THE intelligent JOBSITE

By John B. Chaney

How using new technology can dramatically improve the quality of project communication

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> *"The secret of war lies in the communications."*
> – Napoleon Bonaparte

Napoleon may be an ignoble figure, but his military accomplishments are legion. He achieved astounding military success by cutting off his enemies' lines of communication, leaving them unable to react effectively to rapidly changing conditions.

When it comes to communication, a little knowledge goes a long way. Like commanders on multiple fronts, CFMs and executives must execute their directives to their teams at various jobsites, where work is being performed in constantly changing, remote locations. These managers and executives only succeed to the extent that they can execute informed decisions that translate company-wide.

Some of us become our own worst enemies, unintentionally setting up communication barriers among staff. Work teams end up uncoordinated and isolated, particularly those that operate in both the office and on the jobsite. CFMs' decisions are only as good as the information gleaned from the jobsite. Their messages are effective to the degree that they are quickly delivered and clearly understood.

Simply mandating "better communication" has never been enough in the construction industry. Building communication into business processes is necessary, but with increasing amounts of data associated with every job and growing expectations for immediate information, this is no longer sufficient. In the face of rapidly changing technology and increasing demands for data, construction companies must regularly reevaluate how connected their teams really are – and thus how intelligently their jobsites are able to perform.

A Confluence of Technologies

The key to empowering field staff with business intelligence (BI) is understanding how the nature of intelligence is being changed by technology. Three technologies, each with separate but related trajectories, are currently converging to impact BI in a powerful way.

- *Cloud computing:* This has the potential to deliver data and processing power to any number of connected locations.

- *New mobile devices*: Smartphones and tablets have the potential to receive and present complex data from virtually anywhere.

- *New breed of software applications:* These applications are being developed, driven mostly by cloud computing and mobility, and resulting in real and powerful intelligence.

Therefore, any analysis of communication within a company should address all three of these converging technologies – and their place within the company's operations.

Considering the Cloud

Cloud computing is nothing new. However, its current status as a business buzzword has stirred up unnecessary confusion about a fairly basic concept. Cloud computing is simply a centralized collection of computing resources that serves up data and applications to the employees who have access to the collection. Within this broad definition, multiple cloud types exist (thus the confusion over the meaning of the term). It helps to think separately about types of cloud *deployments* and types of cloud computing *environments*.

Cloud Deployments

Cloud computing can be deployed in two general ways company-wide:

1) Users can access information via the public cloud

2) The company can arrange for private cloud services

In most ways that matter to end users, the experiences afforded by public and private cloud deployments are indistinguishable. The difference lies in how much control the company has over the resources allocated to its applications and data.

Using applications hosted on the so-called public cloud means using the public Internet as the platform for accessing data processing and storage services. This is not necessarily a bad thing, as it means not having to worry about how cloud services are deployed.

For smaller contractors that have minimal IT budgets or staff, the public cloud can be particularly attractive since virtually all the burden of hardware and software maintenance are eliminated, as well as the need to select or manage a hosting service. However, for mission-critical applications (e.g., accounting or payroll), most companies prefer having more control over the amount and type of processing and data storage.

Some enterprise software is indeed delivered via the public cloud, notably customer relationship management (CRM) systems. It is one thing, though, to lose access to contacts and customer data for a short time, and another to have accounting and payroll go offline.

For this reason, most companies that use cloud-based software for financial or business management purposes opt for private cloud deployment. They either purchase and maintain their own web servers and all the requisite software and hardware to create a centralized source for application and data hosting, or they outsource it to a third-party hosting service.

In both public and private cloud deployment, companies benefit from not having to load and maintain client application software for every user. Also, the requirement to constantly upgrade user devices with greater processing power and the latest operating system is removed.

So, if a choice between a public or private application presents itself, the deciding criterion is how much control a company wishes to have over its cloud computing resources. In the public cloud, there is little control; in a private cloud, the company has more control over the resources in return for more responsibility to establish and maintain them.

Cloud Computing Environments

The different computing environments used to access applications in the cloud have caused even greater confusion than the public vs. private cloud issue. This is partly because the deployment and computing environment technologies, while fundamentally different issues, are related. Users can access cloud computing resources in three general ways:

1) Remote access (private cloud)

2) Virtualization (private cloud)

3) Through a web browser (public cloud)

Remote Access Technology

Remote access technology has existed for years in the form of virtual private networks (VPNs). Through a VPN connection, a user can essentially turn a device into a "dumb terminal" that uses the resources of a remote computer. If the remote computer is connected to a network, then the remote user can access all the network resources.

The common usage model for VPN services is a remote employee who has an existing computer in an office and must access applications or data on that computer – or on a network to which the computer is connected – usually behind a company firewall. In this case, a remote access environment relies on private cloud computing deployment. Many people would not even consider this an example of cloud computing, but it meets the strict definition of accessing common computing resources.

Virtualization

Virtualization is a hybrid technology between remote access and true cloud computing. As such, it can cause confusion. A virtual environment can allow access to a number of hosted applications, not just those available on an individual's computer. Users rely on access software to log in to these hosted resources.

When using remote access, a user is limited to the resources he or she would normally have at the office. For example, if a contractor wanted to provide access to accounting software via remote access, then it would likely need to ensure that client software for the accounting application was loaded and updated on the office desktops of all staff who might ever need to "VPN-in" remotely.

Comparing a virtual environment and simple remote access, there is usually a better chance that the virtual environment will be online and available for use since it is usually maintained by a company's IT department or a third-party hosting service. For example, if an individual should accidentally turn off his or her computer when leaving the office, an attempt to

establish a VPN from the jobsite will fail since the VPN session relies on connecting to a specific user's computer, not to a managed hosted service. Needless to say, a virtual environment is always part of a private cloud deployment.

Web-Based Environment

Working in a web-based environment means accessing all remote computing resources (the cloud) simply by launching a web browser and places the fewest restrictions on the user's device. Virtually any laptop or smartphone with a browser can access web-based data and applications. This is a dramatic departure from remote access and virtualization, where traditional PC-based applications are accessed and one must use a device that has the correct connectivity software.

Web-based cloud software is commonly associated with the public cloud. However, a web-based environment simply implies that the software has been designed and optimized for delivery over the Internet via browser. "Web-based" does not imply that a subscription is necessary.

Therefore, in many cases, with construction accounting and project management software, for example, companies can opt to purchase (not rent) web-based applications for private deployment. This provides the control of private deployment with the advantages of multi-device access and begs the question: What devices are appropriate for the jobsite?

THE NEW MEANING OF MOBILITY

To make informed decisions about how best to equip field staff with mobile communication tools, it helps to understand how the landscape of mobile communication has changed with respect to devices and how they are being used. These changes can be placed in the context of three major trends:

1) Communication is becoming data
2) Data is becoming mobile
3) Mobility means processing

Communication Is Becoming Data

In 2000, network traffic generated in the U.S. by voice communications was more than twice that generated by data, including the entire Internet. However, by 2015, data across all of North America will exceed voice volume by a triple-digit factor, and voice volume itself will shrink to less than half of the U.S.-only level in the early 2000s.[1]

A number of changes account for this dramatic shift. The amount of content on the Internet has grown exponentially, and more people are turning to online sources for entertainment, including videos and gaming. Even so, as the reduction in voice traffic demonstrates, there has been a fundamental shift in the nature of communication. The sharing of data, documents, and other long-term-use content is taking the place of phone conversations.

Data Is Becoming Mobile

In 2011, the number of wireless devices in use in the U.S. surpassed the U.S. population. (See "U.S. Wireless Devices" on the next page) And, out of the total U.S. population, 56% of people own smartphones capable of web browsing and other data applications, according to the Pew Research Center.
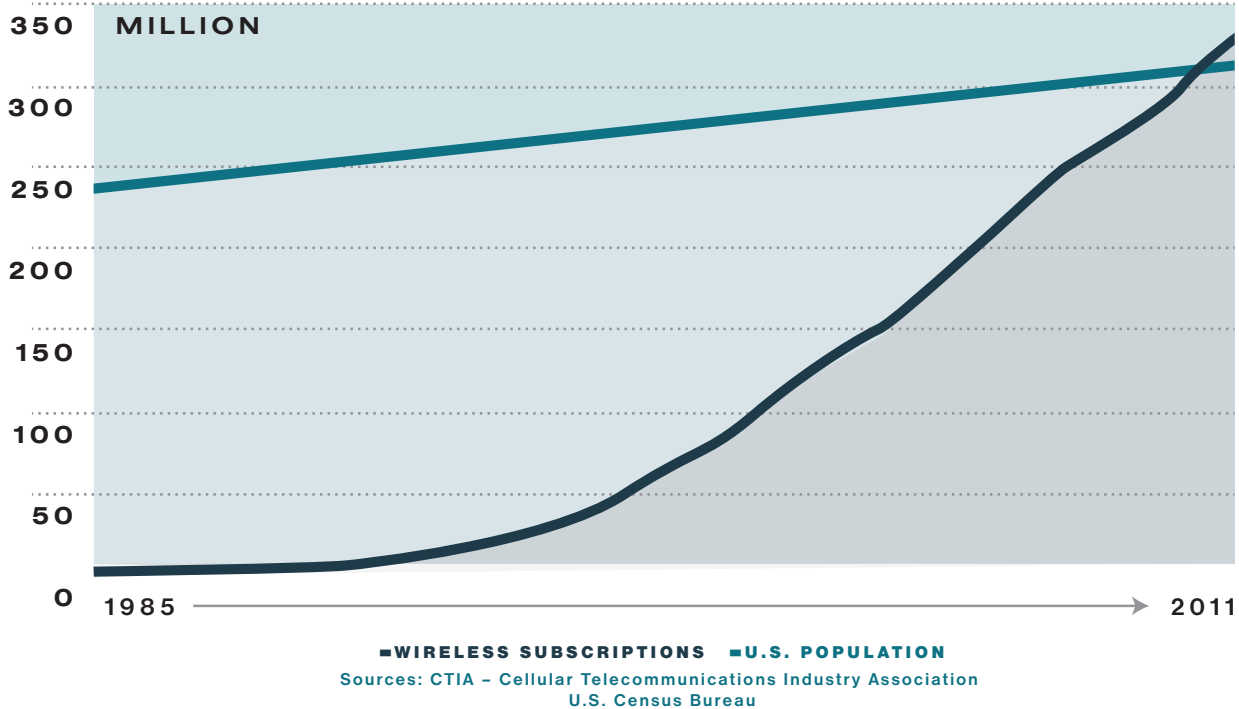
The number of tablets is growing almost as fast (although slowing somewhat), with sales of more than 200 million tablets projected for 2013 – an impressive increase from the 18 million sold just three years ago, according to *Investor's Business Daily.*

THE NEXT GENERATION of software applications that are now being built are designed to run with little or no expectation regarding the user's hardware or location.

U.S. WIRELESS DEVICES OVERTAKE U.S. POPULATION

350 MILLION
300
250
200
150
100
50
0

1985 — 2011

■ WIRELESS SUBSCRIPTIONS   ■ U.S. POPULATION
Sources: CTIA – Cellular Telecommunications Industry Association
U.S. Census Bureau

Mobility Means Processing

The explosion of tablet sales and the fact that more than half the people in the U.S. have smartphones means that a majority of individuals have a device in hand that can serve as a portal to powerful applications.

With the burden of processing and data storage moving to centralized cloud resources, these devices do not need to be designed to run today's more powerful applications or store an ever-growing amount of data. They are designed to make rich media – everything from a high definition movie to a full set of construction plans – available to users wherever they are and give them tools to manipulate and create their own content. It is already possible to download, mark up, and share changes to construction documents from a tablet at a jobsite.

ESTABLISHING JOBSITE COLLABORATION

Powered by cloud resources, these three related trends in mobility – communication becoming data, data becoming mobile, and mobility meaning processing – are changing the way construction teams work. Teams, including groups from different contractors working together, are moving away from individual "send and receive" communication and toward a "share and collaborate" model (see "Mobile Communications"

on the next page) powered by the ability to work on project documents together from the jobsite and remote locations.

Not only does this method of team communication bring order to the chaos of data, documents, e-mails, logs, and other sources of project information, it also adds a level of accountability to the team. PMs can see who is handling a particular issue, track the history of change requests, and identify communication bottlenecks that can lead to slow-downs in workflow or cash flow.

An obvious prerequisite to establishing a collaborative model for jobsite communication is to equip field staff with the mobile devices they need. The "Jobsite Communications" Exhibit a few pages ahead lists some of the most common jobsite uses for tablets and smartphones. In general, smartphones are ideal for single-function, task-oriented applications; tablets can be used for more complex data processing. However, determining how best to equip jobsites and remote employees with mobile devices goes beyond tablet vs. phone decisions.

JOBSITE WORKFLOW

The most important consideration when creating a plan to enhance jobsite mobile communication is to understand the

flow of work in the field and between the field and office. This will provide information for budgeting and application decisions.

Here are some important questions to ask:

- How much can be saved in paper, printing, copying, and reprographics expenses?

- What is your company's average days sales outstanding (DSO)? Would empowering remote staff to collect revenue at the jobsite be a viable way to improve cash flow?

- Is there a service component to your business? How are your dispatchers and field technicians connected? How easy is it for field techs to collect money and access maintenance specs and histories?

- How many trips to physically gather or deliver information between the office and the job trailers can be eliminated, thereby creating efficiencies and reducing communication gaps?

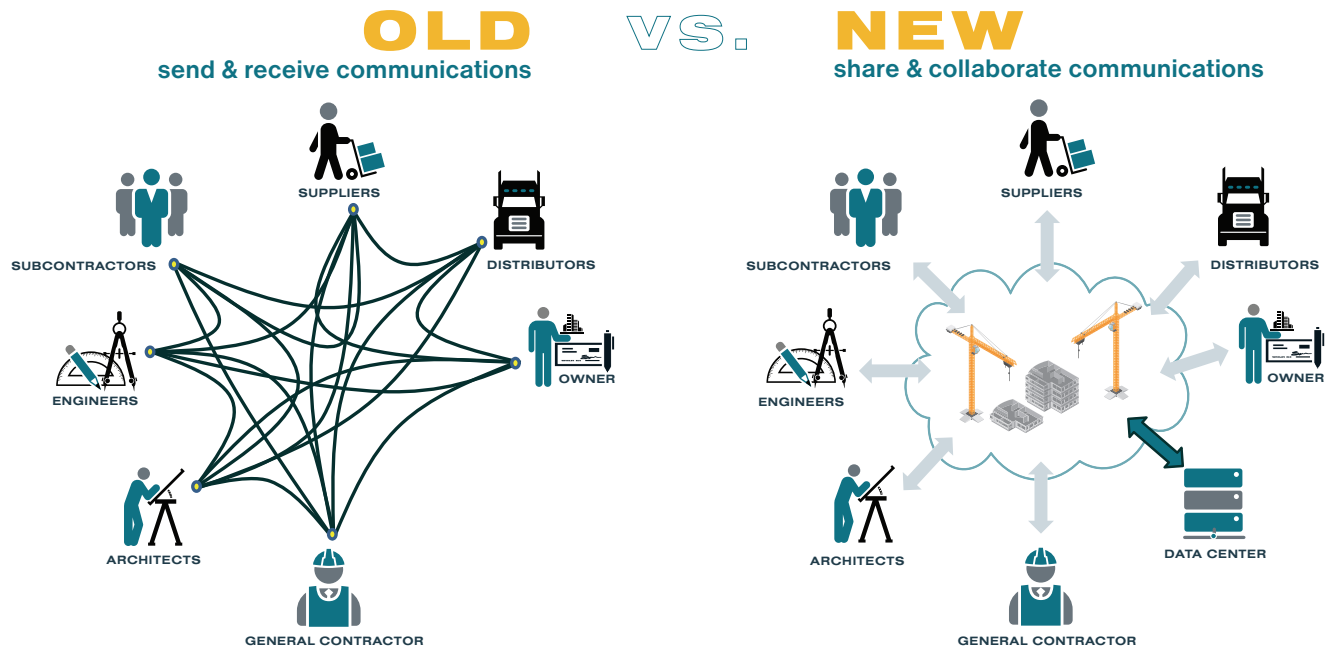- How are project documents shared among team members?

A good example of the benefits of jobsite mobile data technology involves a large rebuild of two terminals at Dallas/Fort Worth International Airport. The prime contractor estimated that by equipping the jobsite superintendents and other key staff members with tablets on which they could view and share project plans, and by placing Apple TV units in the job trailers for large-screen displays of tablet content, the company saved roughly $5 million on document management and reprographic costs alone.
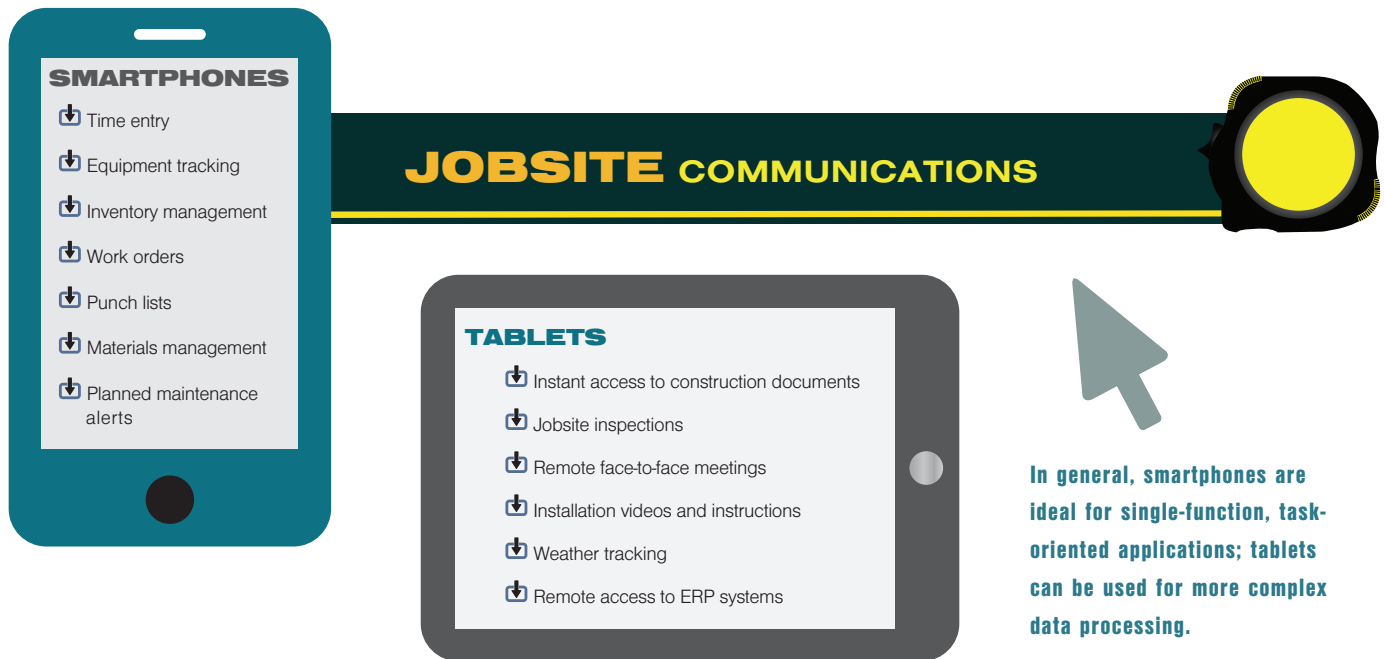
User Devices

It is natural for companies to standardize mobile equipment, and there may be economic reasons to do so in order to receive preferred pricing or reduce training and support costs. Apart from these considerations, however, there are not many technical reasons to mandate a single type of mobile device for the field. Most "native" applications are developed for both Apple's iOS *and* Google's Android platforms. If mobile devices are primarily used to access web-based software, then the application that matters most is the browser.

MOBILE COMMUNICATIONS

OLD vs. **NEW**

send & receive communications

share & collaborate communications

JOBSITE COMMUNICATIONS

SMARTPHONES

- Time entry
- Equipment tracking
- Inventory management
- Work orders
- Punch lists
- Materials management
- Planned maintenance alerts

TABLETS

- Instant access to construction documents
- Jobsite inspections
- Remote face-to-face meetings
- Installation videos and instructions
- Weather tracking
- Remote access to ERP systems

In general, smartphones are ideal for single-function, task-oriented applications; tablets can be used for more complex data processing.

When standardized hardware is not required, the next decision is whether to adopt a "bring your own device" (BYOD) policy. Many companies allow employees to use their own mobile devices on the job. The savings seem obvious, but there are potential pitfalls.

For example, data security issues can arise from mixing work and personal data; productivity may decrease; and staff may expect compensation for additional data usage costs, etc. A well-structured and communicated company policy should be in place to address these concerns.

In addition, technology solutions are available online that help segregate personal and business data and applications for companies employing BYOD. (To learn more, read "Opportunity or Obstacle? Managing a BYOD Policy" by Victor M. Marshall and Scott M. Lewis in this issue.)

Connectivity

One of the attractions of mobile devices for jobsites is that the native applications running on these devices do not, in many cases, require Internet connectivity. These applications, however, typically provide basic toolkit functionality (e.g., looking up electrical specs or performing conversions and calculations). Some applications go a bit further and allow for offline data entry or manipulation, which can be automatically synchronized with enterprise systems when the user is back online (e.g., field time and/or materials entry, project document views and markups, etc.).

While valuable, providing access to offline applications does not help realize the collaborative potential of cloud-powered mobile communication. Companies that are serious about creating intelligent jobsites need to consider how to keep the entire jobsite connected to the outside world.

A number of emerging technologies are addressing this need. For example, in a recent collaboration between Sprint and Feeney Wireless, a device known as Jobsite in a Box was developed to extend connectivity not only to the jobsite, but also to extend the company's firewall across the site.

For work areas where wireless coverage is weak, new wireless devices that act as a type of Wi-Fi network extender can establish a reconfigurable mesh network, connecting all staff to a central Wi-Fi hotspot at the job trailer. As work progresses underground or within a structure, small transceivers can be quickly repositioned to keep all workers connected.

A New Breed of Software

The way contractors are using software is clearly changing, with cloud computing and mobility driving much of this change. Thus, the way software is designed and delivered is also changing. Cost of ownership and usability are driving software away from the legacy client-server paradigm and toward web-based user interfaces, accessible wherever work is being done, using whatever connected devices are at hand.

Contractors that seek new software are looking for applications that have the functionality they need for accounting, project management, and service management. Meanwhile, the software industry is undergoing a change not seen since the days the market moved from DOS to Windows.

So while functionality is paramount, the way software is delivered, accessed, and presented must play a central role in new software decisions. There are many considerations.

Leveraging the Cloud

The point of cloud computing is to remove the burden of software maintenance and reduce the burden of hardware updates. If software is not designed to take full advantage of the Internet as a delivery mechanism and presentation platform, then many of these benefits are lost. As a result, the next generation of software applications currently being built are designed to run with little or no expectation regarding the user's hardware or location.

Mobile Readiness

While true cloud software only requires a connected device and a browser, some applications are too complex to make smartphone use feasible. Well-designed browser-based applications take into consideration typical usage for different parts of the application. User screens for functions performed by jobsite staff likely to use smartphones instead of tablets or laptops should be compatible for the smartphone screen (e.g., time entry). And, given the explosion in tablet usage, even full-enterprise software screens should be able to accommodate this new real estate.

Finally, the use of applications should not rely on the existence of keyboards with function keys or peripheral hardware like a two-button mouse. Look for touch-screen capability when selecting mobile-ready software.

Integration

As more software moves to the cloud, it's inevitable that links between applications that have relied on PC-based application programming interfaces will be broken. However, the cloud does not preclude integration with other applications. An advantage of web-based software is the ability to invoke Internet services, a standard method through which HTML can pass information between applications, including ones that are not in the cloud.

So, moving to a web-based accounting system does not mean that integration with an estimating program will be lost. However, the contractor should confirm that the cloud software provider supports web services and provides the tools or services to effect web-based integration.

Conclusion

Collaboration has been a buzzword in the construction industry for years. Like most trends, it loses meaning with repetition. Communication is at the root of collaborative work, and the jobsite is where the quality of communication translates to tangible results.

If a contractor actively manages the way communication occurs – if it makes technology choices that enable effective information sharing – then project communication gains context and quality. Each participant involved in the project becomes a more informed and effective player.

The collaborative platform provided by cloud computing, the accessibility afforded by new mobile devices and equipment, and the new generation of software designed to take advantage of this connectivity all help pave a path to a more effective, profitable, and intelligent jobsite. ■

Endnote

1. Google's "A Comparison of PSTN and IP Traffic from 1997 to 2015."

JOHN B. CHANEY, CPA, is President and Co-Founder of Seattle-based construction software developer Dexter + Chaney, founded in 1981. John is involved in all aspects of development of Dexter + Chaney's construction software, working closely with clients throughout the U.S.

A frequent author for *CFMA Building Profits,* John is also an active member of CFMA's Puget Sound Chapter, a former member of the chapter's Board of Directors, and a former chair of its Academic Scholarship Committee. He frequently writes about topics relevant to construction financial professionals.

John earned his MBA from the University of Washington, Seattle, WA and his BS from University of the Pacific, Stockton, CA.

Phone: 800-875-1400
E-Mail: jchaney@dexterchaney.com
Website: www.dexterchaney.com