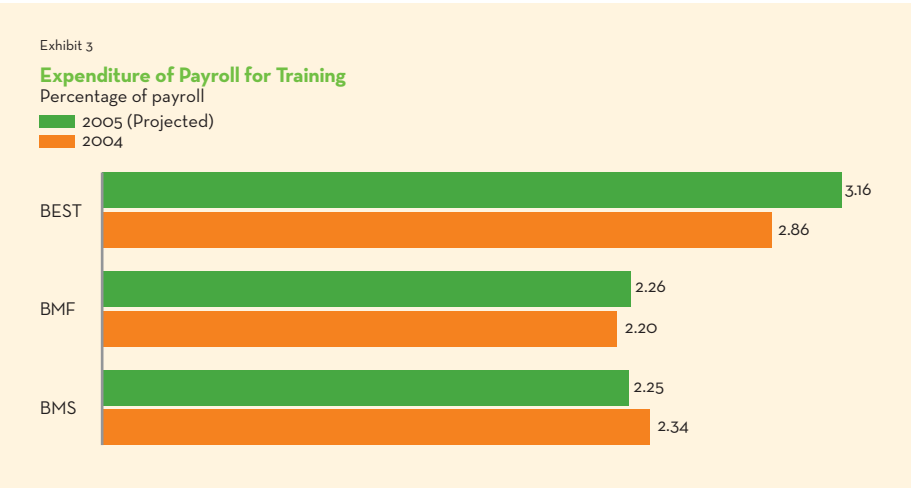
Posting job openings on company web sites rounded out the top three recruiting tools, with 68% of respondents indicating this is how they searched for talent.

**HOT TRENDS IN TRAINING**

Over the past several years, FMI has examined a variety of trends in training and developing employees. Previous trends included online coaching, simulations, blended learning, and mini-360 feedback, just to name a few. This year’s survey highlighted some new electronic trends that companies nationwide are employing to assist in employee learning, including building information modeling, mobile learning, and wikis.

**Building Information Modeling**

The National Institute of Building Sciences defines a building information model (BIM) as “a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its life-cycle from inception onward.”<sup>2</sup>



BIM allows a company to keep project information up-to-date and fully integrated within a digital environment. This easily accessible digital environment provides project managers, engineers, owners, and builders a clear vision of the

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**BIM allows a company to keep project information up-to-date and fully integrated within a digital environment.**

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project goal. It also supplies information to make more accurate and timely decisions about a project, increasing both quality and profitability.

The Associated General Contractors (AGC) recently published its *Contractors' Guide to BIM*. The guide outlines best practices for contractors using BIM to virtually build hospitals, hotels, bridges, offices buildings, and more, using intelligent computer software that helps simulate construction. According to an article in *Cadalyst* magazine, "BIM is changing the face of the construction industry, making collaboration the top priority in the execution of a project. BIM methods

are ensuring that everyone on the team — from the architect to the general contractor and the specialty contractor to the supplier — is working from a real-time, living model of the project."<sup>3</sup>

Les Snyder is COO of Barton Malow Company, headquartered in Southfield, Mich., and consistently ranked among the top 10 builders in the nation in their niche markets. He is also one of the co-authors of the *Contractors' Guide to BIM*. *FMI Quarterly* had a chance to speak with him about BIM.

**FMI Quarterly:** Your web site points out that you are using BIM. Is this for all of your projects?

**Snyder:** Right now not all projects are compatible with BIM, and there are a variety of circumstances that surround that issue. However, when we have control over deciding to use BIM, we do so 100% of the time.

**FMI Quarterly:** How has BIM helped reduce the time between actual design phase and project completion?

**Snyder:** BIM is actually the tool that leads to much better ultimate collaboration between all parties, which includes owners, contractors, designers, architects, mechanical, electrical, structural, subcontractors etc. It allows collaboration to happen far earlier in the process.

BIM usage widely varies to the degree that it is used. The degree of use determines how much speed you can put into the process. Our best use of BIM at Barton Malow has been with a manufacturing client, and we're on our ninth major project with them. By driving collaboration to its ultimate, we are constantly improving the process. With BIM and 3D modeling, we're now incorporating information, which used to be in the shop-drawings phase after construction started, before we ever break ground.

**FMI Quarterly:** What training is involved, and how long does it normally take someone to become proficient in BIM?

**Snyder:** Let me divide that into two categories: technical and cultural training. Technical training depends on the degree of computer familiarity and skills. Some of our employees who are already familiar with AutoCAD are proficient in about 90 days. For others, if they want to be trained, we first determine what part of BIM they need to learn, and then we focus on that objective. While it could be months, that's really a short amount of time in the big picture. We are willing to invest in training so that the proper people are able to use it.

The cultural aspect of the training is still being defined. It is a key point because BIM's lead in collaboration is enabling more rapid decision-making. It really depends on how much an individual is willing to accept the new culture. Those embracing BIM are picking the culture up quickly and realizing the efficiencies and teamwork from it early on in the project.

**FMI Quarterly:** Do you see any generational differences as far as people accepting and integrating BIM into their projects?

**Snyder:** Generational differences absolutely come into play here. On the technical side, those of us who did not grow up in a completely electronic world, find it more difficult. The younger generations are more attuned to accepting new cultures, and new means and methods of applying techniques. They generally pick up this knowledge more quickly and are thus able to apply it faster. On the opposite end, we do have some superintendents who have been in the business for years, and they have seen what BIM can do and are embracing it.

**FMI Quarterly:** In addition to increased collaboration, what are some of the other advantages of BIM?

**Snyder:** On the projects where BIM is used as a tool to encourage further collaboration, it really lends itself to lean construction. Let me give you a simple example. In the past where 3D modeling or BIM was not used, you'd go through the shop-drawing process. Say you're doing ductwork; it would be fabricated in a shop and then taken to the field for installation. There might be some cuts and bends and things that need to be adapted in the field because of other coordination issues. In a 3D model using BIM, most of that is already taken care of. We can go to the site, take the ductwork off the truck, and put it right into place since everything has already been coordinated. We save the waste from materials in the field. We save labor used to modify the fit. Lean construction, or "leaner" construction, is clearly a major benefit of BIM.

**FMI Quarterly:** Do you see any drawbacks to BIM?

**Snyder:** Absolutely, although it's unfortunate. With any new technology, the rate of adoption varies widely, and with that people speculate on its eventual adoption. Others worry about legal ramifications. There are insurance questions, and other issues. However, we don't think we can do worse with 3D. Time will tell.

### Mobile Learning

Mobile learning, sometimes referred to as m-learning, is learning accomplished with the use of small, portable, wireless computing devices. These devices include smartphones, portable digital assistants (PDAs), and portable digital media players such as iPods® and Tablet PCs. One of the advantages of mobile learning is that training and information sharing can be provided on location, anywhere in the world.

Smartphones are becoming more sophisticated with major features that include Internet access, e-mail capabilities, messaging services, graphics, downloads, built-in cameras, and navigation devices. The voice aspect of a cell phone may be used to teach employees new languages, public speaking, and writing skills. These phones now come with memory cards, and companies are creating downloadable teaching programs that can be used anywhere for information sharing and training purposes.

Portable digital media players have upwards of 60 GB of memory and store everything from music, videos, and text, including PowerPoint presentations and spreadsheet files. The opportunities are many to seamlessly create, organize, distribute, and access all types of information and training material. In combination with other software, these portable media players can connect to any TV or projector to present material. One example of how portable digital media players such as iPods® can be used by construction companies is to teach basic ESL courses through podcasts. A podcast is an audio file that is downloaded from the Internet. According to the Bureau of Labor Statistics (BLS), almost one-third of the construction workforce is Hispanic,<sup>4</sup> so using this technology would especially benefit firms with non-English speaking employees. There are numerous courses available in a variety of languages.

One of the most sophisticated forms of mobile devices is the Tablet PC. Relatively light-weight (approximately three to four pounds), Tablet PCs



are fully-powered personal computers with technology that allows the user to operate it with a stylus or digital pen instead of a keyboard or mouse. By interacting directly with the screen, the PC is comfortable and easy to use, especially out in the field. Most models are equipped with handwriting and voice recognition features. Because of their large-screens and high-resolutions, online courses are easy to read on tablet PCs. They can be used as collaboration tools and for advanced interactive simulations, just like regular PCs and laptop computers.

While technology in and of itself does not ensure better learning, it can help focus a learner's attention and sustain his or her interest by relating new information to what he or she already knows. Businesses that realize the potential increase in productivity and efficiency resulting from being able to disseminate information and train on the fly will fully leverage its potential.

#### Wiki

A wiki is simply a type of web site where unlimited users may create or edit existing content on simple web pages from any browser. Wikis support hyperlinks and have a simple text syntax for creating new pages and links between internal pages on the fly. They are largely open-source and web-based. One of the reasons wikis are gaining in popularity is because they are so easy to use, much like e-mail. They can serve a variety of purposes, such as document management and project management, and allow individuals and teams to collaboratively write and edit documents without the need for knowledge of HTML or special tools. There are a number of wiki software packages available for immediate download on the Internet, and many of them are free.

Wikipedia ([www.wikipedia.org](http://www.wikipedia.org)) is one of the most popular wikis. Launched in 2001, it contains over 1.5 million articles on literally thousands of topics in a variety of languages, including Spanish, French, Japanese, Chinese, Russian, and Italian, to name a few. It has steadily risen in popularity since its inception, and currently ranks among the top 10 most-visited web sites worldwide.

#### PCG BEST OF CLASS

The *Talent Development Report* featured a number of "best of class" construction firms. One of those companies, Performance Contracting Group (PCG), developed a customized knowledge management system to help track employee training and development needs. Based in Lenexa, Kan., PCG is an employee-owned specialty contractor with annual revenues of \$700 million and more than 50 offices throughout the United States. In 2006, PCG once again held the No. 10 spot in *ENR Magazine's*

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**While technology in and of itself does not ensure better learning, it can help focus a learner's attention and sustain his or her interest by relating new information to what he or she already knows.**

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ranking of the top 600 Specialty Contractors in the United States for the second year in a row.

One of PCG's strategies for retaining talent included the development of a customized knowledge management system, which incorporated a strong learning management system (LMS) component. According to Gordon Pinsky, director of strategic development at PCG, several different committees worked together to establish and launch their LMS. His department first determined the exact processes used by the company's top five branches, and how the individuals in those branches performed their jobs. They identified 21 generic, primary processes used by all construction branches such as processing payroll, payables, billings, collections, setting up jobs etc. Once these processes and the related, specific activities were identified, Pinsky's team decided which activities to standardize. The result was 21 operating procedures, one for each primary process, that clearly spelled out what was mandatory vs. what was optional.

The team then assessed who needed training and managed the process through their creation, the Training Assessment Guide (TAG). Three different working groups, consisting of administrative staff, estimators, and project managers, determined the sub-steps and the skill sets needed for each of the processes. These were grouped into three levels of competency: awareness, working knowledge, and full-mastery. The final step was to assign the correct level of competency needed for each position in the branch.

The TAG system was built in-house, using an SQL database in a Windows environment. It includes a user guide with detailed instructions on how to:

- Use the skills assessment input screens
- Review or update individual skills
- Read and use the self-evaluation reports
- Submit information to managers for approval
- View training needs for the next promotable level
- View a summary of one's proficiency levels for all skills
- Find and access training resources for all skills.

Most employees reacted positively to the new TAG database, while some managers initially resisted the new system, fearing that it was going to create a great deal of extra work for them. *FMI Quarterly* recently spoke to Pinsky to learn how the TAG database is continuing to be implemented. The system is readily gaining acceptance, he said. The company originally developed TAG as a tool for employees to track their needs and for instructors to query who needed training and in what areas. In their last review period, senior managers were anxious to get their departments' group totals. They wanted to learn what their branches and divisions looked like — which employees were ahead and which

ones were behind in terms of specific knowledge and skills. Pinsky said this desire for access to the data revealed the system's benefit and use. The next evolution for TAG will be additional soft skills such as leadership development, negotiation skills

etc. This is a big goal for PCG as the company expands its focus from training employees to developing them to support the strategic objectives of PCG.

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## The war for talent is here, and how we choose to maneuver to come out on the winning side is up to us.

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The war for talent is here, and how we choose to maneuver to come out on the winning side is up to us. In order to remain sustainable and successful in the knowledge-based, global economy of our present industry, construction companies must continually invest in their human capital. Organizations that strategically address the need to develop talent through recruiting and hiring, training

development and delivery, performance management, career pathing, and evaluation will maintain a competitive advantage and win the talent wars.

To obtain a copy of FMI's *2007 U.S. Construction Industry Talent Development Report*, which has been highlighted in articles written for *Engineering News-Record*, *Forbes.com*, and numerous trade publications, please contact Kelley Chisholm. ■

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<sup>2</sup> Davis, Dianne (2007). National Building Information Model Standard NBIMS. National Institute of Building Sciences Facilities Information Council. Retrieved on June 29, 2007, from: [http://209.85.165.104/search?q=cache:Cku29oYqgXoJ:portal.opengeospatial.org/files/%3Fartifact\\_id%3D20644+agc+definition+building+information+modeling&hl=en&ct=clnk&cd=5&gl=us](http://209.85.165.104/search?q=cache:Cku29oYqgXoJ:portal.opengeospatial.org/files/%3Fartifact_id%3D20644+agc+definition+building+information+modeling&hl=en&ct=clnk&cd=5&gl=us)

<sup>3</sup> AGC releases Contractors' Guide to BIM (2006). Cadalyst Magazine. Retrieved on June 26, 2007, from: <http://www.cadalyst.com/cadalyst/article/articleDetail.jsp?id=375968>

<sup>4</sup> Stakes, V. Bridging the safety gap with Hispanic workers. Retrieved on June 15, 2007, from: <http://www.contractormag.com/articles/column.cfm?columnid=569>

# Software Systems and the Construction Organization

If companies put as much organizational commitment into their system strategy as they do time and money into the software itself, they would experience a dramatically different result.

*By Christian Burger*

**S**uccessful use of new information systems or major modifications to existing systems is as dependent upon people and organizations as the technology itself.

Christian Burger, a long-time systems consultant to the construction industry, shares his perspective on how companies can get more value from their IT investment by changing the way IT is managed within their organizations.

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Companies have to realize that systems are a lot like exercise equipment; it is only through use that they have any value. Ownership alone provides little benefit except maybe a false sense of security that you are buying something inherently “good.” Management should always look internally at their organizations and the teams who will be implementing the new systems before making the financial commitment to buy new software. Questions to ask include:

- Is the team prepared for this undertaking?
- Do they understand the mission and expectations?
- Do they have the resources and time available to do the job well?
- Is the organization ready for the required degree of change?

Training has long been a neglected expenditure in the construction industry. Contractors spend all kinds of time and money on safety training, even equipment training, and with good effect. However, when it comes to system training, managers have a harder time seeing the correlation between system training and increased productivity or effectiveness.

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## Training has long been a neglected expenditure in the construction industry.

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Some larger U.S. construction companies are taking a “university” approach to training, investing in a dedicated training coordinator with specific curriculum and a set schedule. In these cases, training is mandatory, not optional. With safety training, you don’t have to spend much time on “why” it is important. If you have been in the field for any length of time, you

know the stories or have experienced the consequences of poor compliance with safety standards. In this case, training on “how” is most important. Systems are a little different. Here, not everyone understands the “why.” Therefore, training on new systems and processes should spend 40% of the time on:

- What the new system can do for the organization (e.g., efficiency, control, information)
- Why this is important to the company (e.g., better bidding, lower down time for equipment)
- How everyone’s use of the system and compliance with processes will make a difference.

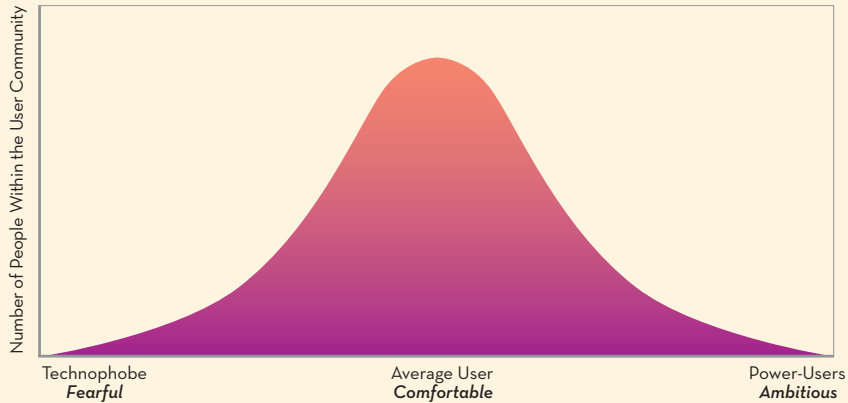
The other 60% of time can be spent on how to perform data entry, which reports to run, and the like. Also included should be a clear message from management stating that using these tools is not a personal choice. If an excavating contractor had a foreman who preferred to have his crew do trenching using shovels, he would be shown how to use a backhoe, encouraged to use a backhoe, and then dismissed if he couldn’t adapt. Yet, this isn’t the case in many estimating departments. Some companies have installed estimating systems, yet still have two or three estimators continuing to use spreadsheets as their personal method.

Many construction companies begin their systems implementations poorly, fundamentally undermining their own efforts to get high adoption rates. They often overlook the need to prepare the organization, commit the resources, and provide clear direction on what they are trying to achieve.

Within a construction company or any organization, the user community can be grouped into three categories: the technophobes, the masses, and those on the leading edge. On a bell curve, the masses are obviously the middle group and represent anywhere from 70% to 85% of the organization. (See Exhibit 1.) They are OK with systems and technology if it works and makes their job easier, but they won’t necessarily be the source of innovation. They are also not particularly patient when it does not work. Technophobes will be little help in getting new systems deployed, but if they

Exhibit 1

### Dispersion of User Proficiency Within Typical Construction Organizations



are handled correctly, can be less of an obstruction than usual. And with proper guidance, those on the leading edge can be fairly helpful in a new system rollout.

When first using a new piece of technology, whether it is an iPod, GPS device, or portable DVD player, we are generally thrilled when it works and often disappointed when it does not. How someone reacts to new technology is largely dependent on which category (technophobe, masses, or leading edge) the person falls into. Individuals on the leading edge are likely to work patiently through any issues that arise. The main body of the user community can be depended on to use systems adequately when they are operable and call for help when they are not, but not much more. The technophobes of course only need a small malfunction, even if it is their own fault, not to adopt or use the new tool.

So what does all this suggest? It is critically important to have the new system or technology working bug-free before deployment. Way too much technology gets rolled out from the manufacturer before it has been completely tested. The consumer pays a big price for this, but then so does the manufacturer in terms of increased support calls and higher warranty costs. The companies experience latent costs such as low adoption rates, lost momentum, and generally ineffective use of the new tool. This is where technology frontrunners can help.

The individuals most likely to persist in working through systems issues in testing are the technically ambitious. These individuals understand and accept new technology's flawed nature and can work through it. Often, these people see the new system's benefit or value and work toward achieving it. Ultimately, it is when this group has worked through these issues with the

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new technology that it is ready for the next stage of the rollout process: the masses. Much of the risk of a new system deployment will have been eliminated at this point, and some individuals within the company will now understand how the system works, have helped to debug it, and can be proponents of it within the organization.

Those who are afraid of the technology or are easily intimidated by it require more work. One suggestion to aid this group's adoption is to provide training to one or two of these individuals on the new tool. When others in the company see that one of their peers got something new, they will start to become curious, finding out more about it, and ultimately asking for one. They will at least be open to training on the new tool, at this point. Every organization will have a few individuals who are unable to be converted into a user of the new technology. Management must ultimately decide what to do here — whether to spend more time on training and coaching or let them go. But keep in mind that the cost of non-compliance by one individual is more than just one person not using the system. It sends a message to the organization

that use or compliance is optional. When this person is either a titular or social leader, the negative message is amplified.

Another position that has proven invaluable in system implementations and deployment is the super-user. You won't find the super-user on any organizational chart, and the position certainly does not follow conventional line/staff reporting. Instead, the super-user is someone from within the user community who has decided that they really

like a particular system, understand it well, and enjoy showing others how well it can work. Many construction companies have someone in this position for their project management system, like Prolog or Expedition. The person is or has typically:

- Been to formal training on the application,
- Used it for a few years,
- Gotten creative in the use of the system,
- Been considered an advanced or power user,
- Understood the value of the application to the organization,
- Kept current on upgrades and enhancements,
- Developed some documentation, and
- Enjoyed sharing the power of the application with others.

With that kind of skill set, you have an internal champion, someone who can leverage the application within the organization. This person can keep the application fresh for the organization, train new users, help some of the less-adept users learn the basics, and help debug the program when problems arise. A construction company should have someone in this position for every major application. The person should see the position as a challenge and a positive career move. Some small incentive should be considered for the effort even though few taking the position would accept it for that reason.

You might be thinking: what about the IT department? Shouldn't they have a role in all this? The answer is "yes," but it might not be what you would expect. Fifteen years ago in systems and software implementation, someone in data processing was either told to build an application or buy one and make it work. Then this person rolled it out to the organization, usually well after the demand for the application had changed or diminished. Today, the most progressive companies have a different view of IT. First, IT is typically busy

with infrastructure, communications, and security. These are all critical functions and almost always a full-time job. So they don't have the kind of time it takes to learn and get involved in applications. Second, they don't have the expertise or knowledge of the process and requirements to make an application work. Only the users do. Many IT managers and CIOs now take a different position when it comes to supporting the technology needs of their company. For example, when someone from estimating, accounting, or another department comes to them and says, "We need a new application," the answer tends to be, "OK, how can we help you?" In the old days, the reply would have been, "OK, give us three months and let us see what we can find."

IT can:

- Help a department or team search for systems effectively,
- Ensure the vendor and technology are viable,
- Negotiate the license agreement,
- Develop an implementation plan,
- Install the software and ensure it runs effectively on the network,
- Help with data conversion, and
- Develop custom reports or integrations, if required.

Otherwise, a new application should be the responsibility of the user community. They are the ones who have to decide how badly they want a new system, if they are willing to make it work, and what they need. IT-backed initiatives are almost always destined to become shelf-ware or marginally utilized systems, at best.

To ensure that new systems or technology are going to be effective, careful selection is critical. This also involves people from within the user community. It also requires due diligence. Frustration with your current system may make many alternatives look good, resulting in a quick purchase without careful thought. One of the most significant parts to a good selection is input and buy-in from users. IT may be able to discern the merits of the database or technology associated with one system or another, and certainly someone in this group will want the most ambitious solution available. However, these are not important criteria.

A small team of users or potential system users should be given the task of selecting

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**To ensure that new systems or technology are going to be effective, careful selection is critical.**

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the new system. The make-up of the team should mirror the spectrum of users, including one naysayer. This ensures all perspectives are heard, and the least progressive team member will ensure everyone else does not forget who the users are. Oftentimes, just being on the team will convert a naysayer into a willing participant. The selection team should ask the following questions of the vendor or dealer:

- Who else, like us, is using this software?
- Can we talk to someone from these companies?
- How many people from our organization are required to implement the system?
- How much time commitment is required from each of these individuals?
- How many new system sales were made last year? During the previous year?
- How often do maintenance releases and upgrades come out?

Countless articles have been written on the subject of software selection and methodology. The following are just a few key principals that directly relate to the organizational commitment necessary to manage an implementation well.

**Expectations** are everything, and people typically work in the wrong direction when it comes to setting them. What is promised from the software in a brochure, during a demo, or on a web site can happen, just not typically on the first day. As an implementation manager, it is better to keep expectations low in terms of delivery and high in terms of challenges and hard work. Then, if it is actually easier than planned or if the system does provide some important deliverables immediately, you look amazing.

**Consistency and accountability** are common terms tossed around at the beginning of implementations. Standardization is too for that matter. The only problem is management lacks the willingness to follow through and “walk the walk,”

thereby letting everyone know that non-compliance is an option. Many of those who resist the standardization often think that their creativity is being infringed upon. Oftentimes, the functions they want to have freedom with don't add that much value to begin with or are important but only if everyone does it consistently (e.g., change-order processing or forecasting).

**Process-orientation** is something else companies do not consider carefully enough. Implementations of new software systems almost always involve changes in processes. The biggest mistake companies make is holding on to older conventions that were in place from many years ago and have little to do with the required outcome. Then

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**The biggest mistake companies make is holding on to older conventions that were in place from many years ago and have little to do with the required outcome.**

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they spend thousands of dollars and add considerable risk to the implementation trying to make the new system behave like the old.

If you are reading this and are part of the upper-management team, or you are the upper manager, don't assume you have a small role in the implementation. Top managers in any company have two important roles. Your first role is Executive Sponsor. Years ago, implementations were taken on with little or no oversight from senior management. Someone was

tasked with "making it work" and then left to figure out how to do that. When resources were pulled, disagreements about process came up, or the vendor didn't meet commitments, this project leader had nowhere to go. As the Executive Sponsor, you are committed to the project, or at least the project goals. While the sponsor isn't involved in the day-to-day issues, this person is available for the project manager in terms of reinforcement, resolution, or clout. Your second role is to send a clear message to the rest of the organization that the efforts of the implementation team (or individual) are important.

If companies put as much organizational commitment into their system strategy as they do time and money into the software itself, they would experience a dramatically different result. They will also develop a culture and an attitude within the organization that embraces change and technology to support those changes. ■

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**Christian Burger** is a principal of Burger Consulting Group, a consulting firm in Chicago, Ill., dedicated to the information systems needs of the construction industry throughout the United States and Canada. For more than 15 years, Christian has worked with contractors on software selection, implementation management, IT strategy and planning, and the evaluation of current systems. He may be reached at 630.942.1875 or via e-mail at [crburger@burgerconsulting.com](mailto:crburger@burgerconsulting.com).

# Succession for Boomers

Succession for a successful business is a good problem to have, but not easy. A number of changes for baby boomers are making the transition more complex.

*By Stuart Phoenix*

**F**MI has helped contractors plan ownership transitions since 1971. Our succession planning practice grew out of our management consulting business triggered by the familiar scenario of soldiers returning from World War II, starting a construction business, and wanting to figure a way out of the business by the 1970s.

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Much of what business owners need now in planning a transition is the same as it was three decades ago. For the baby boomer generation, however, we are seeing a number of changes that make planning more complex and that require it to be more comprehensive.

Some of the changes in succession for boomers are:

**Companies are larger.** Growth in the American economy has meant greater opportunity for the construction industry. The result is that successful companies are larger in revenues, profits, asset-base and are more complicated to manage.

**People are living longer.** Longer life-spans mean potentially longer retirements or longer careers.

**The industry is more complicated.** There is more regulation, a more diverse labor force, and more sophisticated clients. Businesses, therefore, are more complex to manage for the next generation.

**Generation X employees require different management than boomers.** Attracting people to the industry and providing effective leadership has always been a challenge.

**Boomers want to retire differently.** Retirement used to involve ceasing work and perhaps moving away. Boomers may want to retire sooner, or stay and reduce their role. In addition, upon retirement, they may seek another career or activity to keep them engaged.

**Investment alternatives are more confusing.** Boomers are looking for less risk and more diversification when selling their business. Stocks, bonds, cash, and real estate used to be the prime categories for investment. With the difficulties of the markets, particularly since 1999, hedge funds, international investments, and private equity, among others, have been increasingly sought as investment vehicles.

**More third parties say they want to buy construction businesses.** The mergers and acquisition community is very active, and most business owners are inundated with inquiries, real and false.

**Tax law affecting ownership transition has changed.** Tax rates, estate law, S Corporation, LLC, and ESOP rules have all changed, making planning simpler in some cases and more complex in others.

The changes listed above have created new challenges to succession planning. Let's consider them one by one.

## COMPANIES ARE LARGER

Larger companies require more money to buy out the selling stockholders and greater management/leadership capabilities in the next generation to run the business. Some of the largest companies have developed a culture around employee ownership. For example, Kiewit and PCL maintain broad employee ownership and a detailed mechanism covering share pricing and stock offerings. Both companies serve as excellent examples for privately held companies wanting to remain private.

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**Boomers are looking for less risk and more diversification when selling their business.**

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Making this work for Kiewit and PCL is an arguably conservative valuation for stock transactions and the ability to develop talent. A conservative valuation puts less strain on the company's balance sheet in a transition while developing people ensures succession and a strong management team to drive profitability.

Size and success have also attracted more exotic structures such as ESOPs (Employee Stock Ownership Plans) and recapitalizations with the help of private

equity. Numerous ESOPs exist in the construction industry. For some companies, ESOPs have become a dominant owner and a culture-changing vehicle for broadly held ownership. For others, ESOPs represent a competitive buyer and may or may not be a long-term owner. At FMI, we have often seen ESOP companies sold to third parties, or bought out by the company.

Private equity for a narrow segment of companies in the industry has provided a lucrative means of transition. Companies with \$3 million and greater in annual EBITDA may attract this type of capital; however, this type of investor is most interested in companies with a well thought-out growth plan, strong successor

management, limited bonding needs, and high net margins. If you meet these criteria, this may be a viable means to achieve a strong valuation and reasonably quick liquidity, though you will likely be expected to continue with the company and rollover some investment.

Strategic buyers and international firms also continue to make acquisitions in the industry. Initial Public Offerings come in cycles but are an increasingly used tactic with larger firms.

In short, size has created more options for companies in need of ownership transition while demanding improved management and leadership. Larger contractors who have made a lot of money have more options to consider.

#### PEOPLE ARE LIVING LONGER

Since people are living longer, company owners are concerned with funding a longer retirement, including health costs. Some owners define themselves closely with the business and decide to own the business longer. This can be frustrating for the next generation of family or employees that want the reins but have to wait until later in their careers.

At the other extreme, some owners want to retire early or slow down. To maximize their financial security, these owners may ask for a greater price for the business or sell stock more slowly as their role is reduced to maintain an income stream.

It is hard to predict how much money is needed or wanted to retire. Living to age 90 or even 100 is not out of the ordinary today, and health costs continue to increase. Thinking through the financial and personal issues surrounding a transition is important for owners contemplating one.

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Since people are living longer, company owners are concerned with funding a longer retirement, including health costs.

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#### THE INDUSTRY IS MORE COMPLICATED

This is no surprise. Safety; federal, state, and local regulations; construction methods; technology utilization; longer distance competitors; and the changing banking and bonding industry are more complicated areas today. For boomers, this means that their successors need more time and training to learn what they need to know to operate in today's environment.

In the past, plans may have focused

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## For successors taking over decision-making, management systems provide a framework for them to learn about the business and your decision-making.

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important part of countering complexity. In the past, you likely made some decisions based on your own experience, without consulting others. For successors taking over decision-making, management systems provide a framework for them to learn about the business and your decision-making. It also provides an opportunity to observe successors' thinking.

more on the stock sale or transfer issues. Today, people issues are more important. Hiring the right people is critical. Hiring the wrong people causes a "double whammy;" you don't have the right people to succeed you, and you've lost the time it takes for you to learn they are the wrong people when you could have been developing others.

Training and development becomes more important since there is more to learn, and failure to provide training may result in losing the next-generation leader.

Management systems, including financial reporting, planning facilitation, and communication systems are an

### GENERATION X EMPLOYEES ARE DIFFERENT THAN BOOMERS TO MANAGE

Extensive literature exists about the differences between the "greatest" generation that grew up in the Depression and emerged from World War II to build the modern economy, and the baby boomers who grew up in prosperity and social turmoil. Generation Xers also grew up in the prosperity that followed boomers. While these are generalities, Generation Xers seek more out of work than a paycheck.

Just as the greatest generation was challenged to lead the boomers, the boomers are now challenged to lead Generation X. Xers have numerous career alternatives besides construction. Successful construction firms are recruiting Xers and keeping them. More and more we are seeing the development of corporate universities, increased training opportunities, and leaders seeking additional leadership training and education. Generation Xers want to be sought out, desired, and involved. The challenge for business owners is to stay on the offensive to attract the next generation and to develop and retain the current talent. Firms that understand this and work towards this will be the ones most likely to succeed.

### BOOMERS WANT TO RETIRE DIFFERENTLY

Business owners are starting to discuss transition issues at a younger age. They are also less certain about

what they want to do. Typically, these owners have made a lot of money by mid-career and are at the peak of their earning-years. Yet, they see other things they want to do such as spending time with family, pursuing other business opportunities, and traveling. Others are tired of the cell phone ringing at all hours and the resulting constant demand

for attention. While these owners may be “away” more, they don’t feel “away” since they are always reachable and their clients and employees know it. Boomers often don’t want to retire outright as many of the greatest generation did, but instead want to change the dynamic of their working life. This might mean taking a lesser role within the company (a non-CEO chairman vs. a CEO), starting a new venture, or becoming a philanthropist. Many of these owners try retirement and don’t like it. Other owners fear retirement.

Retiring-while-not-retiring is neither simple nor easy. Paying less attention to a construction business you own can be dangerous, and selling too soon can mean giving up income and value. Empowering the next generation may put you in their way. Deciding what to do next after making the transition is not easy, and whether you will like your next endeavor is unknown. Therefore, the process of going from a successful, engaged business owner to the “next step” requires some soul searching and experimentation. There is no one-size-fits-all answer.

#### INVESTMENT ALTERNATIVES ARE MORE CONFUSING

Conventional wisdom once was to put your nest egg in a combination of cash, real estate, and stocks and bonds. Two things make some business owners hesitant to follow this logic. First, private ownership of a business usually provides better returns than an owner’s diversified investments. Second, market volatility has made diversification more complicated as a protection for your nest egg.

Private companies outperform most investment vehicles for two reasons. First, entrepreneurs are driving the business, and there is no substitute for enterprising individuals motivated by ownership. Second, private construction companies are typically valued at three to six times pre-tax earnings in acquisitions and other valuations. In a low-growth business, three to six times earnings implies a return of 17% to 33% pre-tax return on the value of your investment. Contrast that with the stock market where price-to-earnings ratios average over 20 on after-tax earnings. That implies a multiple of about 12 times pre-tax earnings or about an 8% return,

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**Boomers often don’t want to retire outright as many of the greatest generation did, but instead want to change the dynamic of their working life.**

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excluding growth. For real estate, capitalization rates are typically in the range of 8% to 10%, meaning investors will pay 10 to 12 times cash flow. That's why investors offered a 17% to 33% return like most industry business owners effectively receive, would gladly take the higher anticipated return. Indeed that is exactly the logic that

private equity funds use — buying private companies for their investment funds. The difference is that if you own private businesses through a private equity fund, you are paying tremendous fees to fund managers, and buying businesses you do not know.

Following this logic, why would anyone want to own anything but a private business? The answer is risk. Any business can turn upside down for any number of reasons. Hence, diversification protects your wealth, while a healthy investment in your own business provides tremendous opportunity to achieve above-market returns.

FMI generally counsels owners to continue to invest in their own business since that is usually where the best returns are. In addition, we recommend allocating some assets to diversified investments to protect the owner's nest egg. In other words, have your "get-rich money" seeking high returns and the remainder of your money in a diversified portfolio to keep you rich.

Regarding the second point above that causes business owners to hesitate to diversify their nest egg, market volatility has always existed. But two events have hit boomers. The first was the real-estate meltdown in the early 1990s. This put many developers out of business and hurt many boomers with real-estate investments. Since the early 1990s, real estate has been one of the best places to invest money. The second event was the bursting of the technology bubble in 1999. The NASDAQ fell by half, and the stock market went flat for several years. These two events sent investors looking for other investment vehicles. Most investors did not abandon real estate and the stock market entirely, but they sought other ways to earn returns that were not correlated to real estate and stocks.

Asset allocation became a prevalent strategy. Historically, a stock and bond portfolio might have earned 9% to 10% per year, on average over the last 80 years. Simply put, investors started looking for other ways to make 10% per year. Since the stock market fluctuates from year to year, investors sought alternatives so they would show positive

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**FMI generally counsels owners to continue to invest in their own business since that is usually where the best returns are.**

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returns during a down year or flat period in stock or real estate. Large investors such as university endowments, pension funds, and high net-worth individuals were the first to go into alternative asset classes. In the last 10 years, investment has greatly expanded in international stocks, hedge funds, and private equity. Strategies within each of these categories vary tremendously, providing a diversity of vehicles to achieve returns at varying correlations. Asset allocation is used by investors to protect against any downside while seeking the upside.

Some business owners have shunned the asset allocation strategy for two reasons. First, as previously outlined, owners have achieved better returns in their privately owned business, and second, they understand their business or local investments, such as real estate, better. The problem with this strategy is the risk involved. The business could have a problem or the local real-estate market could turn upside down. Further, in construction, these two events could be correlated.

The take-away for boomers is to diversify assets outside your business in areas you understand or invest with a knowledgeable advisor. Continue to hold onto your private investment as long as prudent and productive. It is *prudent* as long as you can limit your liability from personal signatures on bonds and bank lines. It is *productive* if you are not driving off management that drives future profits by keeping your stock away from them.

#### **MORE THIRD PARTIES SAY THEY WANT TO BUY YOUR BUSINESS**

Most business owners we talk with receive regular letters and calls from people saying they want to buy their business. This type of solicitation has increased dramatically in recent years with the increase in merger and acquisition activity in the industry and the expanding number of private equity firms. It is flattering, and sometimes the interest is real. However, much of the time the contacts are from business brokers trying to drum up business, or inquiries from people that do not understand your business.

Until recent years, inquiries in the industry were fewer and probably easier to sort out. Now it is easy to operate under the assumption that there is a buyer out there when there is not, or alternatively, to ignore a serious buyer.

The difference today is that the odds of a strategic buyer having the resources and interest to purchase your business has increased, and if you fit a private equity

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firm's criteria, you may have the opportunity to take significant money off the table while retaining an interest in your business. This changes an owner's thinking. If an internal sale is the only option being considered, lining up the next generation or contemplating a shutdown is more dominant in an owner's mind. If a third-party sale is possible, the owner may hesitate to prepare the internal sale option even though it may be needed.

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**It may be hard to believe, but tax law has, in many ways, become friendlier to ownership transition in recent decades.**

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#### **TAX LAW EFFECTING OWNERSHIP TRANSITION HAS CHANGED**

It may be hard to believe, but tax law has, in many ways, become friendlier to ownership transition in recent decades. The big change was when Ronald Reagan cut tax rates in 1981 followed by the 1986 overhaul that substantially cut personal rates. The drop in personal rates in 1986 to below corporate rates caused many owners

to change their corporation from C corporations to S corporations, removing the problem of double taxation. It also led to more companies using the Limited Liability Company (LLC), a pass-through entity for taxes like an S corporation, for their business structure.

ESOP tax law has also become friendlier over the years as Congress has sought to increase its use. One of the most beneficial changes to contractors came in the 1990s when S corporations were allowed to have an ESOP as an owner.

Tax rates have crept back up to 35% since Reagan left office, but planning has not become more complicated since more firms are using S corporations and LLCs. One area that is more complicated is transfers of stock among family members. There are IRS Chapter 14 rulings that require transfers to be done at fair market value, which does add compliance costs to a transfer.

#### **WHAT IS A BOOMER TO DO?**

Given all these changes, FMI's advice to the boomer owner contemplating future ownership is as follows:

- Pay more attention to leadership in your business. Spend more time understanding and developing your leadership skills. Spend more time hiring the right people to work for your business and more time understanding how generation Xers think. Finally, spend more time and invest more money training your next-generation leadership.

- Use your management systems. Know your costs. Have business planning sessions involving next-generation leadership. Communicate with your team in order to manage your risk, and develop your successors.
- Manage your personal balance sheet and indemnifications. Grow your business, but also grow your balance sheet outside the business. If you need help for investment outside the business, get help.
- Control your exit strategy. Don't be forced to sell when you are not ready. Develop the next generation; don't run them off. You need them whether you sell to them or a third party.
- Wrestle with how you want to retire, if you call it that. Do you want a clean break? Do you want to transition slowly? Do you want to go out with your boots on? Is your spouse ready for your retirement? What are your other interests? Is the non-profit world fulfilling or tedious for you? Put your toe in the water.

Wrestling with the personal transition is probably the least comfortable piece of the puzzle. Do you really want to have more free time? What would you do? Will you like it? Do you have enough in your nest egg to give up your compensation and returns from your business? How much do you want? How will you shift your energies? Succession for a successful business is a good problem to have, but not easy. ■

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# Accelerating the Benefits of Construction IT

Understanding the broader landscape beyond the realm of construction increases peoples' willingness to reconsider their assumptions and adopt innovative approaches to IT integration.

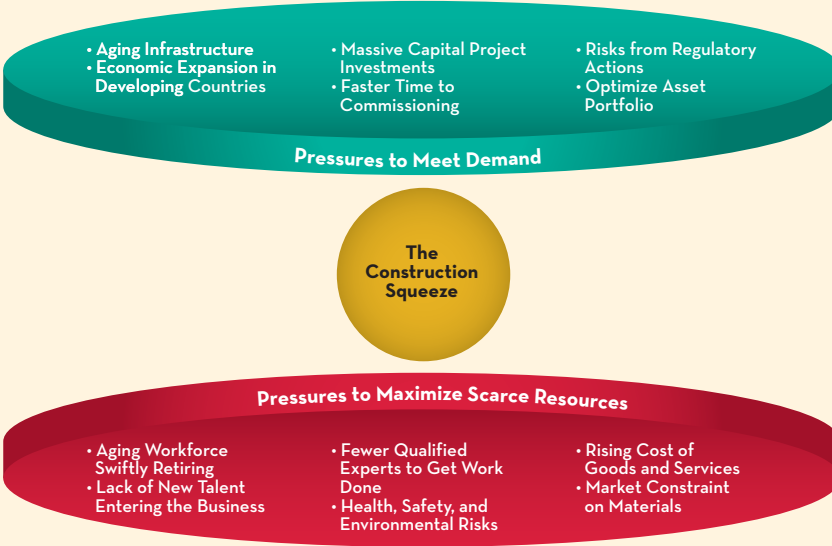
*By Marisé Mikulis and Kathryn Robinson*

It has been more than 50 years since the construction industry experienced the overall infrastructure demand at work today. Growth in demand is hyperactive, driven by aging infrastructure, immigration patterns, migration patterns, demographic trends, and general economic growth, all of which necessitates new and upgraded highway, bridge, rail, transportation, education, healthcare, power generation, transmission grid, and water/sewer systems infrastructure.

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U.S. demand is compounded by expansion underway in the developing world, including China, India, and Russia. On the supply side, however, the industry is strapped, trying to apply the right skills in the right place at the right time. The baby boomer generation makes up the majority of the construction workforce, both contractors and owners. This bubble is quickly approaching retirement age — a constraint worsened by the small pipeline of new industry entrants. The same pinch is happening with the availability of building materials globally. It's no wonder that construction costs have inflated and parallel the rise of material and construction commodities over the previous five years. Exhibit 1 illustrates the result of these forces — the “construction squeeze.”

Exhibit 1

**The Construction Squeeze****LOOSENING THE GRIP**

The best practices of yesterday such as innovative sourcing structures are the minimum requirements of today. As the bar continues to rise, simply tweaking a business model, imitating an industry leader, or adapting to economic change will no longer be sufficient to maintain a competitive advantage in the marketplace. Innovations will need to be adopted ... and quickly. Is it possible to build the plane during takeoff? One answer lies in integrated information technologies.

Yet, the application of information technology (IT) has received mixed reviews as a tool to help the construction industry wriggle free from the grip of the forces outlined above, and thus, meet its challenges and thrive. The question remains: Why are so many of our IT-related efforts classified as disappointments even as they are launched into service? Whether it's an upgrade to a project management system or an innovative Building Information Modeling (BIM) program, our industry is full of well-intentioned and well-planned undertakings whose outcomes range from mildly annoying to "train wrecks." It's no wonder that this business meets new IT undertakings with dread. Illustrating this are common responses heard to IT-based recommendations, which include:

- "That's way beyond what our people at the job site can handle."
- "The contractor will use that system because we are going to tell them to. Period."
- "All that general IT collaboration stuff is world peace. We need to focus on BIM and expand from there."
- "We use a spreadsheet for that, and it works just fine."

Fundamentally, IT's capacity to benefit a business depends on its adoption by target users. This might seem obvious and fundamental; yet, bridging the adoption chasm is neither easy nor quick work. The most experienced construction IT

managers and “gurus” (both internal and external) have learned to go back to basics — persuading users of the new technology’s soundness and personal benefit. Business value is the watchword; sizzle is secondary. In “tech speak,” the acronym, WIFM — What’s In It For Me? — is the users’ question of the day.

Progressing from the historical IT practice of requiring the organization to accommodate rigid software systems to requiring the software to serve the business dynamic is how soundness and personal benefit are achieved. Otherwise, the business and IT tools are disconnected.

### THE IT DISCONNECT: “IF WE BUILD IT, THEY WILL COME.”

**Common Sense IT Rule No. 1: Technology is only successful when it enables those individuals running the business to achieve their business objectives.**

The good news is that these individuals — whether in design, planning, construction, or operation — are generally eager to receive help. People at all industry levels are laser-focused on the job-at-hand due to ever-increasing performance pressures. As a result, any efficiencies offered by technology are welcomed.

More good news is that widespread advances in IT, largely driven by the thriving video-gaming industry and the public, are ripe to give the construction industry the very efficiencies that have been so elusive for the past two to three decades: collaboration, visualization, security, search, mobility, and timely information for making sound decisions.

**Common Sense IT Rule No. 2: The soft stuff is the hard stuff.**

Construction solutions made possible through IT applications may be complex and expensive to produce. Still, the hardest part will actually be the “soft stuff” — the investment in training time and dollars needed to ensure adoption by the user-community. Too often business and operations managers are counseled by their IT managers and gurus that the most critical success factor in applying IT improvements

is the careful identification of needs in order to steer system selection and/or development. Thus, companies invest considerable time and planning into specifying functionality requirements and schedules that systems must meet. Indeed, most system enhancements and new systems suffer from functionality overkill. The thinking is: If you can do something one way, why not provide five or 10 ways to achieve the same end-result? So programming bloat and training difficulties ensue. Rather than a first-thought, the time and money

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**People at all industry levels are laser-focused on the job-at-hand due to ever-increasing performance pressures.**

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needed to train and give system-users the confidence to adopt work-process changes introduced by the new system, it is instead treated as a post-script. Training is paramount to reaping the new technology's intended benefits.

**Common Sense IT Rule No. 3: If it sounds too good to be true, it probably is.**

Experience is a good teacher. The maxim above is frequently applied, either consciously or unconsciously, as people assess risks related to business decisions, including IT undertakings. Yet, an important dependency is just as frequently overlooked: The soundness of this maxim depends entirely on having accurate assumptions. If our assumptions are wrong, then we may judge an option as too-good-to-be-true and miss an extraordinary opportunity for innovation and even first-mover advantage.

Construction-industry users in the office and in the field will be inclined or disinclined to adopt IT solutions based on assumptions, and these assumptions are commonly incorrect.

The situation is innocent. Users are often making a decision based on some prior disappointing experience. In the interim, they have fallen out of touch with the technology advances widely in use since they haven't been inclined to track them.

In some ways, today's IT managers and gurus are victims of their own success. Among the reasons IT groups exist is to offload from the people on the front lines the need to track and understand the complex and swiftly changing aspects of IT. It's not a priority for the users to keep up with IT trends and developments. The challenge arises when these under-informed users' assumptions drive their adoption decisions. Unfortunately, having once offloaded this role, the front-line decision makers then position themselves as knowledgeable arbiters of the final decision while holding in (slight) contempt, their diligent IT staff.

### EARNING ANOTHER CHANCE

Adoption and diffusion of IT solutions can be accelerated only by persuading users of their viability and value. The critical factor involves making a compelling case about our technologically connected world to a skeptical

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**Adoption and diffusion of IT solutions can be accelerated only by persuading users of their viability and value.**

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audience. Building trust that users' assumptions are worth relaxing is the real task.

Thomas Friedman's *The World is Flat* is a popular example of just such an assumption-busting foray. He identifies 10 "flatteners" or transformations that have fundamentally changed the world's overall business landscape, regardless of market sector or geography. He defends his thesis that IT has played a central role in these 10 transformations. The conclusions give the nonprofessional greater trust that IT advances are far more mainstream than someone on the sidelines might assume. These 10 flatteners show how widely and deeply such technology advances are already ingrained in business; those who would classify them as "cutting edge" — even within the construction industry — would be sorely mistaken.

## TEN FLATTENERS THAT CHANGED THE WORLD ... OF CONSTRUCTION-RELATED IT

### 1. Nov. 9, 1989

Nov. 9, 1989, is the day the Berlin Wall fell. With this step, a seismic shift in the interdependency of worldwide market economics occurred. The opportunity and the complexity of global supply chains grew exponentially. This milestone is attributed largely to the former Soviet Union-population's growing awareness of the rest of the world, which was stimulated by the introduction of the Intel-based PC in 1981, coupled with the introduction of Microsoft Windows in 1985 and Windows 3.0 in 1990.

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**Defining a business process for people to follow is one challenge; it is quite another to ensure it is followed.**

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### 2. Aug. 9, 1995

On Aug. 9, 1995, Netscape went public. This move set in motion the Internet boom as we now know it. The computing style for the masses was transformed from a stand-alone experience to one with instant access to vast knowledge. This new world arrived with the wide adoption of open protocols, such as Hypertext Transfer Protocol (HTTP), and investments in fiber-optic cable. Business to business (B2B) and e-commerce were born. In construction, these technologies enjoy some presence, but the use of systems such as electronic invoicing and payment remains spotty at best. Still, this type of automated vehicle dramatically decreases submittal errors, benefiting the owner and speeding the payment process, benefiting the contractor.

### 3. Workflow Software

Some outside of IT have heard of workflow software, but experience with it is still limited. Defining a business process for people to follow is one challenge; it is quite another to ensure it is followed. Friedman explains that progress during the early 1990s advanced transport protocols that became standards of practice (e.g., Extensible Metadata Platform<sup>1</sup> (XMP) and Service Oriented Architecture Protocol<sup>2</sup> (SOAP)). This accomplishment helped interaction move to the level of software program to software program, well beyond person to person.



So what? So automating the routing and management of design and construction documents is not merely an aspiration, but can easily become accepted practice at little cost. So BIM is not a pipe-dream, but rather, a realistic approach to deliver gains in efficiency and effectiveness by harnessing information-sharing practices widely accepted outside the construction industry. A contractor can reasonably expect to know in real-time how a job proposal will align with a materials-sourcing strategy and vice versa.

#### 4. Open Sourcing

Open sourcing is the fourth flattener Friedman cites. In plain English, this concept highlights that knowledge is power and emphasizes that sharing knowledge increases the power of both the provider and the receiver. Rooted in academia, open sourcing enables self-organizing collaborative communities. In construction, open-sourcing ideas reinforce collaborative and sharing needs on all levels. For owners, this plays out with electronic designs that evolve into as-builts used in operations and maintenance. For contractors, this plays out as “co-opetition,” with information-sharing via secure sites opened to selected clients and partners during specific engagements.

#### 5. Outsourcing

Next on Friedman’s list is outsourcing. Here outsourcing means taking some specific, but limited, function a company was performing in-house, such as research, call centers, or accounts receivable, and having another company perform that exact same function. Then, the company reintegrates their work back into the overall operation.

Outsourcing-related IT experienced a zenith as preparations swelled for Y2K. It blossomed in India largely due to the bandwidth of the fiber-optic networking established with flattener No. 2. Closer to home in construction is the growing popularity of systems located and managed offsite from our offices, which is a direct manifestation of this IT concept. These “hosted systems” provide IT software and data management services specifically oriented to our industry, from names such as e-Builders and Textura. Such providers complement the more general IT hosting provided by Accenture,

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**In construction,  
open-sourcing ideas  
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EDS, HP, and Microsoft. The attraction of these hosted systems stems from the flexibility and reliability of the service provided.

## 6. Offshoring

When China joined the World Trade Organization, offshoring really crystallized. Offshoring, contrasted with outsourcing, is when a company takes one of its factories that is operating in Canton, Ohio, and moves the whole factory to Canton, China. The factory produces the same product, the same way, only with cheaper labor, lower taxes, subsidized energy, and lower healthcare costs. Such a venture only became reasonable when supported by the robust connectivity and collaboration now afforded by IT systems.

For us, off-shoring movements certainly contribute to the hyperactive demand for materials by developing countries. In addition, when large fabrication projects can be disaggregated, such as a multi-million dollar deepwater drilling and production platform, a considerable amount of module construction activities have been shifted to other countries, from Norway to South Korea. BIM approaches are essential to executing such complex arrangements.

## 7. Supply Chaining

The unchallenged champion at supply chaining is Wal-Mart. This flattener recognizes information as a competitive advantage, grounded in openness with suppliers regarding sales and inventory database. Analysts call this “full-asset awareness.” It’s about amazing new levels of visibility with which to make decisions. The outcome produces business growth for both parties.

Are the multiple contractors executing a new sports arena able to gain full view and context on the project? Can they anticipate impact of accelerations and decelerations? For example, the power of an enterprise project management (EPM) system lies in someone’s ability to make more-informed decisions. Achieving more-informed decisions depends on having the right data at the right time. The implications of this are vastly different between a highly customized limited-access system and an EPM that is accessible and usable by multiple project participants and widely intuitive. Is your EPM actively used by all your contractors? Are your field workers, direct and contract, connected with your EPM via their mobility devices?

The supply chaining flattener signals that the complexity associated with this level of collaboration is now technologically manageable and delivers payback — in money, time, and especially, innovation.

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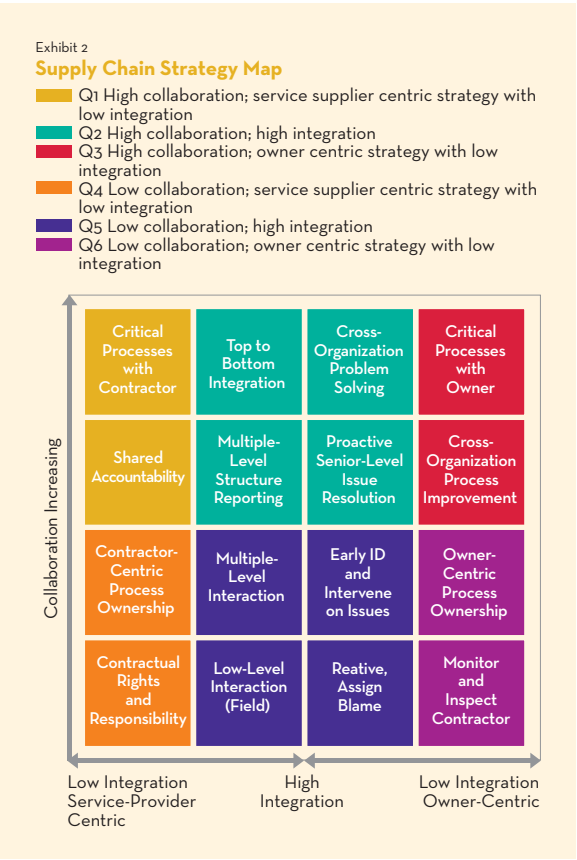
8. In-sourcing

As a flattener, in-sourcing is an especially innovative development. So its impact has been far-reaching. Here’s an example: Did you know that when you arrange for your Toshiba PC to be repaired and UPS comes to pick it up, the PC never actually goes to Toshiba? Perhaps you guessed that for operational efficiency Toshiba would hire some outfit to perform the repair, like outsourcing. But did you know that the extraordinary PC repair outfit that Toshiba uses is UPS?

Today UPS doesn’t just deliver packages; it provides logistics services, synchronizing global supply chains for customers large and small. The service is called in-sourcing

because UPS engineers come right inside your company; analyze its manufacturing, packaging, and delivery processes; and then design, redesign, and manage your whole global supply chain. And if necessary, they’ll even help finance parts of it, such as receivables and COD payments. UPS, a blue-collar delivery firm, has harnessed IT to completely reinvent itself.

Outsourcing, off-shoring, and in-sourcing all manifest in our business. Judging the best approach or blend of multiples for an operation can be a challenge. Having the options, however, is definitely welcome, particularly in light of demographic challenges we



are wrestling with. And activating these options depends on enlightened relationship dynamics, strategic partnerships, and extended enterprises.

For construction owners today, this speaks to fundamentals of sourcing and construction delivery overall. Ultimately, there are four questions to address:

1. What degree of collaboration and integration is optimal for my sourcing strategy?
2. How will I contract construction delivery?
3. How will I build?
4. How will I manage construction?

Exhibit 2 illustrates the dimensions of collaboration, highlighting the pros and cons of various courses.

### 9. In-forming

In-forming is the flattener related to search — Google, Yahoo, Live Search. Through the transformative power of searching, we can become informed, according to our unique question, unique logic, and our unique timeframe. Today, few of us would choose to be without this, and we each have our favorite search engine that we rely upon.

How many people in construction use search technologies to find things on their own computers, though? In construction, time is money, and huge amounts of time are lost looking for and checking the accuracy of the information we need. We can search our Outlook e-mail; we can search our local PCs across the documents we produce. The breakthrough is that now search technology spans many different types of data at the same time: Word and Excel documents, Primavera schedules in Oracle, and e-mail. Now, novice construction users can realistically expect to get the complete answer to questions, and quickly.

The question is whether the construction industry is willing to try it. Just because we assumed we couldn't do this doesn't mean we were right.

### 10. Steriods

The steriods (digital, mobile, personal, virtual) amplify and further empower all other forms of collaboration. Foremost is the availability and widespread acceptance of digital content that can be shared. A mutually reinforcing scheme of computation, storage, and I/O technology enabled this. Next is availability and widespread acceptance of highly robust mobile devices; wireless is the most natural form of communication. Ultimately, these have produced what Friedman calls the "Mobile Me," personal and always connected online.

These technologies in particular hold extraordinary promise for construction because they are perfectly matched to our work styles: Orchestrating field work and material delivery in concert with sophisticated project scheduling, accounting, and design. Yet when proposed, our management and leaders rush to observe that IT-based solutions are beyond what construction field workers can handle. This assumption is no longer true, and we are missing important opportunities for gains. How do we expect to attract new entrants who have cut their teeth on video games and cell phones, whether American or immigrant? The case for video-based training modules is quite similar. How can we ignore this

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**In construction, time is money, and huge amounts of time are lost looking for and checking the accuracy of the information we need.**

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extraordinary vehicle that can help accelerate solutions to the critical skills shortage and Health, Safety, Environmental (HSE) risks we face?

### THE TRIPLE CONVERGENCE

Skeptics frequently cite the long time it can take to see the effects and realize the value of IT projects. With Friedman's flatteners at work for over a decade, why have the transformational effects outlined only recently experienced increased momentum? Friedman addresses this with "Triple Convergence:"

- Complementary reinforcement of technologies
- New ways of doing business
- New population of workers

First, the flatteners needed time to converge and start working together in a complementary, mutually enhancing fashion. This occurred around 2000, with a new playing field for multiple forms of convergence. The net result was the creation of a global, web-enabled playing field that allows for multiple forms of collaboration — the sharing of knowledge and work — in real-time, without regard to geography, distance, or, in the near future, even language.

Second, it took time for new technology to combine with new ways of doing business. The changes were unfolding not just in IT, but also in new business processes and their associated new skill types. Stated another way, the people doing work needed time to adopt the new practices and this time needed to be recognized and budgeted in IT project deployment schedules.

Third, there was an arrival of a huge new population of workers from Mexico and Latin America, as well as China, India, Russia, and Eastern Europe. This demographic shift was due to the collapse of Communism in the Soviet Empire, India's turn from autarky, China's shift to capitalism, and population growth all over.

It is this triple convergence — of new players, on a new playing field, developing new processes and habits for horizontal collaboration — that

Friedman believes is the most important force shaping global economics and politics in the early 21st century. This wide access to tools of collaboration and to information through search engines and the web ensures that the next generation of innovations will come from all quarters.

This translates to construction in the unprecedented business challenges our industry is wrestling with. We're not going to "save" our way out of this one. Competitive advantage depends on quick innovation. In an industry that contributes almost 10% of the U.S. GDP, yet is challenged to capitalize on proven technology

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## Competitive advantage depends on quick innovation.

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developments, how is it possible to pick up the pace, catch up, and keep up with the other runners in the race? Information technologies may hold the answer.

### THE ASSUMPTIONS HAVE CHANGED

*The World is Flat* is helpful ammunition to illustrate to the layperson how innovative IT approaches are being actively adopted far beyond our own

construction arena. There is a certain solace and enhanced confidence in knowing that the rest of the world is pursuing such advances with success. It's important to recognize that these overtures to harness IT for business improvement aren't only happening in construction. Much skepticism about IT's value contribution exists throughout our industry on all levels, but understanding the broader landscape beyond the realm of construction increases peoples' willingness to reconsider their assumptions and adopt innovative approaches. ■

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<sup>1</sup> The Extensible Metadata Platform or XMP is a specific type of extensible markup language used in PDF, photography, and photo editing applications. It was first introduced by Adobe Systems in April 2001 as part of version 5.0 of the Adobe Acrobat software product.

<sup>2</sup> SOAP originally stood for Simple Object Access Protocol, and lately also Service Oriented Architecture Protocol, but is now simply SOAP. It is a protocol for exchanging XML-based messages over computer networks, normally using HTTP/HTTPS. SOAP forms the foundation layer of the Web services stack, providing a basic messaging framework that more abstract layers can build on. There are several different types of messaging patterns in SOAP, but by far the most common is the Remote Procedure Call (RPC) pattern, in which one network node (the *client*) sends a request message to another node (the *server*), and the server immediately sends a response message to the client. SOAP is the successor of XML-RPC, though it borrows its transport and interaction neutrality and the envelope/header/body from elsewhere, probably from Web Distributed Data eXchange (WDDX).

# BIM Changes the Culture of Design and Construction

This new collaborative approach in which all design and construction entities interact as partners and team players will require a huge cultural shift.

*By Sabine Hoover and Nick Schubert*

**T**he construction industry has changed dramatically over the past several decades, both in the U.S. and abroad. Increasingly, owners demand delivery of larger, more complex projects, at lower costs and on shorter schedules. Recent labor scarcities and material price fluctuations place additional pressure on design and construction teams to increase productivity and improve value engineering, culminating in what are now routine, challenging project specifications.

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These trends are forcing many in the construction industry to explore new avenues to improve their approach to designing and building complex projects. During the last few years, building information modeling, or BIM, has emerged as an important vehicle to improve the design and building processes.

BIM represents the evolution from 2-Dimensional architectural computer aided design (CAD) to a multi-dimensional, information-rich modeling tool. This new modeling process, also known as virtual design and construction, or VDC, allows stakeholders to design and analyze projects in a virtual, visual environment before breaking ground in the field. The BIM design process is more collaborative than a CAD-based design process since more information is available to users sooner.

The BIM design process will likely replace the traditional 2-D, CAD-based design process over time, and it appears ready to transform the way design and construction teams collaborate to deliver projects in the future.

**BIM DEFINED**

This new technology has gained widespread popularity in the last few years. However, while BIM is becoming more widely known, it has not been consistently defined. One of its many definitions is the general definition from The Associated General Contractors of America (AGC):

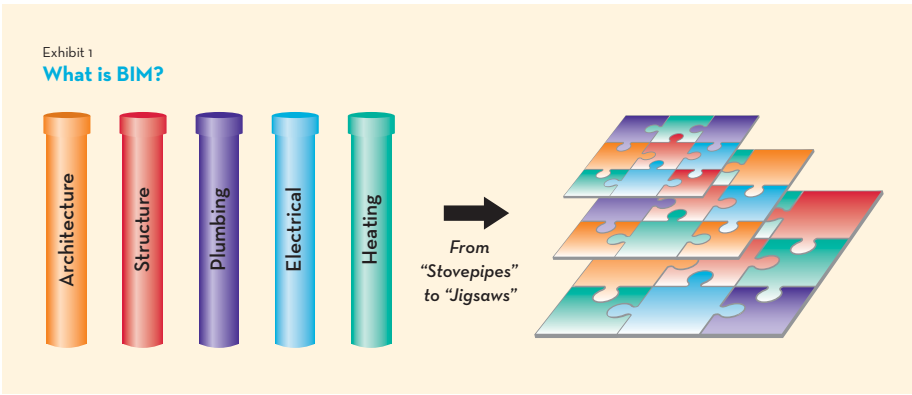
*“Building information modeling is the development and use of a computer software model to simulate the construction and operation of a facility. The resulting model, a building information model, is a data-rich, object-oriented, intelligent, and parametric digital representation of the facility, from which views and data appropriate to various users’ needs can be extracted and analyzed to generate information that can be used to make decisions and improve the process of delivering the facility.”<sup>1</sup>*

The early information from BIM allows stakeholders to detect conflicts and redundancies before breaking ground.

In other words, BIM can be seen as a composite model: a model that integrates and stores traditionally separate models (sitework, structural, architectural, MEP etc.) developed by the various parties to a construction project. (See Exhibit 1.) These models include both graphical (drawings) and non-graphical documents (specifications, schedules,

cost estimates etc.), which can all be stored and manipulated in one location. The key characteristic of BIM is that it allows users to simulate the “behavior” of common building elements and the building overall, in addition to the individual construction processes’ sequencing and scheduling, before construction begins. The early information from BIM allows stakeholders to detect conflicts and redundancies before breaking ground.

The files created through BIM effectively allow project stakeholders to evaluate the validity and accuracy of the individual models that form the composite, enabling





the project team to make informed, knowledge-based decisions before committing resources in the construction process.

### BIM VS. CAD<sup>2</sup>

BIM and CAD both provide building models, but they communicate different content to users. There are three types of communication content:

- **Data** (basic facts);
- **Information** (data given context and relevant detail); and
- **Knowledge** (information combined with experience and skill).

Ultimately, the most successful construction projects occur when all involved parties — design professionals, general contractors, owners, and subcontractors — are able to see beyond the raw data included in design drawings to the essential information. They can then apply their experience and skill to create knowledge-driven projects. Knowledge-driven projects have fewer traditional problems such as misunderstandings about project scope, RFIs and change orders, and ultimately rework and schedule delays, which plague projects with less than ideal communication.

**CAD:** CAD provides data. Only a limited amount of information can be added to the raw design data in a CAD file. With CAD files, users receive raw data detailing numerous design elements. To transform raw data into useful information, users must interpret the data from the CAD file by applying their understanding of the elements' context and the underlying details necessary to move forward in the construction process. (See Exhibit 2.)

While some CAD systems allow users to attach limited supplemental information to various design elements, CAD files are essentially raw data illustrating design elements such as walls, floors, and property boundaries. Problems arise when users' interpretations lead to varied understandings of exactly what information the data in the CAD file represents. Eventually, incomplete or inaccurate information hinders critical parties' efforts to apply their knowledge to the project, leading to conflicting ideas of how to construct design elements.

**BIM:** Beyond the data and limited information that CAD provides to users, BIM provides users with complete information, which is necessary for knowledge-driven projects. By providing both the data and the context and detail necessary for data to become useful information, BIM allows users to more easily combine information

Exhibit 2  
CAD Process

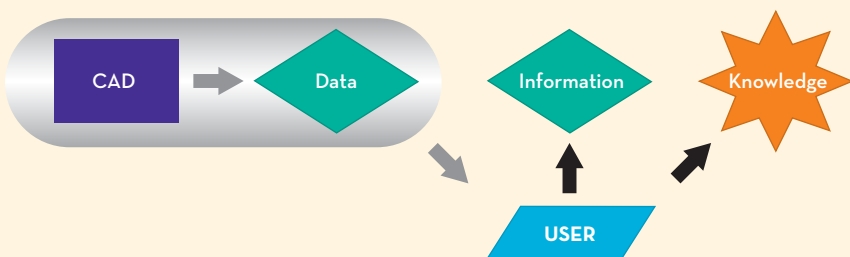
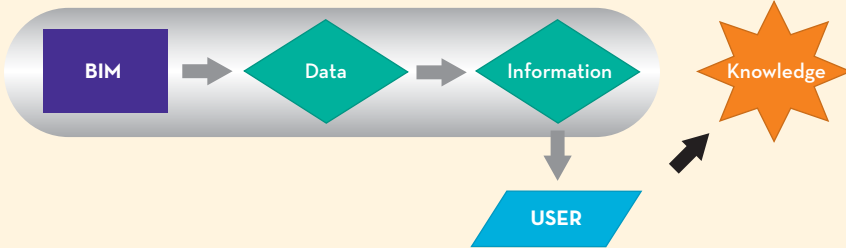


Exhibit 3  
BIM Process



with experience and skill. Thus, BIM provides users with more valuable content — information rather than simple data. Essential information helps BIM users to properly apply the knowledge necessary to drive projects. (See Exhibit 3.)

The broader range of content communicated through BIM avoids users interpreting different information from the same data. By limiting interpretation and making information available to those who need it, BIM helps to limit or avoid the pitfalls mentioned previously, including traditional project breakdowns such as misunderstandings about project scope, RFIs and change orders, and ultimately rework and schedule delays, which plague projects with less than ideal communication.

However, the true value of BIM compared to CAD may go further. Beyond simply limiting or avoiding many of the usual construction problems, BIM changes many of the commonly adversarial relationships within projects. Because communication is more complete and more accurate, parties such as general contractors and design professionals, which may have been at odds with each other in the past, are now able to collaborate early on in their projects to find solutions to potential problems.

A new level of collaboration is possible since BIM allows users to detect problems early, before construction begins. Previously, in using CAD to communicate project specifications, parties such as general contractors and design professionals often made changes far into projects. The result was delays and rework.

Delays and rework are frustrating for owners, but they are downright caustic to construction relationships. Parties such as general contractors and design professionals, who should be working together to solve problems on

knowledge-driven projects, can be reduced to bickering to protect their own profits on individual jobs. With the collaborative, early approach to problem solving enabled by BIM, inconsistencies are apparent much earlier in the construction process than they would be with the simple data in CAD files, so parties can solve problems as they arise, before the point at which changes require at least one party to sacrifice profitability.

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**Delays and rework are frustrating for owners, but they are downright caustic to construction relationships.**

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## A MAJOR BIM BENEFIT: COLLABORATION AND COMMUNICATION

Problems with coordination and collaboration among project team members ranks near the top of owners' lists of concerns, as highlighted in the *2005 FMI/CMAA Sixth Annual Survey of Owners*.<sup>3</sup> According to the survey, "Successful owners build a culture of ownership through the construction process to align stakeholders and achieve desired project outcomes and program goals."<sup>4</sup> A key element in building this type of ownership culture and aligning stakeholders is effective communication and collaboration, and BIM is an excellent tool for improving both.

Through 3-D visualization (sometimes even 4-D and 5-D, if scheduling and cost dimensions are added), project teams have a common framework or "language" they can refer to when analyzing and interpreting the various models. Having all the individual models (e.g., architectural, structural, plumbing, electrical etc.) combined into one composite model that can be viewed and shared by all participants simultaneously, allows project teams to communicate more effectively. BIM allows users to run "clash reports," which identify any conflicts among the various model components. Furthermore, an audit trail is available for each clash. This allows the design team, together with input from the owner and contractor, to eliminate virtually all of the clashes during the design phase. Reports indicate that this early conflict correction process reduces the potential for errors in the field tremendously. For example, the Cincinnati-based owners group, Construction Users Roundtable,

### BENEFITS OF BIM

**Improved Construction Efficiency:** The model behaves almost exactly the way the real building will so problems can be fixed before they turn up in the construction process. This increases construction efficiencies by ensuring the feasibility of planned sequences and best use of all resources.

**Reduced Risk:** By running "clash reports" and identifying errors and redundancies in advance, risk is greatly reduced.

**Improved Communication:** Project participants can better understand design and shop drawing models due to better visualization, illustrating various scenarios and construction phases. For owners, visualizing the end-product helps them express their needs more specifically before construction begins.

**Increased Collaboration Among All Project Teams:** BIM is accessible to all project participants. All changes are immediately reflected in the composite model. BIM becomes the central touchstone of the collaborative process and reduces communication errors.

**Increased "Auditability:"** BIM becomes the equivalent of "project memory." All changes to BIM are recorded; it is always possible to ascertain who made a change and when. This assures strong accountability throughout the construction process.

**Reduced Time to Produce Material Takeoffs:** Traditionally, estimators use 2-D drawings to undertake material takeoffs. BIM can generate takeoffs automatically, delivering quicker turnaround, more accurate estimates, and a streamlined procurement process.

**Maintainability:** BIM serves as the basis for design, planning, construction, project management, and facility management, providing a vehicle for moving seamlessly from one phase of a project to the next. There is also great value in BIM to the owner in the period following construction (e.g., commissioning, maintenance data, spare parts lists etc.)

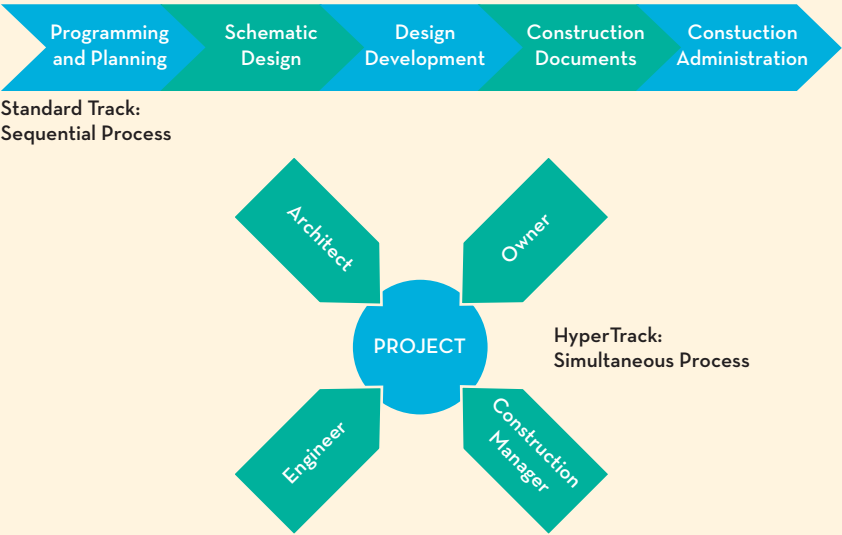
**Productivity Increases:** Building simulation allows for gains in operating efficiencies. (Note: This data is still anecdotal at this point.)

estimates a 7% productivity increase for projects using BIM.<sup>5</sup>

One important distinction between BIM and CAD projects is that unlike the traditional design approach in which parties work in sequential order, BIM encourages stakeholders, including the owner, architect, contractor, and subcontractors, to work together collaboratively, as partners during the project. With all major stakeholders involved from the beginning of the design process, decisions can be made simultaneously, greatly enhancing communication and overall efficiency. (See Exhibit 4.) Additionally, because cost and schedule information is also embedded into BIM models, it may be possible to eliminate the traditional value engineering process altogether on some projects.

However, despite significant collaborative changes to the project approach under BIM, stakeholders remain responsible and liable for their own models, as in a

Exhibit 4  
Sequential vs. Simultaneous Process



Source: The Greenway Group and Design Intelligence

Exhibit 5  
Examples of Simultaneous Project Delivery Approach\*

Project	Recent Project Results Using HyperTrack							
	Size Sq. Ft.	Budget \$ Millions	Actual Cost \$ Millions	Savings \$ Millions	Savings Percent	Typical Schedule Months	Actual Schedule Months	Time Savings Months
A	363,000	109.0	103.0	6.0	5.5	26.0	18.0	8.0
B	250,000	83.0	77.3	5.7	9.3	18.0	6.0	12.0
C	500,000	130.0	102.0	10.0	9.2	30.0	16.0	14.0
D	160,000	26.1	25.4	0.7	2.7	24.0	18.0	6.0
E	205,000	49.0	44.5	4.5	10.1	30.0	28	2.0

\* Referred to in this exhibit as "HyperTrack"  
Source: The Greenway Group and Design Intelligence

traditional design approach. Architects are still accountable for the design, and contractors remain accountable for the shop drawings. Forming a composite model to increase efficiency in the design and construction processes should not change risk or liability for any stakeholder.

A team-based approach to design allows stakeholders to capitalize on the experience and expertise of project team members, leveraging project information to project knowledge. This kind of holistic approach to design and construction has already resulted in significant cost savings for many companies. A recent study of five projects (cited in the March 5, 2007, issue of *Engineering News-Record*) reported average savings of nearly \$5.4 million per project and an average schedule acceleration of 8.4 months.<sup>6</sup> Exhibit 5 lists specific details for each of these projects.

### HOW TO GET STARTED WITH BIM

So what does it take to get started with BIM? There is no magic formula for successfully implementing BIM. Depending on the type and size of company, geographic location, area of expertise, project sizes, and other factors, optimal implementation strategies can vary widely. However, in speaking with several contractors from across the country who have successfully implemented BIM, FMI noted several important considerations.

#### Senior-Level Support and Commitment

Support for implementing BIM needs to come from the highest level within an organization. This does not necessarily mean that executive-level personnel need to be involved in managing daily BIM-related tasks and activities. In several cases, contractors have designated a leader to champion BIM — a person who understands the company's core business, who is technologically astute, and who has the authority to make significant implementation decisions. Decision-making authority in particular is crucial for implementing BIM successfully.

JE Dunn Construction's recent implementation initiative is an example of a well-supported effort to integrate BIM into the construction processes within an organization. JE Dunn's CEO Steve Hamline directly supported the company's BIM implementation initiative by hiring Rodd Merchant, a licensed structural engineer already familiar with BIM, to manage the process. When asked by FMI about the importance of top-down leadership for the implementation process, Merchant noted, "If the top-level commitment is there, the buy-in is immediate, and integrating BIM will be much more successful." He continued: "It is different to assign responsibility for the BIM initiative within a firm to an assistant estimator than it is to assign it to a high level-manager. BIM programs need to be supported from the executive level. It is important for the person responsible for driving the BIM initiative to have a broad perspective. Failure to make the BIM initiative a full-time responsibility can also

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**Support for  
implementing BIM  
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**BIM: ELEMENTAL TO A NEW, NON-LITIGIOUS ERA FOR THE CONSTRUCTION INDUSTRY**

***“The old idea of a good bargain was a transaction in which one man got the better of another. The new idea of a good contract is a transaction that is good for both parties to it.”***

— Louis Brandeis, Associate Justice, United States Supreme Court<sup>7</sup>

Despite legitimate initial concerns regarding proper risk and liability management in light of the new approach to construction processes using BIM, the long-term impact of BIM on litigation in the construction industry may be an overall reduction in adversarial dispute resolution in favor of proactive, efficient collaborative efforts to resolve problems early.

The traditional construction process relies on a variety of stakeholders functioning independently to complete a project. These parties' relationships can be largely comprised of adversarial communications such as RFIs, change orders, and claims. Under this traditional model, small disputes quickly polarize relationships within projects, as parties escalate disputes, and react to protect their profit margins by asserting that other parties are legally liable. The unfortunate, but all-too-common, result of this posturing extends beyond profit-eroding rework and schedule delays, to dissatisfied owners, costly litigation, and eventually a poor image for the construction industry as contentious, litigious, and uncooperative.

BIM offers a significant improvement over traditional adversarial dispute resolution in the construction industry. BIM enhances communication to provide stakeholders with the information they need to solve potential problems before they become actual problems that are inherently costly to resolve. As a result, the project parties are not pitted as adversaries attempting to protect their individual profit margins. Overall, as a vehicle for positive communication, BIM can help the construction industry avoid disputes escalating to the point of litigation by improving transparency within individual projects.

Accordingly, FMI believes that legitimate early concerns regarding risk and liability allocation should not dissuade best-of-class contractors and design professionals from working to integrate BIM, when the ultimate potential for BIM as an emerging technology is a significant reduction in the adversarial nature of construction relationships.

derail successful BIM implementation; having someone divide their time between BIM and other duties such as project management or estimating will not work.”

Other companies such as the Walbridge Aldinger Company, for example, have established a BIM steering committee that helps promote and coordinate BIM-related activities across the company. This team approach to BIM implementation allows an internal group of leaders to serve as an implementation think-tank, enabling staff to explore new ways for improving BIM processes and activities, and enhancing the alignment of BIM activities with other core business processes.

**Integrating BIM With Core Business Processes**

Several contractors that FMI interviewed stated that it is crucial to identify business processes that lend themselves readily to BIM. In other words, identify what your company's core strengths are and evaluate where BIM can add additional value to existing business processes and teams.

JE Dunn's recent BIM implementation initiative illustrates this phased integration concept. JE Dunn first focused on implementing BIM in the company's self-perform concrete business division. For JE Dunn, the concrete division seemed most logical as an initial focus for BIM implementation since driving the group's productivity

provided the greatest immediate return on investment. Further, JE Dunn regularly works with mechanical, electrical, plumbing, and steel subcontractors that routinely utilize BIM in their own work, allowing for increased coordination and fewer field problems. Capitalizing on information created by subcontractors allows JE Dunn to maximize the benefits of BIM while growing the staff. When asked about this staged implementation process, Merchant summarized the approach this way, "I think contractors need to compartmentalize their approach to BIM by aligning their BIM implementation strategy with their core business processes." He added, "Contractors need to determine what they do well and identify how BIM can supplement that. Start here, and don't try to do it all. We started the BIM implementation with the concrete self-perform division of the company because that was a business unit we knew could improve productivity and efficiency with BIM."

Also important, contractors must staff their key business processes with team players who emphasize sharing information continuously, throughout the construction process, during each BIM model's lifecycle. In order to enhance collaboration, interviewees recommend standardizing processes and procedures as well as adjusting data formats so that all team members can readily access and share information without experiencing either difficulty finding information or information overload.

#### **Commit to a Realistic Financial Investment**

In the *Contractors Guide to BIM*, the authors suggest that, "For as little as \$5,000 you can get started with BIM and begin to see the benefits. A wise plan would be to consider an investment of \$10,000 to \$50,000, depending on your needs, recognizing that these costs will quickly be recovered by the benefits your company attains."<sup>8</sup> Based on FMI's experience with construction firms who have gone through the implementation process, the total costs usually range between \$40,000 and \$150,000. Realistic implementation budgets will include provisions for training (for example, three to six months of technician support at \$25,000 to \$40,000; or third-party classes, tutorials, and manuals at \$5,000 to \$20,000), in addition to the obvious allowances for hardware and software.

Interviewees further stressed the importance of selecting the appropriate hardware and software to make the BIM tools work properly. This is not the time for thriftiness. It is critical to ensure that the hardware and software solutions selected for BIM implementation work well in the internal computer environment, and with construction partners' systems.

### WHAT ARE SOME OF THE HURDLES?

So if BIM is such a catalyst for enhancing collaboration, productivity, and improved quality, why has it not gained more momentum in the industry? What are people afraid of? There are several reasons for peoples' reluctance at this point, many of which evolve around basic human nature. For many companies, the fear of change or the fear of the unknown are reason enough for continuing to do work the way they always have.

For some, the initial investment costs and the time it takes to learn the software and associated processes represent significant barriers. However, numerous companies who have adopted BIM technology state how these initial costs are quickly recovered through schedule and cost reductions due in part to more accurate cost estimates and take-offs, improved sequencing of trades and resources, as well as overall productivity increases.

Some companies may be particularly concerned with the contractual implications and risk brought on by adapting the BIM process. As mentioned previously, despite significant collaborative changes to the project approach under BIM, stakeholders remain responsible and liable for their own models, as in a traditional design approach. Coordinating, merging, and analyzing multiple models into an amalgam of models and objects should not change the risk or liability for any stakeholder since documenting how and when the various elements come into the "model" help define responsibility and liability. Furthermore, issues relating to the contractual framework or "ownership of the model" can be worked out through contract language. Currently, there are several groups working on developing new contract terms and

BIM guidelines, which define standards for who is responsible for entering what type of information into a model. Such organizations include the American Institute of Architects, AGC, Construction Users Roundtable, National Institute of Building Sciences, Design-Build Institute of America, among many others.

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**Many people in the industry see BIM as the biggest change that will happen to the construction industry in our working lifetimes.**

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### THE BIM OUTLOOK

These are fascinating times to be involved in the construction industry. Many people in the industry see BIM (and the way it is affecting project collaboration and delivery) as the biggest change that will happen to the

construction industry in our working lifetimes. Steve Jones, who heads up McGraw Hill's thought-leader initiatives around BIM, states that: "If BIM becomes successfully adopted as an enabler of integrated project delivery, then it will greatly reduce the risk on projects, enable extensive prefabrication and off-site assemblies, which will speed up projects and make them safer. Until the tools and processes are mainstreamed, it is unrealistic to expect dramatic cost or schedule savings, although some people are already experiencing this."



Efforts to mainstream and standardize tools and data formats are underway. Many of the large software companies such as Autodesk, Graphisoft, Bentley, among many others, are working to increase interoperability between multiple technology platforms, which is often one of the main hurdles to project team collaboration. However, this issue will likely remain contentious in the future, as software providers remain

hesitant to opening up the numerous programs to true interoperability (for obvious reasons).

Several organizations listed previously are also looking into the development of data and information standards. The National BIM Standard Project Committee of the NIBS began work on its first BIM standard in August 2005. The Committee will be publishing the second version near the end of 2007 (National BIM Standard Version 1, Part 2).

As these efforts evolve over time and technology innovations spur further progress, experts predict that the integrated project delivery approach — in which design professionals are thoroughly integrated with the construction process — will become standard in the industry. New business models may emerge in which the traditional designer, builder, and fabricator models are fused into one, for example. This will result in high-level turnkey project delivery models with teams of skilled professionals to design, fabricate, assemble on-site, and even operate facilities (Steve Jones, McGraw Hill, personal communication).

Owners who are already experiencing the value of BIM-driven projects will likely start demanding these types of collaborative projects on a regular basis, ensuring more transparent processes and consistent results in the future (similar to what happened with CAD in the architecture domain back in the 1970s). This collaborative approach in which all design and construction entities interact as partners and team players will require a huge cultural and mental shift, but is likely to lift the industry to the next level. ■

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<sup>1</sup> The Associated General Contractors of America. The Contractors Guide To BIM. Edition 1, 2006.

<sup>2</sup> See generally: [http://www.aecbytes.com/viewpoint/2005/issue\\_20.html](http://www.aecbytes.com/viewpoint/2005/issue_20.html)

<sup>3</sup> FMI/CMAA Sixth Annual Survey of Owners. 2005. ([http://cmaanet.org/foundation\\_research.php](http://cmaanet.org/foundation_research.php))

<sup>4</sup> Id.

<sup>5</sup> Buckley, Bruce. "A Cultural Shift: BIM Creates virtual intelligence for building systems and structures." *Colorado Construction* (May, 2007).

<sup>6</sup> Architects Belatedly Are Moving Toward the Light. Scott Simpson. ENR March 5, 2007.

<sup>7</sup> Prior to serving as a Justice on the United States Supreme Court from 1916 to 1939, Justice Brandeis authored the following publication, from which this quote is drawn: *Business — A Profession*. Boston: Small, Maynard, 1914.

<sup>8</sup> The Associated General Contractors of America. The Contractors Guide to BIM. Edition 1, 2006.

# Extending Your Intelligence With Unstructured Data

Emerging solutions for creating intelligence out of unstructured data creates business opportunities.

*By Gayle Sheppard*

**D**eriving value from unstructured data is one of the major unsolved problems for many businesses today. Tools and techniques that have proved so successful in transforming structured data into business intelligence just don't work with unstructured data. What is unstructured data? E-mail, service-call notes, project conference and meeting notes, customer inquiries, work-order comments, and descriptions of work completed are just a few examples. The proliferation of this type of data makes many of us long for the good ole' days when we used to say, "If only I had more data."

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The challenge faced by today's executive is not acquiring and storing data, but leveraging this data into practical, valuable intelligence — to better serve our customers, manage our businesses, and gain competitive advantage.

So it is not surprising that the new question we hear ourselves asking is: "With all this data, why is it still so hard to discover what we really need to know when we need to know it?" We need to put what our company knows — but doesn't know — into actionable strategy to improve our business.

**BUSINESS INTELLIGENCE SOLUTIONS FOCUS ON STRUCTURED DATA**

Current business intelligence applications are quite good at helping companies analyze transactional business data. This transactional business data is typically thought of as “structured data” and includes financial, operational, transactional, marketing, and customer satisfaction data — anything that can be stored in databases, spreadsheets, web forms, and the like. This data is organized and stored in a highly structured format, with the role of each data item clearly defined. Exhibit 1 illustrates a simple example of structured data for a June 2007 subcontractor billing activity.

In Exhibit 1, the structure of the data clearly defines its type and role. We know that TomCat Excavation has billed-to-date 80% of a \$25 million contract and that after withholding our contracted 10% retainer and prior applications, the net amount due is \$3.0M. Another structured data record would tell us when and how much was paid to TomCat Excavation. This is structured data, and the majority of business intelligence applications available on the market today focus on internal, structured data such as transactional data from financial systems, project costing systems, and materials management systems. What’s missing from the puzzle is the wealth of critical information hidden in plain sight, or unstructured data.

**INTELLIGENCE HIDDEN IN PLAIN VIEW**

Recent studies show that 70% to 80% of all the data available to corporations is unstructured data. The definition of unstructured data varies depending on the context in which it is used, but it usually refers to data that can’t be stored in rows and columns such as e-mail files, word processing text documents, image and video files, news articles, customer service free text comments, and so on. Additional classifications include semi-structured data such as e-mail in which some of the information can be stored in a relational database management system and include author, time, and date, for example. Industry projections from Gartner (an IT research and advisory company) indicate that white-collar workers will spend anywhere from 30% to 40% of their time in 2007 managing documents, up from 20% in 1997. And according to IDC (a global provider of market intelligence for the IT markets),

Exhibit 1

**Structured Data Example:  
Subcontractor Applications for Payment**

Date	Application Number	Sub-contractor	Contract Value \$Millions	Work Completed Previous Application \$Millions	Work Completed This Period \$Millions	Total Completed and Stored to Date \$Millions	Percent	Balance to Finish \$Millions	Retainage \$Millions	Net Due \$Millions
6/25/07	3	TomCat Excavation	25.00	15.00	5.00	20.00	80	5.00	2.00	3.00
6/25/07	2	ABC General Contracting	15.00	5.00	5.00	10.00	67	5.00	1.00	4.00
6/25/07	1	TooGood Removal	2.50	1.20	1.00	2.20	88	0.30	0.22	0.78

Exhibit 2

**Unstructured Text Sample:  
An Article from the Gloucester County Times**

**Gloucester County TIMES**

**County awards new contract, looks to 2007 finish for DREAM Park:**

Wednesday, July 04, 2007

**By Siobhan A. Counihan** [scounihan@sjnewsco.com](mailto:scounihan@sjnewsco.com)

LOGAN TWP. The road to a 2007 opening for the county's proposed equestrian park was cleared figuratively with a literal clearing to come later through the awarding of a \$3.4 million contract Tuesday by the **Gloucester County Improvement Authority**.

**Berlin-based Mount Construction** will supply the labor and materials for various site projects, such as the access road to U.S. Route 130, sewer lines, landscaping and drainage systems, according to **George Strachan**, GCIA assistant administrator. These projects will ready the site for construction of **equestrian facilities** on the 74-acre property.

40% of corporate users cannot find the information they need on their company's intranet to perform their jobs. Exhibit 2 is an unstructured content sample.

From Exhibit 2, we know that a contract was awarded, who it was awarded to, for what purpose, when, and where. It is this information that is often lost from unstructured text since there is no meaningful way to capture it so that it can be understood and used. The people, places, and things we can track from this information have been bold-faced. Even though current database and business intelligence applications cannot capture this information, a business analyst can understand the data and relate it to other learned information to make better business decisions. In this way, humans use the brain to remember and retrieve information, creating memories for each one of the people, place, and things learned about and their relationship to each other. As new information arrives from news, e-mails, and other unstructured sources, this information is incrementally understood and related to everything else, automatically. However, the human brain has one main challenge: one person cannot remember all this information.

Across the construction industry, project managers, superintendents, subcontractors, customer service, and call-center technicians are generating

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large volumes of textual, unstructured data. Yet, they lack the tools to identify trends and emerging issues in this content — potentially missing valuable insights. A large HVAC service contractor recently said: “I am having thousands of conversations with customers weekly, and I don’t recall what is being discussed. Although I see the end-result of these conversations — changes in service plans or service dates for example — I am deaf to the content of these conversations. Who knows what I might discover if I had insight into these conversations?”

Valuable data is buried in unstructured electronic documents. Plus a wealth of information exists beyond the corporate firewall in public sources on the World Wide Web. Executives want to capture this data for yet another reason: to integrate data across multiple customer channels in order to understand customers’ issues more broadly. For example, a home builder who can see across his business channels in

time to incorporate discoveries being made in post-closing warranty work into new home construction techniques or standards could save warranty dollars while improving the end-quality for the customer. Ultimately, we want to be able to connect the structured and unstructured data, and use it in our business analysis in order to provide a complete picture of our business.

### PUTTING UNSTRUCTURED DATA TO WORK

A new generation of products is helping create structure out of unstructured data by automatically organizing it into a hierarchical structure

(taxonomy). By developing standards for the organization of unstructured data, we can begin to analyze the knowledge this data contains. These categorization tools, like their business intelligence brethren, typically require extensive investments in technology and resources for implementation. This means not only learning a new technology, but training people in librarian-like skills to manage that technology on an ongoing basis. Think about a stack of papers, then the effort to file those papers even before the information can start to be used.

Even more promising are new, forthcoming technologies that aim to solve a different problem — end-user, real-time analytics for unstructured data. Called Memory-Based Reasoning (MBR) technologies, they are designed to read, comprehend, and remember all the associations that exist in the data between people, places, and things. These technologies work like the human brain and are designed to remember, learn incrementally, recognize patterns, and anticipate new events. They are also designed, unlike statistically based applications, not to require extensive predefined rules and models or to rely on “samples” of data. Rather, they ask questions of all the data available in free-form query modes, much like you use a traditional search engine. However, unlike search engines, which have difficulty answering questions in context (for example, a search on “cardinals” returns web pages related to sports



teams, religious leaders, and birds), MBR technology is focused on understanding the question and providing the relevant analysis in context. The human brain uses MBR, but given the massive and growing volume of data, it is still overwhelmed. MBR technologies can help. (See Exhibit 3.)

**MEMORIES ARE MADE OF THIS**

Let's look at three examples of how to apply this technology. Examples No. 1 and No. 2, which follow, work with unstructured text within a company's firewall. Example No. 3 expands the data used to incorporate unstructured information available from the Internet using open-source content and/or subscription news services.

**1. Leveraging Knowledge About Construction Defects**

By leveraging knowledge about construction defects, contractors can minimize warranty repairs while incorporating the knowledge gained back into new construction practices. MBR technology can read all service records — including structured and

unstructured text — to create memories for each person, place, or thing and their corresponding associations between each other. In this example, a "person" could be the customer, manufacturer, supplier, service tech, or the construction manager. (All would have their own "memories.") A "place" could be the building location, specific work area, floor, or office. (Again, all would have their own memories.) The "thing" could be the service call, defective product, replacement product, timeframe, or type of repair (with each having its own memory). With MBR technology, each

**The human brain uses MBR, but given the massive and growing volume of data, it is still overwhelmed. MBR technologies can help.**

person, place, or thing remembers how it is associated with the other person, place, or thing. The service record itself is linked to each person, place, or thing to create a frame of reference or “context” for the memory. At this point, we can ask questions of the data such as: Who is having problems with XYZ defect in the Atlanta area? and Who or what else are they linked to? We can also ask: What products are being used to repair XYZ defects in Atlanta, New York, and Los Angeles? Who or what else looks like this particular service defect? All these questions are useful in identifying similar warranty problems that may have common root elements — location, time of year, weather, project manager, supplier, or product manufacturer. The ability to understand these findings in context of the original service work order furthers our ability to zero in on the findings that are relevant and in context to the problem or issue at hand. This saves time, money, and improves overall product quality.

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**Today, many good techniques exist to forecast costs and schedule at completion based on current cost and schedule variances. These are mathematical computations that use structured data.**

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## 2. Anticipate Project Overruns

MBR technology helps contractors anticipate project overruns. Now that we know about memories within MBR technology, let's apply them to gain a better understanding of schedule delays, including their cause, timing, and impact on the project outcome. Today, many good techniques exist to forecast costs and schedule

at completion based on current cost and schedule variances. These are mathematical computations that use structured data. What if we can incorporate project managers', superintendents', subcontractors', and material suppliers' text-based reports into the analysis? Using the principles for MBR “memories” described in Example No. 1 above, we can create a corporate memory for each project, project manager, super, subcontractor, material supplier, project, material, or process component, and how they relate to each other. Through these memories,

we can discover patterns and trends among these same people, places, and things to help us anticipate, in addition to the analytic formulas used, schedule and/or cost overruns. When combined with the warranty memories for these people, places, and

things from Example No. 1, we can also anticipate warranty issues and take corrective actions well before the project is complete. This preventative action helps to avoid significant cost overruns, increases customer satisfaction, and leads to more productive and effective business practices.

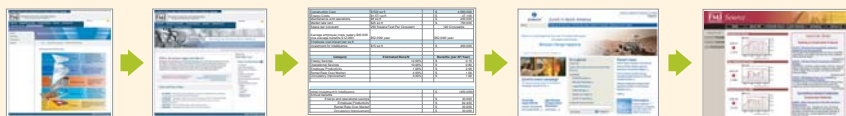
**3. Identify Trends in Material Product Defects**

We can also identify trends in material product defects with MBR technology. Let's expand upon Examples No. 1 and No. 2 and incorporate data from outside our company's firewall. This information can include content from manufacturer's specifications, subscription services to technical publications or general news sources such as *Engineering News-Record*, or even from blogs or other open sources of interest. (See Exhibit 4.) We can now incorporate information available from outside our firewall to understand if "others" are having problems with a particular customer, product, manufacturer, or supplier. We can incorporate this public, published knowledge into our corporate memory while maintaining a direct tie to the information source as evidence supporting our analysis. MBR technology reads and organizes all this information so we don't have to. Then *push* technology,<sup>1</sup> such as RSS feeds (a family of web-feed formats used to publish frequently updated content) alert us to new, critical information findings.

Examples No. 1 through No. 3 identified above are critical business situations where reputation risk, cost overruns, and losing customers is high. We don't need to look far for a plethora of valuable MBR technology applications. These include identifying the best project team combinations including employees, vendors, and subcontractors as well as winning building/customer/manufacturer combinations that can be translated into repeatable business opportunities. Today, MBR technology is being adopted within the government defense and intelligence communities for national security. It has also had success in the upstream oil and gas industry for oil-well, adverse-event prediction, and it's in the early stages of adoption within the financial industry for fraud investigation in addition to being used with Internet-based consumer social networks. Any industry, such as the construction industry, with large, complex, *unstructured* data sets, can certainly benefit from these new technologies by applying them to their corporate knowledge.

We don't need to look far for a plethora of valuable MBR technology applications.

Exhibit 4  
**Sources of Information**





## THE FUTURE: INCORPORATING ALL THE RELEVANT KNOWLEDGE AVAILABLE

Understanding relevant information in a timely manner from outside the corporate firewall continues to increase in importance. The success of the World Wide Web has resulted in a massive amount of data available to read, analyze, understand, and use in our day-to-day operations, ongoing business development, and financial forecasts. We have moved from a world of “hit the refresh button” to a world of streaming real-time content. Studies show that the proliferation of open-source data

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**The success of the World Wide Web has resulted in a massive amount of data available to read, analyze, understand, and use in our day-to-day operations, ongoing business development, and financial forecasts.**

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alone (data that is created and available outside the company) is staggering. One example of this ballooning data is blogs. According to *Technoratie*, the size of the blog-o-sphere alone has doubled every five months over the last year and a half and a new blog is created every second. What's more, three out of five teenagers are creating their own on-line content. With open-source data comes opinions, current issues, and problem identification and a wealth of “attitudinal” information that, *if understood*, is helpful to not only the intelligence community, but business development professionals, construction managers, marketing research departments, product managers, and risk managers, to name a few.

Combine this with corporate intranets, subscription news services such as Dow Jones' Factiva.com, open-source news, and the volumes of data resident in our corporate archives, and we have

created a new problem: rapid assimilation of data into intelligence. Intelligence is best defined by the brain's ability to capture and use its experience. MBR captures experience in memory and then uses this memory to recall and reason from experience.

The implementation of MBR technology for commercial corporate use is in the early stages of adoption. Best use of this technology today is in analyzing massive, complex data sets. Project logs, engineering reports, subcontractor reports, and customer service records are just some of the examples of text that, if read, captured in associative memory form, and available for analysis could extend the intelligence of the corporation. The benefit? Finally knowing what you know you should know, but can't find. ■

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<sup>1</sup> The prearranged updating of news, weather, or other selected information on a computer user's desktop interface through periodic and generally unobtrusive transmission over the World Wide Web.

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