Internet bidding adoption in large transportation agencies - from innovation to the norm

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Abstract: More and more agencies are taking the leap over to electronic and Internet bidding and these organizations, and the contractors that bid on their work, are experiencing the associated benefits. In fact, across the US and Canada, there are more than 8000 highway construction contractors that are bidding online. They do so by downloading project data over the Internet, preparing bids on their computers and then uploading their bids back to the Internet. These contractors have experienced a reduction in paperwork and the significant time and cost savings associated with Internet bidding for state agencies, and they are now seeing this as an option for local work as well.

This paper reviews how several large US DOTs approached Internet bidding and, most importantly, got buy-in from the contractors. It provides insights into agencies evaluating the use of either electronic or Internet bidding. Topics that are addressed include: What is the difference between e-procurement, electronic bidding and Internet bidding? How does a public works agency determine the best system to implement for road and bridge construction projects? What are the benefits and efficiencies gained through the use of electronic or Internet bidding technologies?

This paper also discusses how large and small public transportation agencies have reviewed and evaluated the risks in several areas of the project bid and award process, and how the use of an Internet-based bidding tool can mitigate and even eliminate those risks. Some of the issues discussed are the potential for unauthorized or incomplete bid submission, privacy and security of bid information, bids that may be 'lost' using the electronic medium, and the guarantee that vendors are bonded for projects prior to bidding. The innovation of Internet bidding diffused slightly faster than a typical technology to become the norm with transportation bidding over the last decade. This paper examines why and how this took place and what the future holds for internet bidding.

Paper bidding dominates

Each month departments of transportation across America bid out complex highway construction projects. These projects require a highly-specialized mix of equipment, labor and materials. Heavy highway bid contractors are a unique, specialized group of firms that have grown to understand and embrace the bidding process as cumbersome but necessary to meet Federal and state/provincial requirements for effective bids and management of the resulting contracts. These contractors also understand that the bidding process is fraught with possibilities of errors, omissions, and missed deadlines.

In the past, transportation agencies would create packets of information (proposals) for projects scheduled for bid opening in a given month. Contractors would either visit an agency to collect these proposals or have them sent by mail or courier. After they selected projects on which to bid, contractors would begin the tedious, time-consuming and paper-driven process of preparing their bid. In addition to their understanding of the construction work on which they were bidding, contractors had to comply with all required bidding specifications and submit appropriate forms,

signatures and affidavits for every paper proposal packet. Once contractors completed that paperwork and manually calculated prices for each of their respective bids — typically using a calculator or pencil and paper — they would travel to the state capital to submit their bids in person. This was necessary to obtain the time-stamp which validated that they had submitted their bids before the bid deadline. If car trouble or a traffic snarl resulted in a late arrival to the agency's headquarters after the deadline, a contractor's bid would not be accepted.

In that highly competitive environment, contractors were forced to take extreme measures for bid preparation and the accommodation for changes to their bids up to the very last minute. In some instances, this required that bid team members stay in a local hotel, along with any equipment that was required to alter the bid at the last minute before the submission deadline. Complex computations might be changed on the fly in response to a late quote from a supplier or a subcontractor. Bids made of stacks of paper and paper bid bonds were dropped in a box just prior to the deadline. The bid opening took place at agency headquarters and was typically broadcast to a nearby hotel or conference room. The broadcast took place for two reasons; first to comply with federal regulations requiring a public reading, and second for the benefit of the contractors that wanted to get information on winning bids as quickly as possible. Bidders stewed, waiting for the results to be read and verified. At the end of the day, they would pack up their mobile offices, travel home and begin work on the jobs they were lucky enough to win.

Month after month, this process repeated. It was an expensive and time-consuming venture that cost money for hotel stays, meals and other travel expenses, not to mention personal time that could not be spent at home with family. Further perils associated with regular travels through snow and ice or other inclement weather to submit bids made this monthly ritual even more difficult, costly and inefficient.

The process was not easy for the agency staff, either. Agencies needed to prepare a great volume of paper files monthly. Temporary help was needed on the bid opening day to handle the paperwork and data entry. All too often, a low bidder would be disqualified due to a technicality, or an administrative or mathematical error. This could cost the state thousands or even millions when mistakes forced a contract to be awarded to a higher bidder. Another concern was always looming: was the agency unintentionally creating an environment that invited collusive behavior by block-booking rooms in the hotel and bringing bidders together?

However flawed, that process was the status quo. Each month at transportation agencies around America, the same ritual was performed.

Electronic bidding: A step in the right direction

In 1992 a revolutionary bidding software program was introduced that was specifically designed to automate state transportation agency bidding processes and thereby eliminate the need for paper bid submissions. Info Tech, Inc. created the application and sold it to the American Association of State Highway and Transportation Officials (AASHTO), which now licenses it through its catalog of products. The application, called Trns•port Expedite®, is a suite of small programs that assist both

the agency and its bidders. The bidder component is free for contractors. With the Expedite software, contractors could complete an electronic bid included in a proposal file that the contractor had downloaded from the agency requesting the bid. The file contained all of the bid items and quantities, so the contractor only needed to enter unit prices. The Expedite software had optional capability that allowed bidders to import and export data easily to and from their own applications, including standard software like Microsoft Excel and specialized software such as HCSS or Hard Dollar. The Expedite software performed calculations automatically. Because bidders only had to enter unit prices, mathematical errors were virtually eliminated. With a simple red-green color-coding system, the Expedite software alerted bidders to omissions in bids, including required check boxes or other information on standard bid forms. The Expedite software nearly eliminated the possibility of an accidental submission of an incomplete bid.

Around the same time, electronic verification of bid bonds also emerged. Contractors were then able to supply a code from a surety agency that verified the existence of an appropriate bid bond for the project instead of a paper bond: this code was part of the electronic bid, and therefore the paper bid bond was no longer required as part of the submitted bid.

Because the Expedite software allowed bidders to save their bid to disk, and because the surety companies now provided bid bond verification codes, bidders now only needed to drop a disk in the box: this process is known as “electronic bidding.” The great monthly piles of paper required by the old- fashioned paper submission process vanished almost instantly. It was a great step forward for bidders, agencies and the environment. While the mathematical errors, bid omissions and paper piles decreased, however, the hotels were still flooded with bidders every month, and contractors still faced the issues inherent with centralized bidding: the difficulties of making last-minute bid adjustments and delivering to the agency in time for the official bid opening.

By 1999, the Expedite software was in place at most state transportation agencies. Bidders and agencies enthusiastically embraced the benefits of the system. The Expedite program included an easy automated way for agency staff to enter data from paper bids (although, in many cases, agencies stopped accepting paper bids in favor of electronic bids). Agencies believed that their investment in the Expedite software had paid off: processing time was greatly reduced, and low bidders were rarely rejected due to a technicality.

The next step: the Internet

Business use of the Internet exploded in the late 1990s and another new paradigm emerged: ‘e-procurement,’ or the purchase and sale of supplies, work and services on the Internet, was gaining popularity in government agencies of all types because of the increased efficiency and cost savings inherent with Internet commerce. E-procurement did not, however, allow for the delivery of a sealed, secure, digitally signed bid, so its use was limited in highway construction contracting. People wondered: if the entire bid was small enough to fit on a disk, would it be possible to submit that file securely over the Internet? How could the sealed bidding process be applied electronically?

Then, an e-commerce milestone marked the new millennium: in the year 2000, the United States Congress enacted the Electronic Signatures in Global and National Commerce Act (E-SIGN Act). This law opened up the Internet for more commerce than ever previously imagined. With this legislation in place, an electronic signature was now just as legally binding as a written, 'wet' signature.

When digital signatures became acceptable for bid submission, Internet bid submission for state transportation bidding was no longer a far-fetched idea: contractors could bid from home, save on hotel stays and travel expenses, and still get real-time bid results. The possibilities were endless. Agencies could save on temporary staff and no longer needed to worry about collusive activities among bidders - it was a win-win situation.

Certain obstacles remained in the road of innovation, for the Internet was (and is) highly unregulated and open to numerous threats. A new Internet bidding service which would implement digital signature technology must ensure the integrity of the bidding process: the service would need to protect bid information through encryption, ensure that bid information could only be read at the appropriate times and by the appropriate people, maintain high availability and redundancy, and the service must be trusted by both the agency and the contractors. A failure of any of these elements would lead to failure of the entire service, so the service would need to withstand continuous and rigorous auditing to make sure that the most secure and reliable service possible was being provided to the users.

In 1997, a new bidding service was available to state transportation agencies using the Trns• port Expedite software. The service was essentially a virtual version of the old paper bidding process, incorporating the security, efficiency and integrity functions essential to Internet operation.

Internet bidding: How does it work?

The key to any sealed bidding process is that no one is allowed to access anyone else's bid until the opening. Bids are placed in sealed envelopes and held in a locked box, which is not opened until a certain time. Replicating the lockbox digitally is fairly straightforward; standard computer security mechanisms are used to restrict access to the submitted bids. Replicating the sealed envelope is more difficult. The key was finding an innovative way to solve this issue.

Traditionally, bids are placed in sealed envelopes so that nobody can read them without leaving physical evidence of breaking the seal. Therefore, even bad behavior by a trusted guardian of the lockbox could be detected. There is no comparable evidence left behind when someone accesses digital information, so the 'sealing' is done with cryptography instead. The bids are encrypted by the bidding software before they are submitted, and only the agency who issued the project has the key needed to decrypt the bids. If anyone managed to gain access to the submitted bid, whether a trusted guardian of the lockbox or an unauthorized intruder, they would still be unable to read the information in it, effectively keeping it 'sealed'. The service retains the bid files until the official bid opening, at which time they are turned over to the agency to be decrypted and read.

The digital lockbox and sealing of bids protects the bids from disclosure prior to their public opening, but what about protection from loss? The bidder needs to be certain that any bid they have submitted to the service is reliably and correctly delivered to the agency that is requesting the bid. How is that accomplished in the digital realm?

The first step is to protect the bidder even if something does go wrong with the Internet bidding service. Whenever a bidder submits a bid over the Internet, the service returns a digitally signed receipt, and a copy of the encrypted and signed bid is kept on the bidder's computer. Should the service fail to deliver the bid to the agency, the bidder can use this information to prove that the bid was properly submitted, and can even document that the data on his or her computer matches the data that was submitted.

The next step is to make sure that the first step is never needed. All bid submissions are stored on multiple computers, in multiple cities, to prevent the service from losing a bid file. The service also logs all submissions in multiple places, to make sure that everything received is actually found at the time of the bid opening. The logged information includes the identity of the signer of the submitted bid, the date and time of submission and a 'fingerprint' of the encrypted bid.

Finally, the bidder and the agency must both be certain that the bid as delivered has not been altered in any way from the bid that was submitted. Digital signatures, in addition to their legal value, provide this information security. A digital signature uses cryptography and a key known only to the bidder to produce a digest of the submitted bid that anyone can check, but nobody but the holder of the bidder's key can create. Any alteration of the bid file would invalidate this digest, leading to immediate detection of unauthorized changes. Digital signatures protect the bidder by making sure that no one else can make changes to the bid, and they protect the agency by making it impossible for a bidder to repudiate a bid by claiming it was altered.

Agencies jump in

While this process sounds very appealing on paper, agencies were hesitant to adopt this radical paradigm. After all, they were very happy to be accepting bids on disk, so why make things more complex? Remember, Internet bidding was first available in 1997 –dial-up connections were commonplace and unreliable, and many contractors did not even have email addresses.

Overall, the adoption of Internet bidding followed the 'diffusion of innovations theory bell curve'[1]shown in Figure 1, although at a slightly faster rate. The agencies that were licensing AASHTO's Expedite software were all candidates for the technology, yet some were more hesitant that others.

[1] Rogers, Everett M. (1962). *Diffusion of Innovations*. Glencoe: Free Press.

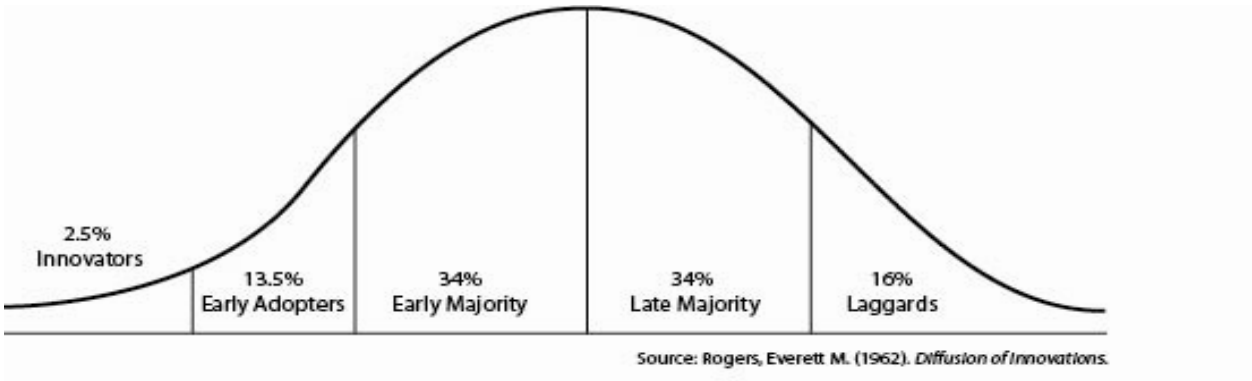

Figure 1 – Standard curve for technology adaption.

A few agencies stepped up to pioneer the service. The Wisconsin Department of Transportation was the innovator in this model, followed by the early adopters who were the Departments of Transportation in Georgia, South Carolina and Iowa. These agencies were the first to accept Internet bids. Then, between 2001 and 2004, 12 additional state transportation agencies came on board with the service – the early majority. By 2009, 15 more US state transportation agencies were on board, plus one Canadian province. These were the late majority and during those years it seemed that new agencies were signing on each month. There are currently 39 agencies licensing the Expedite software and only 4 that are not using an Internet bidding service.

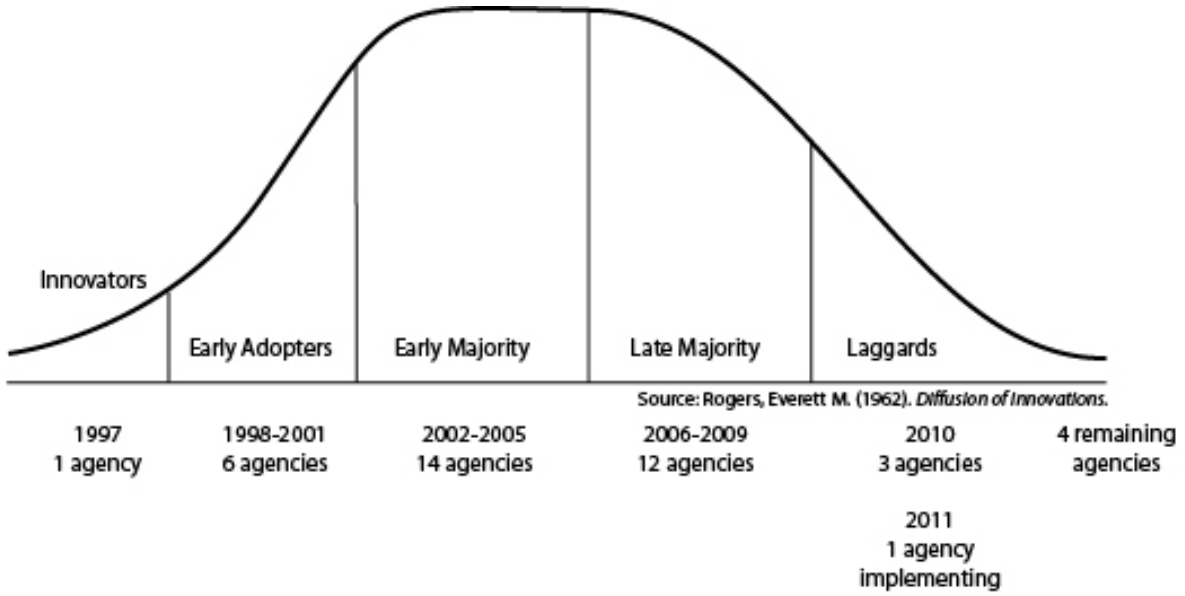

Figure 2 – Skewed curve for technology adaption with data showing adoption of Internet bidding service by U.S. transportation agencies using the AASHTO's Expedite software.

Why the accelerated pace? Internet bidding gained popularity because the contractors themselves became advocates of the service. As they became accustomed to staying home to bid, accommodating last minute price changes, and submitting and re-submitting up until the last

moment with the push of a button, the idea of going back to paper bids seemed prehistoric. Large contractors that bid to many agencies monthly grew frustrated bidding to those agencies not accepting online bids, and many of those contractors advocated the online bidding service to the slow-to-adopt agencies.

Contractors who were pleased with online bidding at state agencies also advocated the online bidding process to local agencies. Again, the pain of paper bidding had them pushing local agencies to move forward with electronic and Internet options. Even though local work contracts were generally smaller, the paperwork was just as complicated and error-prone. (At this time, more than one dozen local agencies are using the Bid Express® service.)

Other factors contributed as well. In Iowa, for instance, a terrible snowstorm hit the day before a large bid letting and the Iowa DOT team knew that, with Internet bidding, the weather would no longer be a factor. Officials in the state of Louisiana saw the success and savings being experienced by the Louisiana Department of Transportation and Development, so they decided to mandate that local agencies provide bidders with an electronic bidding option.

Add-on services

In addition to Internet bidding, service providers can offer add-on services to bidders and consulting firms. In this respect, the service can be a one-stop shop for bidders' needs. For example, bidders and consultants can subscribe to the Bid Express Bid Tab Analysis service where they can look at low, average and high prices for items in past bids. This service can help a contractor determine how his or her pricing compares with other contractors; or the service can help a consulting firm by providing historical data reflective of market conditions for estimation purposes. Another add-on service is the ability to access plan sheets online. With this option, contractors can view and download plan sheets for a project, and even order printed sets, all from the online service.

Current status among agencies

State transportation agencies are most certainly ahead of most other governmental units in the adoption of this type of bidding technology. While there are still many transportation agencies relying totally on paper for bid submission, most are taking small steps towards automating. Though true sealed, secure Internet bidding provides the most economically beneficial results, there is a range of ways transportation agencies can leverage the Internet to improve on paper bidding processes.

At a low level, agencies can simply leverage an existing governmental website to post data online. This can include advertisements and notices to contractors, letting schedules, proposal files, eligible bidders lists, plan holder lists, DBE lists, plans, plan sheets and bid results/bid tab data.

At a more complex level, agencies can utilize the Internet to additionally facilitate contractor interaction by offering email notification of projects and moderated message boards.

At the next level, agencies further employ the Internet by facilitating services such as online vendor registration, auctions/reverse auctions and bid, quote or proposal submission via unsophisticated third party tools. Note that, while these tools may appear to be satisfactory for basic types of bids, they can present significant risks to the owner agency since they may lack the security needed (e.g. sealed repository/lockbox, digital signature requirement) for this type of mission-critical service.

These options, while representing a step in the right direction for many agencies, do not constitute full-scale Internet bidding where sealed, secure, digitally bids are submitted to an agency in a paperless process.

Environmental benefits

With pressure mounting to implement 'green IT' programs, agencies are happy to hear that implementing Internet bidding is a giant step in that direction. Since the inception of Internet bidding services, paperless highway construction bidding has saved contractors and state transportation agencies in the USA and Canada more than 59,000 reams of paper, which translates to more than 3,600 trees.

Before Internet bidding was introduced to the road construction process, agencies were printing bid books for each project and contractors were submitting their bids on paper. Even with conservative estimates, agencies were printing 15 copies of the 50-page bid books, while contractors were submitting bids in excess of 25 pages. Over the past ten years, this adds up to savings of more than 29.5 million pieces of paper. Additionally, the process was ripe for errors, meaning bids were often printed and reprinted many times.

Internet bidding also reduces carbon dioxide emissions. Contractors are able to submit their bids via the Internet, meaning they do not need to drive to deliver their bids to the agency. Over the past 11 years, the internet service is estimated to have saved contractors more than 3.33 million travel miles, which translates into 166,500 gallons of fuel saved. That means that Internet bidding has saved 3.2 million pounds of carbon dioxide emissions.

Today, agencies are constantly being asked to make environmentally conscious choices and to reduce their carbon footprint. Internet bidding is a green alternative to paper bids. Agencies and contractors alike are advocates of Internet bidding for the tremendous cost savings and convenience it brings to the bidding process and the environmental benefits make the process even more appealing.

Conclusion

By allowing Internet bid submission, agencies have made the processes of looking for potential work and submitting sealed bids easier for contractors, more efficient for their own staff members, and more environmentally friendly. In the end, the true winners are the citizens, who now get their road construction project contracts awarded quickly, securely, efficiently, and with the benefit of green technology.