E-Commerce Applications in Construction

CII Research Summary 180-1

Introduction

With the current economic situation and the recent media frenzy about the “death of the dot-coms,” many would believe that e-commerce is all but dead. Recent CII research shows that e-commerce is alive and well — in fact, it is growing in almost all sectors of our industry. Our results demonstrate clearly that companies of every size and type should be considering some aspect of e-commerce in order to remain competitive and to enable the next evolution of performance.

CII gave its E-Commerce Applications in Construction Project Team (PT 180) a special assignment: conclude efforts within one year as opposed to the usual two years or more that many research efforts take. This was considered important because of the rapid changes occurring in e-commerce and the desire to keep the report fresh. This was accomplished.

The Project Team

A superb collection of contributors was assembled for the effort (see Project Team listing at end of report). Many are seasoned warriors who have fought through the complex issues of moving an organizational culture into electronic commerce in a variety of forms. Some have set up large, commercial, e-procurement environments while others have developed strong e-collaboration environments.

The academics for the effort included Dr. Jeff Russell, the 2001 CII Researcher of the Year, and Dr. Raj Veeramani, who not only knows the engineering and construction realm, but who founded and leads a global procurement consortium headquartered at the University of Wisconsin-Madison. This link gave us the opportunity to perform some independent confirmation of our findings and also allowed for supplemental funding to be available to enhance the overall effort for CII. Four exceptional graduate students supported the two principal investigators, and performed all the survey and interview work as well as four case studies under an extremely short schedule.

Team Objectives

The objectives of PT 180 included:

- Identify state-of-the-art applications in construction.
- Study best practices and business models from related industries and find opportunities.
- Identify barriers and challenges.
- Make recommendations on how companies can apply e-commerce successfully to become competitive.

The scope for PT 180 included primarily the same general activities that most CII project teams are asked to accomplish. These included:

- Synthesize available information on e-commerce relevant to the construction industry.
- Conduct a multi-page written survey of members.
- Perform several dozen structured, onsite interviews with owners, designers, contractors, and suppliers from different regions in the U.S.
- Perform four to six case studies on e-commerce efforts in the construction industry.

The project team looked at some other activities to add to the scope, but both the timeframe and the results we received in the initial survey work made it clear that this scope was all that could be accomplished considering the time and funding available.

The Research Process

The planned work products from PT 180 included the research report, this research summary, and a separate analysis of the case studies. One deliverable, the best practice(s), was not done as all survey and interview work showed clearly that this area is much too immature to have any action or process labeled as a “best practice.” In fact, the project team went well out of its way to make sure no one could construe any of our findings as pointing toward a best practice. This included leaving names of software systems and consultants out of the research report so that no one would be misled.

The PT 180 academic team prepared a comprehensive survey involving the broad topics of e-commerce with no preconceived notion about which areas were more important or more likely to be encountered. The survey was sent to all CII member companies. Of the 89 members as of June 2001, 39 responded with completed surveys. In addition, because those experienced in e-commerce knew how important suppliers are to many aspects of these processes, the team decided to survey suppliers. This produced an additional 10 responses that were helpful in confirming the member results.

Based on the survey results and clarification discussions with some respondents, the academic team mounted a complex effort to interview 19 companies in their headquarters locations. The results both confirmed the survey results and provided important details that expanded the knowledge of this effort significantly. It also identified five areas where detailed case studies of specific companies appeared valuable. After these were conducted, it was decided that only four were worthy of publishing. CII Research Report 180-11 details each and is highly recommended reading for any CII member firm considering e-commerce efforts in the future.

Basic Survey Results

Many forms of electronic commerce are in use today and over a dozen were found to be operating or planned in CII member companies. The two primary activities, however, were e-collaboration and e-procurement. E-collaboration most often occurs on project Web sites and may be hosted by CII firms or may use third parties such as Citadon™ or e-Builder™. As many as 300 e-collaboration firms have been active, and basic methods have been studied by many research groups dozens of times. Because of this, PT 180 decided to focus on e-procurement in its many forms and our interviews confirmed we were correct to do so.

The various e-procurement models in use by CII members include:

- E-mail communication — simple replacement of the passage of paper with the use of electronic exchange of the digital form of the same documents coupled with a document control function to know when something went out, returned, or was modified.
- Basic supplier-focused e-procurement for catalog items — using the services of suppliers who make their catalogs available online and who will pre-negotiate terms and conditions as well as some specification elements to speed the process. Often this is done with suppliers with whom the subject company has negotiated national agreements; the companies want these agreements to be fully utilized by everyone in the firm.
- Buyer/supplier integration using common e-procurement package — in this situation, there is an intimate connection between buyer and supplier that is often accomplished through the use of the same package and perhaps service provider as well.
- Marketplaces hosted by third party — though this was a model that many thought would dominate, many of these approaches have died as participants, especially suppliers, decided they did not need a middle entity between them and their customers.

Of all the many findings of this effort, several early conclusions stood up throughout the research process. For example, many organizations do not know where to start or are not sure what issues to consider. Though there are many textbook approaches and packaged solutions, the reality is that e-commerce is much more a people and culture effort and not one so much of technology or process. Also, we found that owners are leading the implementation of e-procurement models, with the greatest success occurring with maintenance/repair/operation (MRO) and commodity-type items. These are largely commodity or pre-specified items that may be part of a corporate-unique catalog created from the many offerings of preferred suppliers. Lastly, some companies have made leveraging equity investments in private, third party e-business exchanges. Success here has been spotty and continues to evolve. In some cases, these were replaced by consortiums of related suppliers who did not want others making brokerage fees off of their products and with their customer base.

Survey Analysis

PT 180 analyzed the results and found that e-procurement and e-collaboration were the main focus for most organizations. This confirmed independent research by our more advanced members. The project team also discovered that other aspects of e-commerce, such as e-marketing, e-customer service, and e-finance, are not a current priority for most CII members.

E-commerce initiatives that are either underway or that are being considered by CII members vary by industry sector. The design/engineers favor e-collaboration, or what is commonly termed “project Web sites.“ This is a relatively mature technology and will become even more enabled by “portal technology,” which appeared in a number of companies’ 2003 plans.

Owners are either experimenting with or using e-marketplaces and reverse auctions. The reverse auction, where a need is posted and bid by different supplier or service firms, has become a preferred target for many. As detailed in the research report, there are many positive and negative aspects to the reverse auction method, but at this time it has become the preferred method of buying anything other than simple commodities off of retail Websites.

Contractors have an overriding belief that current tools do not meet their needs. Some have found and are using current tools successfully, but these tend to be driven by owners demanding that their preferred subcontractors move toward e-commerce proactively or possibly face loss of opportunity. The collective wisdom and experience of the project team is that survey findings are in line with their experience inside and outside the CII membership.

Without question, owners are leading implementation of e-procurement, but are not focused on new construction. Their greatest successes are directed at indirect and MRO materials and services. This is a much more frequent or even continuous set of processes and therefore is likely to produce greater savings. In general, three benefits are seen in making this a prime target: cost savings, relative ease of implementation, and time and efficiency gained.

As with almost every aspect of e-commerce, however, information technology is critical and there are significant integration challenges, both within the implementing companies and with co-participants such as suppliers. Efforts such as CII’s Construction Supply Chain Performance Project Team (PT 172) and those involving extensible markup language (XML) are working on solving this problem.

A much larger collection of efforts is occurring worldwide and CII members can track these initiatives via the coordinating organization called OASIS. Their efforts can be viewed at www.oasis.org and encompass almost every industry and commodity type known.

The challenges in e-procurement that our research uncovered can be grouped by the roles common to the construction industry. It is important to remember that these are survey results and may reflect opinion rather than an accurate reality. For example, some believed there were no tools available for their role, while their competitor may have told us what they were using and how.

For contractors, there were fundamental issues that show why few have ventured very far into e-commerce in this sector of our industry. Issues included:

- Lack of e-business tools that meet needs.
- Culture that often has not embraced IT.
- Difficulties justifying investment in e-commerce tools.

Owners hold a general belief in e-procurement and therefore the issues tend to be more about how well rather than whether or when, such as:

- Internal resistance to change.
- Connectivity.
- Using e-procurement tools with existing backend financial/tracking systems.
- Newness makes accurate planning difficult for all requirements and a “beta test” is needed for a potential solution.

Design/engineers have some issues in common with other roles, but they see e-collaboration as an easier, more mature, and more accessible form of e-commerce that their clients now expect. The main issues for design/engineers included:

- Cultural resistance.
- Added value hard to verify.
- E-collaboration initiatives appear to be better investments.

For suppliers, issues varied widely, but all shared one overriding issue: the unique problem known as “one-to-N.” A supplier cannot develop any method by which to work with the dozens of tools and data formats of the many different clients they have. Because of the lack of standards for both buyers and suppliers, the supplier has the problem of either choosing one method and demanding that all clients use it or developing the N formats and methods and hope that it brings sufficient value to return the investment. This is a serious issue for all members of CII and will impede progress for years to come until it is solved. Efforts like the aforementioned CII Project Team 172 are focused on trying to manage this issue. Several case studies of PT 180 show how different firms are attempting to deal with the “one-to-N” problem.

In addition to the challenges that are related to construction roles, more generic issues or functional challenges exist. Many of these are actually common to any major initiative, especially those related to implementation of a large information system or major process change.

As is often the case in any major change initiative, e-commerce in general and e-procurement in particular must have commitment from top management. Those interviewed confirmed what happens when this is present and what fails when it is not. Without this, the attendant cultural change cannot take place and take root as a fundamental process of the organization.

A second functional challenge involves the various organizations having different levels of willingness and ability to participate in e-procurement. It takes two or more to have commerce and if too few can participate, an organization is faced with running two different processes, one manual and one automated, to achieve their total procurement function. This is the single greatest practical barrier for many players.

As one might expect, significant information systems integration issues arise in any e-procurement effort and those CII members who are implementing today see this as critical. The problems in this area are primarily associated with linking legacy or older systems or integration with existing backend office systems such as central accounting.

Another challenge involves the difficulty in finding e-procurement systems that will remain viable. Many firms offering such systems are having financial problems and may introduce too great a risk for an organization.

As is common with many new processes, there is difficulty in finding or developing compelling metrics to justify the investment in e-procurement. This is not only a problem of understanding and quantifying the benefits and costs, but also involves the unfortunate fact that many firms have little or no information accumulated about how well their current processes work and provide value and therefore have little to compare against.

As Figure 1 shows, there are some CII members pursuing almost every basic form of electronic commerce with a strong bias toward e-collaboration as we anticipated. It is important to note that specialty firms appear to be much less aggressive in becoming involved in any form of e-commerce. This is likely because they are seldom given final document management or procurement responsibilities and therefore their contribution to the complete in-progress and as-built information collection is a subset of the total.

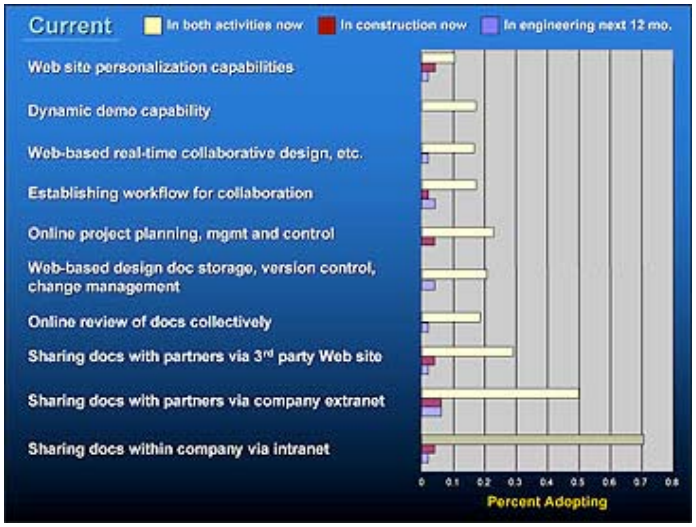

Figure 1

As shown in Figure 2, the organizations surveyed have plans to elevate their efforts toward the more complex variations of e-commerce, but it is clear that engineers and constructors are not yet strongly focused on e-procurement to the degree that owners and suppliers are. It is clear from survey results that some firms are far more sophisticated than others in the areas of e-collaboration, but the majority appear to be moving forward with little evidence of abandoning early efforts as is often the case with immature technology advances.

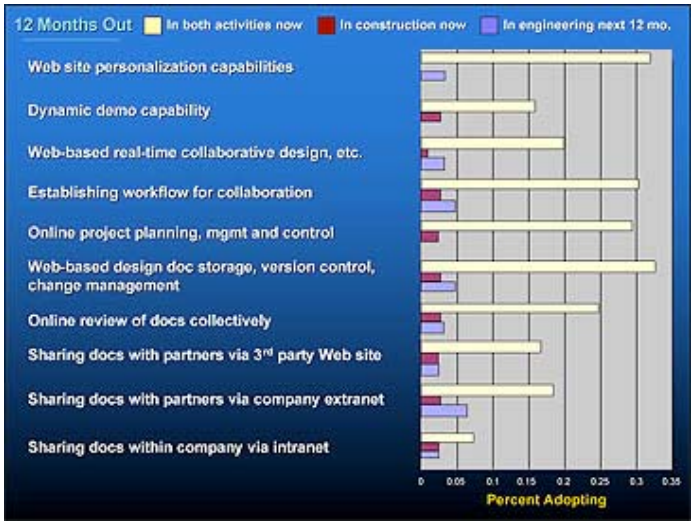

Figure 2

Much like the images in Figures 1 and 2 regarding e-collaboration, the survey information showed a strong stratification across the various types of CII members regarding e-procurement. The owners have taken a strong leading role in moving e-procurement ahead (see Figure 3). The reader will note the almost complete absence of marks in the EPC and subcontractor columns. This figure is changing every day, but the current downturn in the economy ensures that these changes will be slow until at least late 2003 or 2004. During this time, only a few firms will be aggressive enough to invest and only a small number of e-procurement service providers are likely to be able to sustain themselves. Unlike the rush era of e-commerce in 1999-2000, this may provide a more relaxed period of reflection and planning for firms to more thoroughly prepare for doing e-commerce in the next decade.

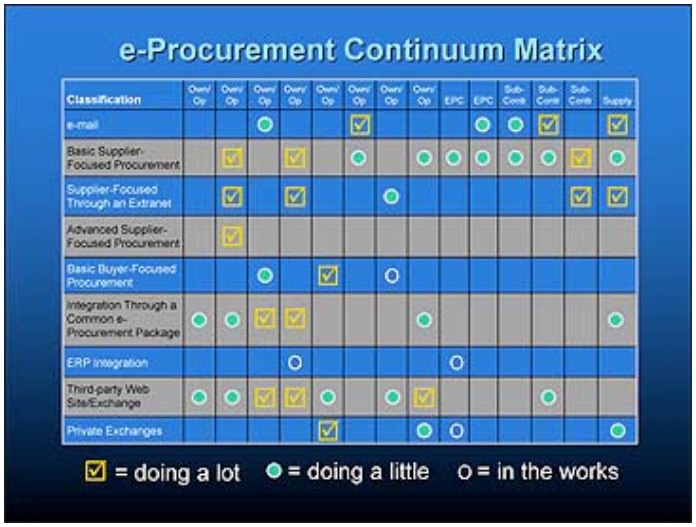

Figure 3

Case Studies

The following five case study subjects were identified from early analysis of the survey results and from the PT 180 original objectives:

- Determining e-Readiness
- Deployment Strategy and Metrics
- e-Procurement of Catalog-Type Items
- Reverse Auctions
- Private Third-Party Exchanges

After examining the early data and interview material, PT 180 was decided that the e-readiness case study presumed that we would find a best practice or at least best path information that could provide a guide. This was not the case, given the immature state of this technology and process domain.

The results of the other four case studies are detailed in CII Research Report 180-11. The following are abbreviated discussions of two of the case studies.

Owner A

Owner A focused on MRO procurement. This involves both buying from supplier catalogs as well as the development of a company-specific catalog of preferred items that may include more complex entities beyond simple catalog commodities. Owner A found several key learning points. First was the need to assess the current organization and processes thoroughly. The focus was on purchasing of raw materials, equipment, construction services and indirects. In this regard, it found that a centralized purchasing structure favors e-procurement and vice versa. Doing it once is hard enough without having multiple ways for the organization to deal with the complexities of e-anything.

A second set of critical observations involved determining the needs of the organization and its projects and then building the correct e-procurement strategy. The need for a thorough e-commerce strategy

was heard many times in interviews and the lack of one was often tied to major failures. In addition, several other concerns were highlighted, including:

- Business drivers — making sure there was sufficient motive for all affected groups to participate.
- Cost — not just cost of systems and implementation, but change process, supplier courting and coordinating and other efforts needed to get all pieces working.
- Lack of relevant data — not of the new process, but about how and how well the old procurement processes worked, what they cost and saved, buying patterns, and many other details needed to establish a baseline for future comparison.
- Inability to leverage globally — current laws and practices make global procurement much more difficult than within the U.S. or a single country. This impedes much of the value acquisition for global firms or those that have needs that cannot be supplied by solely U.S. companies or domestic branches.
- High transaction cost — this can be a major issue unless the process is strongly optimized.
- Simplify field buying — this must be a consequence of the e-procurement effort or can be a major impediment to the overall process.

As far as the systems and tools related to Owner A, the first implementation started in 1998. After several years of study and planning, the actual system took one year to put in place. A third party tool was acquired and the company's Web site was developed into a purchasing portal. The site focused on indirects and MRO purchases. Coupled to this was a strong initiative toward using procurement cards. This is common to a number of implementations we have seen with others.

Though it was initially difficult to get suppliers to consider being involved in the effort, the situation is now inverting. The top 20 suppliers of Owner A are driving the company to migrate to a new e-procurement system platform. It appears likely that other suppliers will have to follow. One could say this will generate the critical mass needed to make the effort by Owner A a lasting part of its business.

Owner A has already been able to identify a number of successes in their early efforts, including:

- Better data means better negotiating leverage for company-wide contracts — it is common that e-procurement creates data collections that can be mined to learn more about corporate procurement actions and processes that bear fruit outside basic procurement.
- Efficient training (mix of Web-based and classroom) — Owner A found that using Web-based training not only increased its reach with a minimum of cost, but can also be a more effective mode than the classroom.
- Transaction cost is less than one-third of previous purchase order cost — this is common in many firms that had disconnected manual processes. It is smaller in firms that had automated the classic procurement process using techniques such as electronic data interchange (EDI).
- Suppliers paid faster — a necessary attraction to gain their interest.
- Efficiency in time spent — this occurs on several levels and requires effort to understand just how broad the impact may be.
- Proven cost savings up to 20 percent.

It is critical to note the savings, which were not calculated on early bids vs. final bids, but rather by comparing final bid results to historical prices from past procurements done in conventional processes. The reader may have expected to see much larger savings. However, savings of 10–20 percent in this area of e-procurement are common from our survey and interview results. When one is dealing with large capital equipment or annual commodity purchases, this is still an impressive level of savings worthy of pursuit.

Owner A had several major lessons learned to share. The bulk of these are related more to change management than technology and include:

- Old habits are hard to change — getting top management support is critical.
- New habits are more efficient — good metrics and better value propositions have to be clear and often tailored to the audience.
- Effective training is key — more than one method is likely to be required.
- Opportunity to transform local/regional agreements into corporate-wide contracts — a powerful corporate motivator, but business units may resist.
- Supplier change management is a challenge — concentrating on their value proposition independent of yours is critical to enlist their involvement.

Many team members believe that supplier change management must go a step or two further. One cannot presume that the suppliers can develop a comprehensive value proposition for themselves; they may need outside help to build a strong enough case to move their management to action.

One recommendation of PT 180 involves this last point. CII has always sought and nurtured best practices in all areas of our industry. However, as new techniques and technologies are created and embraced, there is a long period of learning during which none of these can be considered a best practice as the experience history is too short and is still being assembled. It is critical during this period that any value propositions or cost-benefit analyses that members encounter or are willing to share be placed in the CII Knowledge Structure in a new category. The construction industry (outside of the best owners) does not have strong skills in developing comprehensive value propositions for themselves and their management and this inhibits the adoption of innovation — much as we see today in e-commerce. The American Society of Mechanical Engineers (ASME) has a major initiative to address this issue in many of the industries that it touches, and the project team recommends that CII have some discussion with ASME on this topic.

Owner B

Owner B has a long history of early and strong adoption of technology and advanced processes. For this CII member, the critical issue is strong planning before making any moves. Its first effort was to understand the business drivers in response to strong corporate pressure to move into e-commerce.

Owner B had to decide on the scope of the procurement to be done using e-procurement. Conventional wisdom says that one can do commodities easily. Or, one can build a corporate catalog and buy. The latter also is fairly easy, but takes more time and money. Most believe, however, that buying of engineered equipment or specialized services is too complex to be done with today's tools. Owner B took this assertion as a challenge and developed its plan to do all forms of procurement and ultimately succeeded. In the process, it pushed preferred constructors to achieve with them.

Owner B recommends a genuine e-procurement strategy linked to the overall business strategic plan. Many firms attempt e-commerce based on the belief that it will enhance their strategy without directly incorporating the plans in an integrated manner. This treating of e-commerce as an independent event is likely to fail.

The key actions on which Owner B concentrated were intensive e-procurement tool evaluation and selection, aggressive and supportive supplier recruitment and preparation, and training for the coming effort. Both Owners A and B emphasized this last issue strongly.

After detailed examination of the different methods of e-procurement that it might use, Owner B chose reverse auctions. This is a conclusion that many of those attempting e-procurement also have chosen. Reverse auctions involve a company telling a set of potential suppliers that it needs a particular set of equipment or services and offers the chance to bid on the opportunity subject to specifications, terms,

and conditions that are part of the overall package. This is similar to conventional RFP processes, but here most of the interaction is done online in a controlled environment where bidders are aware of others bidders' activities via anonymous indicators. The bidders do not know the bids of others, but are aware of whether they are higher or lower and where they stand in the bid hierarchy. What used to take days or weeks is often completed in under an hour and often with lower prices and/or better terms than previously accomplished in classic methods.

For Owner B, the sequence of events moved quickly once it had a solid plan. A third party e-procurement tool was selected in October 2000 as it began recruiting suppliers to participate. The initial auction was held in December 2000 and was focused on valves. The bid opened at $500,000 and closed with a winning bid of $300,000. The owner made sure that this early success was well-celebrated and followed up so as to build momentum for all participants. Subsequent bids have focused on engineered equipment, and recent bids have involved services. As of March 2002, total bid volume had reached $35 million and verified savings had been between 10–20 percent over historically similar bids for the same equipment and services.

In its typically thorough manner, Owner B performed a comprehensive benefits analysis. What it found was that e-procurement:

- increased the size of the marketplace by its ability to conduct events in real time on a global basis.
- provided better cross-functional collaboration within the organization.
- provided a better-defined bid package — online actions require extra clarity and up-front effort.
- changed behavior from reliance on "trusted" suppliers to more open competition.
- increased team spirit through use of the new work process.

These, combined with the 10–20 percent savings over budget that were based on historical successes, prompted this owner to declare that e-procurement was not only its direction for the future, but that it believed use of these tools would become the norm for the best companies in the future.

The lessons learned for Owner B were detailed and produced items others had not noted or told to our interviewers, including:

- The success of reverse auctions is situational — entering the market at the wrong time on a heat exchanger buy, for example, actually ended up costing the company money.
- Not everything is a candidate for online bidding — one must figure out how to obtain sufficient benefit from e-procurement to offset having to retain conventional processes for some of procurement actions.
- Market conditions must be considered, specifically the timing of auctions.
- Significant effort is required to overcome biases to traditional procurement practices — this includes a bias by buyers who want to work with those they know best, even when it might not be best value overall.
- User training is a significant part of success.
- Anticipate supplier reluctance and proactively deal with their concerns.
- More discipline is required to meet procurement schedules.
- Cost of change does not have to be significant.

Owner B efforts are a case study in how a top organization can make something happen by sticking with the fundamentals.

Project Team Report Card

The report card of the objectives of PT 180 contained the following results:

- We identified the best of what peers are doing and how they were able to do so.
- We found no best practices that were clear; this entire arena is still in its infancy.
- We identified barriers for e-procurement, which were experienced by early adopters, regardless of business type or focus.
- Recommendations are offered on how companies can apply e-commerce successfully to become competitive — with serious caveats about how subtle the differences are for each company in almost every aspect of what it takes to implement e-commerce in general and e-procurement specifically.

Summary

PT 180 conclusions include the following:

- Owners are leading implementation of e-procurement.
- The greatest success is with indirect/MRO materials.
- Significant integration (internal and external) challenges exist.
- Use of e-tools will be the norm in the future for the best companies.
- On average, a 10–20 percent savings on budget can be realized.

One strong recommendation is that a CII process be established to revisit this and several other areas of e-commerce on an annual basis. Instead of performing more research, this effort would revisit the survey developed in PT 180 every 18–24 months and would follow the efforts of known leaders in the membership to see what they are learning and how their efforts are evolving. This would take the form of continuous benchmarking, not against an ideal best or a best practice, but rather with early efforts acting as a baseline. With construction performing nearly a trillion dollars in procurement, producing several hundred million drawings, and generating billions of documents annually, e-procurement and e-collaboration will continue to be critical topics. An additional aspect this reporting effort should include are any changes in the legal circumstances surrounding these processes as this area is currently even more immature than the technology or processes.

E-Commerce Applications in Construction Project Team

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