

E-PROCUREMENT IN THE ATLANTIC CANADIAN AEC INDUSTRY

SUBMITTED: July 2005

REVISED: December 2005

PUBLISHED: April 2006 at <http://itcon.org/2006/06/>

EDITOR: K. Ruikar

Jeff H. Rankin, Associate Professor

Department of Civil Engineering, University of New Brunswick, Canada

email: rankin@unb.ca, <http://www.unb.ca/>

Yongjie Chen, Graduate Student

Department of Civil Engineering, University of New Brunswick, Canada

email: b1aeg@unb.ca, <http://www.unb.ca/>

A. John Christian, Professor Emeritus

Department of Civil Engineering, University of New Brunswick, Canada

email: jchristian@unb.ca, <http://www.unb.ca/>

SUMMARY: *Based on the success achieved in other industries, there is the potential for the Architectural, Engineering, and Construction industry to achieve significant improvements in efficiency through the adoption of e-business methods and solutions. There are a variety of issues that must be considered in steering the industry toward these improvements. The issues stem from the root characteristics of the industry including: fragmentation, highly pragmatic, cost conscious, little institutional leadership, and no standards in technology and business models. This paper examines e-procurement as a subset of e-business in an effort to identify the issues surrounding the development of a critical mass of participants required to overcome the organizational and technology challenges. The issues are discussed in some detail followed by the presentation of some preliminary results from a survey which quantifies the current status of the industry in an attempt to support a strategy for progress.*

KEYWORDS: *e-business, e-procurement, technology penetration, adoption issues, industry survey.*

1. INTRODUCTION

In general, there are three key stages in an electronic commerce transaction: product information marketing and procurement, exchange of legally binding documents, and electronic payment. E-business solutions are said to have the most potential for an immediate positive impact to improve a market if products are easy to standardize or customize, easy to aggregate, and not crucial to the organisation (UK DTI, 2001). Although this is not exactly applicable to the construction industry, there remains potential for improvements with a patient approach.

For the purpose of this research the following definitions have been adopted (Schneider, 2003):

- e-business - all business transactions (exchange of information) by electronic means
- e-procurement - business to business purchase and sale of products and services by electronic means (today primarily internet)
- e-commerce - financial transactions by electronic means

The construction industry is appropriately described as a community of risk takers in the business of construction where they “put their organizations on the line for each job”. Thus the industry certainly approaches any change in the process, whether it involves technology or not, with some trepidation. This industry characteristic is a key market factor influencing the adoption of e-procurement and any analysis of its opportunities and motivating factors. In consideration of e-business in general, there is currently more confidence for the use of project collaborative tools than for e-procurement activities. The industry appears to be in a holding pattern, continuing to wait for a consolidation of e-business solutions. For example, electronic business exchanges (buyers/sellers) are difficult to justify on a savings per transaction basis at the general contractor level, but not at the subcontract procurement level (Industry Canada, 2001).

In the meantime, the industry is missing the potential advantages offered through improvements in the procurement process such as: better managed and integrated supply chains, an increase in the range of options for procurement, better customer relationship management, and more effective management of client/vendor/source lists (Wescott and Mayer, 2002). As identified by Malone et al. (1987), these potentials can be examined as: electronic communication effects (i.e., dramatically decreasing the costs of communication); electronic brokerage effects (i.e., transparency of markets and standards); and electronic integration effects (i.e., integrating customer and supplier information, facilitating coordination and collaboration). Adopting new technology provides the opportunity to improve surrounding business processes through automation, rationalization, or re-engineering steps that go hand-in-hand with implementation. For example, a streamlining of the electronic reporting (bidder evaluation) and bidding process offers significant benefits by reducing the time and expense required to attend bid openings and bid submissions in person, while also reducing the amount of data entry and paperwork required to process bid bonds.

This paper identifies and explores Architectural, Engineering, and Construction (AEC) industry stakeholder issues related to e-procurement as depicted in Fig. 1. The discussion begins with an identification of organizational and technical issues and then describes the steps of a more detailed analysis, in the form of a quantification of technology penetration exercise and results from a more in-depth survey of the industry. The work described will result in input parameters for a benchmarking exercise against other industries that have had success with e-procurement and the subsequent development of a strategy for the implementation of technological solutions.

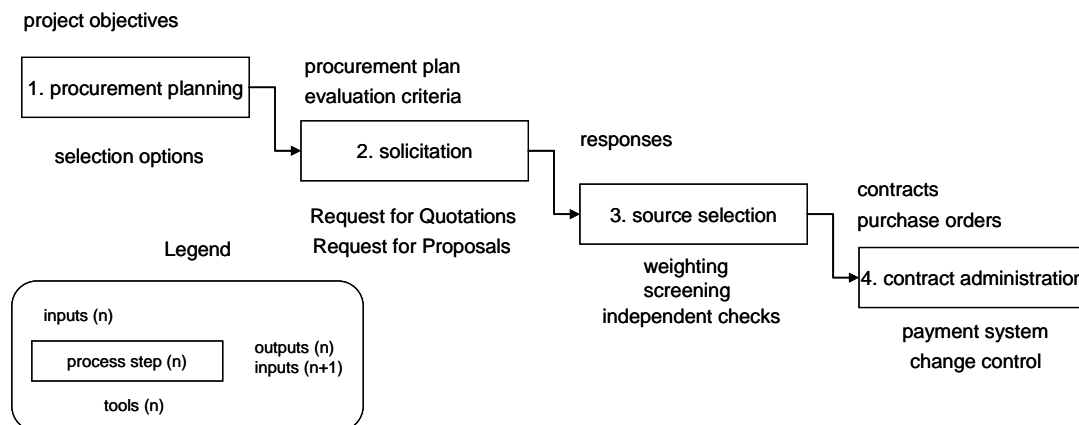


FIG. 1: A generic procurement process.

2. IDENTIFIED ISSUES

The first phase in the analysis was conducted from the point of view of a regional construction association that provides the services of tender administration and bid depository. In reference to Fig. 1 this would include the process steps of *solicitation* and *source selection*. This first phase included the development of a discussion document identifying potential issue categories (CTCA, 2003). The purpose of the document was to facilitate dialogue among industry stakeholder groups (i.e., owners, designers, builders, suppliers, and manufacturers).

To set the context, an overall picture of consolidation of e-business service providers on the supply side is emerging within the AEC industry. While on the demand side, a cautious adoption of e-business services follows an initial focus on using project collaboration services to test the practicalities and encourage confidence, before moving into the potentially more difficult area of e-tendering. There is also uncertainty over which solutions or services will become dominant and this supports the perception of a lack of standards that would be required for widespread adoption of complete solutions. In addition to the industry's inherent conservative business culture, there is less confidence that legal and security issues have been satisfactorily resolved.

Solutions must focus on the quality, dependability and on-time delivery of information (Hong Kong WBTF, 2000). Impediments to the free flow of electronic documents must be identified and addressed (both technical and practice related). Solutions are required to close the loop and support all the steps in the process (e.g., ancillary services of bonds, insurance, permit applications, etc.), under the realization that implementation of new technologies involves the automation, rationalization, or re-engineering of the tender process.

Organizational and technical issues are considered important because of the perception of varying degrees of insurmountable difficulties in their resolution. The organizational topics include: 1) cost appropriation, 2) ownership, 3) responsibility, and 4) capability. The technical topics include: 1) integration, 2) standards, 3) security, and 4) authentication. Each topic is briefly introduced followed by an identification of issues and items to consider for their resolution.

2.1 Issue of cost appropriation

Making the change from current practices will not occur without some costs and these costs need to be identified and appropriated to a particular stakeholder. The obvious costs can include initial set-up costs for software, hardware, and staff for operations. These of course, all depend on the current capabilities of individual firms. However, there are also perceptions of high-costs for the integration of any new system into existing internal systems, and on-going costs associated with newer application versions and the additional effort required for operating in a changed (i.e., electronic) environment.

The costs for changes need to be enumerated and a range of estimates provided based on the role and general capabilities of a firm. Compensation for additional functions must be established. For example, after a tender closes, there are costs and potential charges for drawings in electronic format, for material quantities from CAD generated designs and for as-built drawings in electronic format as a project progresses.

Any approach must be perceived as providing “added value” in the long term without impeding established operations. Financial incentives for a client and design team to use e-procurement could be as basic as a reduction in costs of distributing and printing multiple copies of tender documents and timely revisions. Ultimately, any hardware and software must be reliable and available at minimal cost.

2.2 Issue of ownership

Throughout the tendering process, there are issues related to the ownership of information. There are distinctions to be made between ownership, control, and rights of use, for both tendering documents and bid submissions. Although e-business practices work with a different medium, there is a precedence established in Canada for ownership and control of tendering information (CCA, 2003).

Guidelines that should be adhered to include: maintaining control over access for published documents; ensuring that the intellectual property rights of designers are protected; and maintaining ownership of bid submission (e.g., allowance for modification after submission before closing). Solutions to address these concerns include: clauses in special conditions of tenders that stipulate information use and intellectual property rights, registration for downloading tender documents, and provisions for maintaining ownership regardless of changes in media-neutral laws.

2.3 Issue of responsibility

The roles and responsibilities in the tendering process are quite well defined under current practices. The introduction of electronic solutions introduces subtle changes in the management of information throughout the process and therefore raises certain questions. For example, will service agreements (exclusive or not) be formalized with non-government organisations for distribution through web sites, replication services, value-added through web sites (sorting, filtering, etc.)? Will the information be distributed exclusively in an electronic format (i.e., no hard copies)? Who will be responsible for the registration of users of the system? What are the commitments for availability of services, protection and back-up of data, and for equipment? (ACPSC, 2002)

If industry associations do not provide supporting services someone else will. There is a requirement for complete control and recording of access to information throughout the tendering process and responsibility for the conversion of non-electronic information. It is also necessary to ensure that any new changes conform to the current process and applicable legislation, and where possible do not vary greatly with existing tender practices. For practical reasons, there should not be an expectation or warranty of uninterrupted service.

2.4 Issue of capability

As government departments and other tender calling authorities move towards fully implementing e-procurement solutions they should ensure that the entire bidding community has the capacity to adopt new

processes. Many have adopted a basic two-step tendering process: 1) electronic dissemination (tender documents) and 2) electronic submission (bids) with the ultimate goal of a full synchronization of sellers, buyers and ancillary services. A focus on individual firm capabilities coupled with supporting awareness and training on relevant technology would shorten any transition to new processes.

Existing levels of accessibility to information must be maintained (e.g., connectivity of bidders, accessibility to documents, download time, etc.). The capability for the management of procurement information in an electronic format affects all parties in the process (e.g., designers, information distributors, potential bidders, etc.) and there are challenges with the adoption of any new technology on the human side (change management). Therefore recommendations for the implementation of new processes include the sensible guidelines of:

- Initiating new processes in parallel with current practices (e.g., accepting hard copy bid submissions in addition to electronic);
- Distributing benefits for an improved process to all involved (i.e., incentives for change);
- Supporting through dissemination of information (e.g., publicity, awareness, workshops, communications, education, and training); and
- Coordinating through an industry group that undertakes continued evaluation of new solutions (technology watch) in conjunction with the promotion and monitoring of the uptake of e-business solutions.

2.5 Issue of integration

Some of the more obvious challenges from a general technology standpoint are the issues surrounding integration between any new solutions and so-called legacy systems (e.g., the linkage of a web-based system with multiple internal systems of individual firms). While, this has been a topic of research and development for well over two decades, there is still a lack of a merging solution.

There is generally a disconnection between web-based and internal systems and therefore a mapping to existing back-end systems must be considered. Standards are required for the representation of data, not necessarily for the use of common software applications. A solution is not limited by today's technology but rather by the difficulties in developing and implementing any standard for representation and/or practice. Although there will be a learning curve with any new approach, a single system that supports all processes lessens the burden of users where multiple system knowledge is not necessary. Ultimately, solutions to integration will be driven collectively by industry groups or associations and be platform independent (not relying on a single vendor). Joint industry-government support is required for collaborative efforts to agree on open standards (e.g., an XML schema for transactions).

2.6 Issue of standards

Beyond the standards required for the representation of information as a solution to integration issues, there are also instances related to everyday practice where standards are required or desirable in order to improve a process. For example, efficiencies can be realized by defining standards to be used for physical documents, defining standards for the information contained within documents, using a standard specification system, the communication of standard time clock, and defining the legal rules under which a process takes place, to name a few.

The requirements for standards must be identified and a consensus gained by multiple parties or enforcement by one and acceptance by others. Development of any standards should be considered in conjunction with any re-engineering activities and new technology implementation. As well, the legalities under which a bid is submitted must be clearly identified.

2.7 Issue of security

Nothing is 100% secure; however, electronic exchange can be more secure than traditional paper and allows the possibility to provide added protection (e.g., the use of digital certificates, and incorporation of encryption into the process). Although governments have been quite ambitious in proposing single portals for all government e-procurement, many later switched to a pilot project approach, and are now discovering that further work is needed to maintain a level of security and increase uptake of the service on a broad basis (US DOT, 2002).

There is an obvious need in any business process to ensure that a document's integrity and security is maintained (e.g., it is not changed from its original state or accessed by people not intended to access it). Policies must be clear as to what actions to take should there be an identified breach of security during a transaction. Therefore, solutions to maintain a document's integrity are centred around using digital file formats based on data-image (e.g., PDF format) as opposed to native (e.g., DOC or RTF) format. For example, typical asymmetric encryption works with a public key that the sender uses to encrypt the information being sent to the receiver who reads the encrypted information with the corresponding private key. Techniques are also available in conjunction with encryption that time lock documents and provide notification of unauthorized opening.

2.8 Issue of authentication

In general, the status of digital documents and signatures on legal documents (forms of tender, contract prices, and contractual notices) as a means of authentication continues to undermine full implementation of e-procurement. However, recent legislation supports the use of electronic signatures and its admission as evidence in legal proceedings. E-commerce specific legislation, policy, and directives at both the federal and provincial level, are setting out the principles for online transactions (CDJ, 2003, NS, 2000). Requirements that are specific to the construction industry include relatively large online transactions (bid security) that require an accreditation system for service providers.

Uncertainty over legal status of on-line contracts and transactions (e.g., Whether all copies of a digital document require digital signatures?) exists as well as recognition and validity of electronic signatures. There is also the additional authentication, certification, and validation specifically for bid security submissions. Again, most legal jurisdictions are developing or have defined media-neutral laws under which the criteria for a signature consist of: unique to individual, control by individual, verification of identity, and integrity of information. In fact consent of exchange by electronic means has been accepted as an e-mail address on a business card or through the action of buying products or services on-line. Bidder authentication has been used successfully through a combination of electronic signatures and bidder-enabled passwords through registration processes. There are third party options available that provide authentication, certification and verification of bid security.

3. NEW BRUNSWICK CASE EXAMPLE

These issues identified above were validated through a case study. This case study relates to construction work that is publicly tendered through the New Brunswick Department of Supply and Services (NBDSS) and the industry's efforts to implement e-business solutions to the tender and bid administration process. Key individuals were interviewed to discover how events have unfolded in the Canadian province of New Brunswick. The individuals were the Executive Director of Design and Construction for NBDSS, the President of the Architects Association of New Brunswick (AANB), and the Executive Director of the Construction Association of New Brunswick (CANB).

A decision was made by the provincial construction associations to give tender information in electronic format through the use of the Construction Information Network (CINet), an electronic plans room and job opportunity portal maintained by the region's construction associations on behalf of its membership. The design community of New Brunswick, and the construction associations met as a result of this decision, and NBDSS was invited. The design community did not initially support the construction associations' decision to post tender information without permission. The argument from the design community was that there would be no compensation for their work (for the conversion to electronic format). There were also issues related to accuracy of documents, additional liability for designers, and the fact that control over access was limited.

With a desire to move ahead with its e-procurement strategy, NBDSS facilitated a solution by requesting that the two sides come to an agreement on how electronic designs could be posted for "information purposes only" as a first step. AANB council made a decision to address members' issues, as there was not complete acceptance for the reasons noted, in addition to being viewed as simply an additional change in the way they work.

The current process has designers submitting designs in electronic format to NBDSS for "information purposes only" and NBDSS posts the designs directly to CINet for the use of construction association members. The entire procurement approach remains in a dual mode (paper and electronic) while solutions to an e-bidding component are developed (e.g., project plans and specification for tendering are available in both paper and

electronic format). Table 1 summarizes the observations of how this experience in New Brunswick relates to the issues previously identified.

TABLE 1: Observations from case study of New Brunswick.

Issue	Observations
Cost	In the short term, NBDSS provided an additional fee depending on the size of the project (\$100-400) for saving in PDF format and uploading. No support was provided for software, as requirements are minimal. There are also savings for 65% and 95% drawings as they are only required in digital format rather than producing paper copies, however, the size of files has been an issue on the receiving end.
Ownership	The designer retains the rights to the design as agreed upon through a clause in the standard consultant agreement. NBDSS have the right to copy and distribute for information.
Responsibility	There was a concern that this would be a long learning curve involved in implementing a new process and create additional RFIs from additional suppliers/bidders but this has not been the case for construction projects. There is still in dual system in place, and no uploading directly for designers, as NBDSS is currently performing this task.
Capability	Information sessions were initiated by AANB to discuss technology systems, features, and uses. Workshops were also held on applications for formatting (Adobe Acrobat). It was recognized that internally the electronic process creates a reliance on a single resource for conversion and expertise in CAD and conversion technologies, although it varies with the sophistication of an individual firm. There was also the recognition of a requirement for awareness and a look ahead to potential technologies. This spurred the creation of the New Brunswick Digital Technologies Committee with representation from all sectors of the industry.
Integration	At this point integration has not been addressed by many individual firms. Although on the technology front, the creation of PDF has some difficulties in drawing line weights that can cause concerns (e.g., existing versus new construction).
Standards	The issue of drawing size has been raised, and there are drawing standards available from the American Institute of Architects (AIA); these are used internally at NBDSS. However, the feeling is that a directive on standard drawing size must come from an owner (e.g., NBDSS requires B1 sheet 1/2 size at 11x17) as it is difficult for an individual firm to justify changing current practice.
Security	As stated, the fear from designers was that drawings would be available without knowledge or consent and in a public forum (NBDSS) then the likelihood of misuse would be is higher. There were also preliminary discussions of increased liability. The aforementioned Workshops were successful in dispelling designers concerns.
Authentication	As the process has only progressed to the posting for "information purposes only" (i.e., no reliance on digital information for bidding and no submission of electronic bid security) issues of authentication and integrity have not been totally addressed.

4. SURVEY OF E-PROCUREMENT

The identification of the issues was simply the first step, there was a need to delve deeper into the status of e-procurement in the construction industry for a full exploration of the possible approaches to overcome current barriers introduced by each issue. The initial focus was on the technology aspects such as the concept of integration (e.g., linkage of a web-based system with multiple internal systems of individual firms). The management of procurement information in an electronic format impacts all parties in the process and the existing levels of accessibility to information must be maintained when implementing any e-procurement solution.

4.1 Quantifying e-business activity

An initial effort was made to quantify the level of e-business within the AEC industry. This was initially accomplished by measuring e-mail and website usage in the construction industry. Rivard (2000) surveyed the Canadian industry to benchmark IT penetration. Applicable results from this survey conducted in 1999 were the level of penetration on the use of e-mail and web browsers (e-mail use for contractors was 74%; web browser use for contractors was 67%). A review was conducted to support the results of an Industry Canada report (Industry Canada, 2001), where the Canadian Province's Construction Association of Nova Scotia (CANS) membership was used as a sample set of data to indicate current levels of activity that were extrapolated to a national view. CANS was selected as a model for this study as it attracts the full range of general contractors, trade contractors, manufacturers and suppliers, as opposed to the association structure of other provinces, where industry representation is composed of many layers of specialty associations (e.g., road builders versus

commercial, electrical versus mechanical). The membership is also representative of the industry on a National basis with respect to distribution of company size. In this case, web site use, as opposed to web browser use was measured and further categorized by the functionality offered.

A follow-up on the 2001 analysis was conducted in the 2004, again with the CANS membership. The results for usage in 2001 and 2004 are provided in Table 2. Trends showed an increase in usage in all membership types with the exception of websites for associate members (those members providing key services to the construction process or have a large focus on the industry, e.g., bonding companies, materials testing and inspections services, legal services, quantity surveyors, etc.). The authors speculate on possible explanations of the decreasing trends as including a change in membership from 2001 to 2004 and/or a realization of the usefulness of websites.

TABLE 2: Websites and e-mail usage.

Membership Type	member totals		% with e-mail		% with website	
	2001	2004	2001	2004	2001	2004
General Contractors	102	91	62.7	86.8	18.6	31.9
Trade Contractors	247	265	58.3	82.6	25.1	34.7
Manufacturers/Suppliers	181	195	85.6	92.8	40.9	61.5
Associate Members	37	45	97.4	97.8	84.2	77.8
Combined	567	596	70.4	87.8	32.9	46.3

The content of each web site was determined based a visit to each site. Sites were classified as: inactive, static, catalogue, and functional. Inactive described the websites under construction or inaccessible. Static referred to websites with only one web page with accompanying text or graphics as information about the organization. Catalogue indicated the websites with developed catalogues providing different types of information about organizations, their projects or products. Functional related to the websites with developed e-business functions providing online business options, such as online procurement, online product search, online payment and online auction. The results of these classifications are provided in Table 3.

TABLE 3: Functionality of websites.

Membership Type	% inactive		% static		% catalogue		% functional	
	2001	2004	2001	2004	2001	2004	2001	2004
General Contractors	15.8	17.2	21.0	17.2	58.0	58.7	5.2	6.9
Trade Contractors	30.6	13.0	24.2	3.3	27.4	64.1	17.8	19.6
Manufacturers/Suppliers	10.8	15.8	18.9	3.3	58.1	57.5	12.2	23.3
Associate Members	15.6	2.9	28.1	2.9	31.3	74.2	25.0	20.0
Combined	18.7	13.4	22.4	4.7	43.3	62.0	15.6	19.9

To gain further insight into the use of websites, during the most recent analysis (2004) websites were further classified into six catalogue types and six functional types as follows:

- **Catalogue 1:** a basic catalogue that contains four or five pages presenting the general information about the companies, their projects or products, employment and contact information.
- **Catalogue 2:** a basic catalogue and it contains a contact web page with a form for the visitors to fill in and leave contact information or any questions about the companies or their products/service.
- **Catalogue 3:** a basic catalogue and it presents several relevant links of other websites for visitors to get further information.
- **Catalogue 4:** a basic catalogue and it contains a site map which presents the table of contents of the website for visitors to speed up their review or search.
- **Catalogue 5:** a basic catalogue and it contains a survey or feedback for conducting online survey of products/service or collecting information of customers.
- **Catalogue 6:** a basic catalogue and it contains a show room for presenting very detail information of the products.
- **Functional 1:** requires visitors to apply for an account for the e-business or e-commerce service and log in with the user name and password of the account.

- **Functional 2:** an independent website for e-business or e-commerce service besides the main site of the companies, where the main site provides a link to the e-business or e-commerce site.
- **Functional 3:** free access to the e-business or e-commerce service and visitors can order/buy the products online.
- **Functional 4:** free access to the e-business or e-commerce service and visitors can search the products available online.
- **Functional 5:** free access to the e-business or e-commerce service and visitors can attend the bidding/tending online.
- **Functional 6:** free access to the e-business or e-commerce service and the visitors can pay bills online.

The breakdown of these more detailed functional categories is provided in Table 4. From the results, it is evident that organizations prefer to manage their information in a catalogued manner, and have a preference for using the functionality of membership for e-business or e-commerce. Again, the authors speculate that the reason for this preference relates to the perception of the security of online transactions.

TABLE 4: Functionality of websites in detail.

Membership Type	General	Trade		Associate	Member Total
	Contractors	Contractors	Suppliers		
catalogue 1	12	37	36	9	94
catalogue 2	4	8	11	2	25
catalogue 3	0	10	14	13	37
catalogue 4	1	3	4	2	10
catalogue 5	0	1	1	0	2
catalogue 6	0	0	3	0	3
functional 1	1	16	14	5	36
functional 2	0	1	9	1	11
functional 3	0	0	3	0	3
functional 4	0	1	1	0	2
functional 5	1	0	0	1	2
functional 6	0	0	1	0	1
Total	19	77	97	33	226

4.2 Detailed survey results and discussion

A detailed survey was conducted to provide a clearer picture of the level of penetration of e-procurement and an understanding of advantages, disadvantages of implementation, the existing barriers to adoption and the expectations of industry. The survey was developed based on the issues framework and the quantification exercise. The survey was initially administered to a smaller construction association in the Canadian Province of New Brunswick and delivered using a commercial web-based survey tool. This trial delivery provided useful feedback on the format and content of the question set and also provided a basis for validation of a modified survey. The modified survey was then delivered to members of the Construction Association of Nova Scotia, also using a commercial web-based survey tool, one that is often employed for other topics of interest to its membership. The survey consisted of 20 questions, presented in 5 sections, and was estimated to require 15 minutes to complete. The sections are categorized as: 1) demographics, 2) e-procurement in your company, 3) advantages and disadvantages, 4) barriers, challenges and solutions, 5) future of e-procurement in our industry. CANS members with e-mail (556 members), were invited to complete the survey by e-mail directed to the primary contact listed with the association. Of the 556 members, 119 members (21%) visited the survey site, 70 members (13%) partially completed the survey, and 44 members (8%) completed all questions of the survey. A partial complete is registered if a single question is unanswered, both partial and completed answers are included in the discussion that follows. The survey response rate 13% was deemed acceptable when compared with a response rate of 10% with similar efforts (Rivard, 2000). Details of the questions for sections 3 and 4 are provided in Table 5. The questions and options for response were based on a similar survey administered by the Conference Board of Canada (CBC, 2004) and the previously validated issues.

TABLE 5: Summary of survey content for sections 3 and 4.

Survey Questions	Options
Advantages	Reduces data transaction costs Reduces paperwork Reduces procurement cycle time Improves data transaction accuracy and reduced errors Increases productivity Allow greater market access and opportunities
Disadvantages	Have a long investment payback period Have technical problems caused by the unreliability of the technologies Have an unexpected impact on the organization (like cost, time and etc.) Creates barriers with potential buyers
Organizational Issues	Cost of investment Changes in workers' responsibilities Shifting the mind-set of people wanting to stay with the current system Cooperation and long-term relationship with customers Finding people with the correct technical and business skills Developing the confidence of using new technologies
Technical Issues	Finding a technical solution and that meets the needs of the organization Replacing and modifying the existing procurement systems Ensuring the security of data transactions Controlling the instability of adopting new technologies Ability to interface with customers' systems Compatibility with the industry e-procurement systems

4.2.1 Demographics

The information collected in the demographics section was used to classify the remaining sections and as a check of the representative sample of the CANS membership. Of the complete and partial complete surveys the distribution of participants based on member type was association (5), general contractor (18), supplier/manufacturer (24), and speciality contractor (23). As an essential means of comparison, the results were filter to these 70 survey responses. Compared with the complete CANS membership, the sample of 70 based on member type and organisation type was quite representative as indicated in Fig. 2 and Fig. 3.

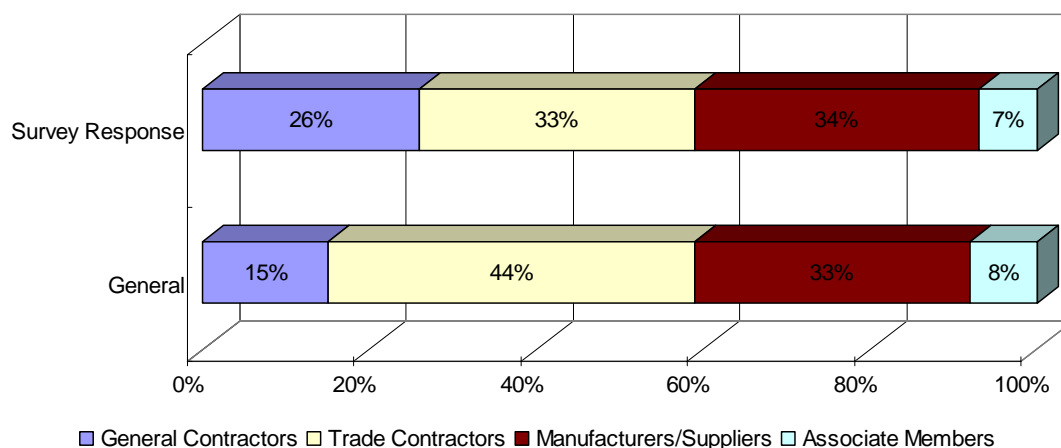


FIG. 2: Comparison of survey respondents to CANS membership by member type.

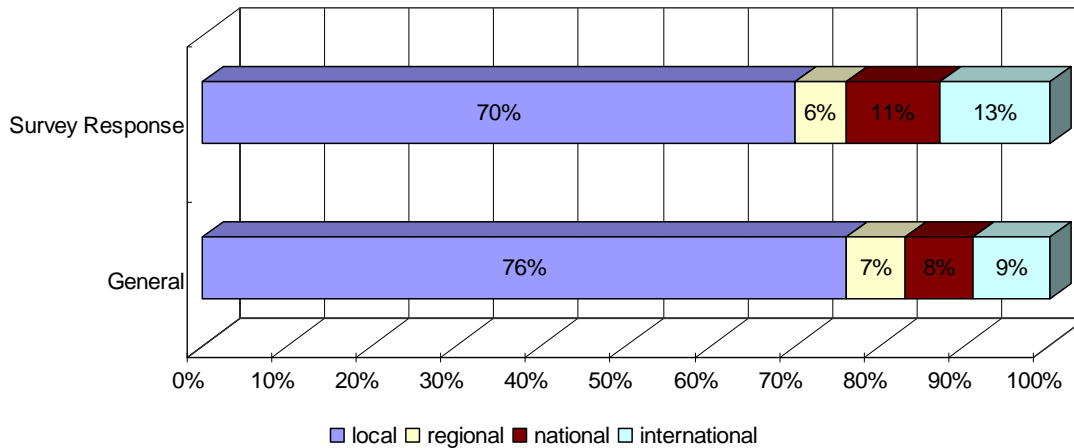


FIG. 3: Comparison of survey respondents to CANS membership by organisation type.

The area of work was also used as a check on the representative sample. Based on the categorisation of: electrical and mechanical, contractor exterior, contractor finishing, and other (e.g., land development, construction management) the breakdown of 21%, 23%, 25%, and 31% matches well with the industry on a national basis (Industry Canada, 2004). It was also determined that the typical respondent has been in business for over 10 years (83%). The responses to the position within the organization could be classified as senior or second level management. There was little difference when responses were analysed based on this classification. Results were then analysed based on: member type, organizational structure, and revenue.

4.2.2 E-procurement in surveyed companies

Respondents were given the option to select all e-procurement activities that their organizations undertake. The top three e-procurement activities selected were:

- searching and finding product information online (94%)
- responding to bidding opportunities online (77%)
- transferring bidding information and documents online (70%)

By member type, contractors and manufacturers/suppliers, conduct the same activities on-line. Associate members are the exception, being less likely to be transferring bidding information and more likely to be searching for other parties online. Based on organizational structure, the single office, local owner was the exception with a greater percentage searching for other parties online. By revenue, as revenue increases emphasis shifts away from locating contractors and supplier and as revenue increases emphasis shifts towards bidding opportunities on-line.

When asked about the level of use over 80% have adopted some type of e-solution, with a similar number of associate members responding that they are frequently used and an integral part of their business. Based on organizational structure 100% of regional organizations responded frequently use and integral part of business whereas only 29% for international organizations. Revenue did not significantly impact results.

Overall there were no obvious trends in technical tools. Respondents slightly favoured e-procurement tools that were characterized as internal systems (41%) versus external systems (28%) or a combination of internal and external (31%). Trends by member type showed associate members favouring external systems and contractors slightly favour internal, and with increasing revenue and for national or international the trend was towards a combination.

4.2.3 Advantages and disadvantages of e-procurement

The advantages of e-procurement selected in order of most frequent responses for all respondents were – 64% thought that it allows greater market access and opportunity; 62% believed it reduces paperwork; 58% thought that it increased productivity; and 57% had the opinion that the procurement cycle time would be reduced. A graphical representation of the responses to the questions in this section and the next is provided in Fig. 4.

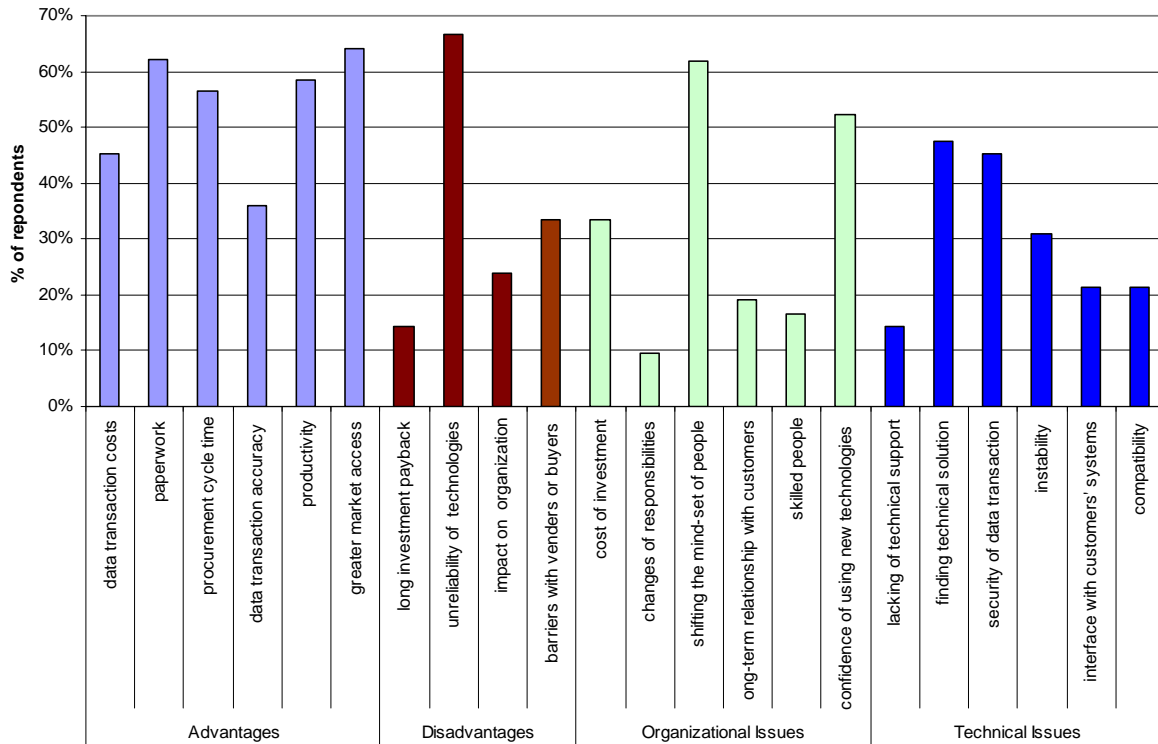


FIG. 4: Summary of responses for survey sections 3 and 4.

By membership type general contractors placed more emphasis on reducing procurement cycle time and paperwork. National and regional organizations had a higher frequency of responses for greater market access. There were also a greater number of responses for increased productivity as revenue increased.

The disadvantages of e-procurement identified by respondents were – 67% were concerned with technical problems caused by the unreliability of the technologies; 33% thought that barriers were being created with vendors or buyers; and 24% felt that introduction of the technology negatively impacted on the organization.

From the perspective of member type and revenue there was consistency in the frequency of responses. Organizations of local ownership placed a much greater emphasis on technical problems and international organizations placed more emphasis on barriers created.

4.2.4 Barriers, challenges, and solutions

The most frequently identified organizational issues in the implementation of e-procurement among respondents were – 62% identifying the challenge of shifting the mind-set of people wanting to stay with the current system; and 52% citing the development of confidence to use new technologies.

Associate members indicated that finding people with the right skills and specialty contractors indicated that the cost of investment were also barriers. Local or regional ownership respondents indicated developing confidence in using new technologies, and national and international had cooperation and long-term relationship with customers as the most frequent barriers. From the perspective of revenue, lower revenue respondents were concerned with the cost of investment where higher revenue respondents were concerned with relationships.

The technical issues most frequently identified by respondents were – 49% thought it a challenge in finding an affordable technical solution; and 46% concerned with the security of data transactions.

Associate members and general contractors were also worried about interface and compatibility challenges as were regional and international organization types. As revenue increases the frequency shifts from finding a technical solution to ensuring the security of transactions.

4.2.5 The future of e-procurement in our industry

The vision of e-procurement shared by all members was an internal system with free access to industry system regardless of member type, organizational structure or annual revenues. The most frequent responses were to having an independent and closed internal system but having free access to an industry system (40%) and having an internal system open to the whole industry, also having free access to an industry system (29%).

Generally, the current annual expenditure on e-procurement is in the range of 0 to 5% (59% of respondents). International companies indicate a higher frequency of expenditure in the 10 to 15% range (22% of respondents). Only 15% of respondents plan to make an investment within the next 6 months.

5. CONCLUSIONS

The significance of the survey is that it presents a picture of the level of penetration of e-procurement activities in the AEC industry. It also shows what the respondents consider the main advantages and disadvantages of implementation, the main barriers to the adoption in both organizational and technical issues, and what the industry expects for the future e-procurement development. It also provides an indication of what effect different organization characteristics (e.g., organizational type, structure, revenues and management level) have on e-procurement activities, tools, and investment.

In general, the industry wants to remain with the current procurement process, even after admitting the advantages of e-procurement. Reasons include the need for personal contact in a competitive environment and the effect that it will have on long-term relationships with customers, as well as the learning curve of using new technologies. An “affordable solution” is a dominant barrier of current e-procurement execution for all the members. In addition to “security of data transactions”, general contractors hope to have a system that works well for any industry solution while the national and international companies want to make sure their system matches their customers’ systems.

What we have at this point is confirmation of issues and benefits, and a vision of where the industry sees itself moving. One of the benefits of being an industry of slow movers is that it is possible to apply a benchmark at an industry level on the adoption of innovations. The next step in this research will be a further refinement of the identified issues based on the survey results that will then be used as input parameters for a benchmarking exercise. Functional benchmarking tools will be used to analyse the unique issues in the AEC e-procurement process by comparing them with the procurement processes in other industries. For example, Clark et al (1999) have used this approach to examine the application of information technology to support supplier management by benchmarking other industries that have used it with some success (e.g., car manufacture, turbine manufacture, aircraft manufacture, railway rolling stock manufacture). Closer to the region under examination, the Conference Board of Canada (CBC, 2004) has also recently documented case studies of e-business implementations in a variety of industries which are serving as inputs to the benchmarking exercise.

6. ACKNOWLEDGEMENTS

The authors acknowledge the continuing support and cooperation of the Construction Association of Nova Scotia (CANS) and its membership, the Construction Technology Centre Atlantic (CTCA), and members of the New Brunswick Digital Technologies Committee and Moncton-Northeast Construction Association. CANS, CTCA, and the University of New Brunswick’s M. Patrick Gillin Chair in Construction Engineering and Management have provided funding for this research.

7. REFERENCES

- Australia Procurement and Construction Council (APCC) (2002). Government framework for national cooperation on electronic procurement, available at <http://www.apcc.gov.au/docs/APCCFRAMEWORK2002.pdf>, last visited April 2005.
- Canadian Construction Association (CCA) (2003). Draft policy statement / guidelines for electronic bidding and tendering, draft 4 June 2003.
- Canadian Department of Justice (CDJ) (1998). Consultation paper on facilitating electronic commerce: statutes, signatures, and evidence, available at <http://canada.justice.gc.ca/en/cons/facilt7.html>, last visited April 2005.

- Clark, A., Atkin, B., Betts, M. and Smith, D. (1999). Benchmarking the use of IT to support supplier management in construction, *Electronic journal of information technology in construction*, Vol. 4, 1-16.
- Conference Board of Canada (CBC) (2004). E-Procurement case studies: Another tool in the toolbox, available at http://cebi.ca/Public/Team1/Docs/e-procurement_report_june_2004.pdf, last visited April 2005.
- Construction Technology Centre Atlantic (CTCA) (2003). Tendering and bidding: e-business considerations, A discussion paper for members of the Nova Scotia architectural, engineering, construction industry.
- Hong Kong WBTF (Works Bureau Task Force on Electronic Tendering) (2000). Discussion papers for implementation of electronic dissemination of tender documents No. 2/2000, Internet dissemination of tender documents No. 6/2000, available at http://www.etwb.gov.hk/boards_and_committees/task_force/index.aspx?langno=1&nodeid=609, last visited April 2005.
- Industry Canada (2001). Strategic plan for promoting e-business for the Canadian AEC industry, prepared for manufacturing industries branch, March 28, executive summary available at <http://strategis.ic.gc.ca/epic/internet/inee-ef.nsf/en/ee00496e.html>, last visited April 2005.
- Industry Canada (2004). E-commerce overview series: construction industry in Canada, available at http://strategis.ic.gc.ca/epic/internet/incc-cc.nsf/en/h_0l00016e.html, last visited, April 2005.
- Malone, T. W., Yates, J., & Benjamin, R. (1987). Electronic markets and electronic hierarchies, *Communications of the ACM*, Vol. 6, 485-497.
- Nova Scotia (NS) (2000). Electronic commerce acts, Province of Nova Scotia, Bill No. 61, ratified November 30.
- Rivard, H. (2000). A survey on the impact of information technology in the Canadian architecture, engineering and construction industry, *Electronic journal of information technology in construction*, Vol. 5, 37-56.
- Schneider, Gary P. (2003). *Electronic Commerce*, Thomson Learning, Boston, MA, USA.
- UK Department of Trade and Industry (UK DTI) (2001). E-Commerce impact assessment - minerals processing & extraction and construction products in the UK, document number URN 02/1174.
- US Department of Transportation Federal Highway Administration (US DOT) (2002). Internet bidding for highway construction projects, available at <http://www.fhwa.dot.gov/programadmin/contracts/interbid.pdf>, last visited April 2005.
- Westcott, T. and Mayer, P. (2002). Electronic tendering: is it delivering? a UK and European perspective, *Proceedings of the RICS Foundation construction and building research conference (COBRA 2002)*, ISBN 1-84233-074-8.