THE STATUS OF CONSTRUCTION EDI IN NORTH AMERICA

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Abstract

Electronic data interchange (EDI) is an innovative technology that has been used effectively in the aerospace, automotive, and manufacturing industries for the direct computer-to-computer exchange of standard business documents. Documents that are routinely transmitted using EDI include purchase orders, purchase order acknowledgements, material releases, requests for quotations, supplier bids, and fund transfers. Over the past three years, the North American construction industry has embraced the usage of electronic data interchange (EDI) through pilot projects, full-scale implementations and the formation of a focussed EDI user group representing many companies--the Construction Industry Action Group (CIAG).

The basic concepts of electronic data interchange are presented and the status of the development of both national and international EDI standards is discussed. This paper will briefly outline the North American construction EDI evolution and discuss successful case studies, important findings and future directions of EDI in the industry.

Electronic Data Interchange

Electronic Data Interchange (EDI) is one of several electronic methods of sending and receiving business documents. The transmission of data between trading partners is a subject that has seen rapid change and progress over the past few years. This technology has revolutionized data exchange in certain U.S. industries and should lend itself to profitable adoption in the construction industry. A recent Construction Industry Institute (CII) study has investigated the construction applications of EDI [Bell 90], [Gibson 90], [Bell 91].

Electronic Data Interchange (EDI) is a relatively recent introduction into the data integration movement within industry with its beginnings traced to the transportation, retail, and grocery industries. It is a computer-based financial and inventory communication system which allows direct computer-to-computer exchange of standard format business documents. EDI gives businesses the ability to transmit documents both internally or externally to remote locations. It is now possible to transmit information associated with approximately one hundred standard domestic (ANSI X12) business documents using EDI, regardless of document format or the type of sending or receiving computer system. These documents include purchase orders, invoices, request for quotes, inventory and shipping notices, transfer of binary or CAD files, and other documents. Typically, EDI transactions are transmitted to third-party value added networks in order to facilitate coupling of trading parties [Bell 90].

Other electronic data transmission technologies such as facsimile and electronic mail are

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useful in certain circumstances. However, their usefulness is limited because any received data must be translated into a computer useable format that requires re-keying, digital scanning, or file conversion. For the exchange of high-volume, repetitive business documents, the only real benefit of these technologies is the speed of transmission.

Benefits

The benefits of EDI have been well documented. Among the tangible EDI benefits experienced in construction and other industries are the reduction of purchasing and accounting related costs, increase in purchasing professionalism, elimination of paperwork, increase in purchasing lead time, reduction of inventories, reduction of data transmission errors, and improvement in materials management planning.

For most applications, EDI provides computer-to-computer communications between two different corporate trading partners. However, internal company communication can also be facilitated through the use of EDI using either industry adopted or internal standards.

Intangible benefits include: promotion of closer relations between trading partners; the necessity to analyze and streamline business processes prior to EDI implementation; and the use of EDI as a mechanism to enhance just-in-time (JIT) construction purchasing. Each of these benefits support total quality management goals through reduction of non-value added processes and higher quality of supplier inputs. EDI can also be used as a "high tech" marketing tool when dealing with sophisticated EDI-literate clients.

It must be emphasized that EDI is only a tool. In order to get the maximum benefit out of its use, EDI must be part of an integrated computer business system that meets the firms stated business goals and promotes transaction processing, management information, and decision support systems.

Standards

EDI revolves around the use of some type of standard business format with which to communicate. The need for EDI standards is based on the multitudes of dissimilar document formats, hardware configurations, and software operating environments that most trading partners use. The standards serve as the central electronic operating environment, or "language", allowing the trading partners to pass information back and forth. Without standard formats, the ability to communicate electronically would be limited.

In 1979, the American National Standards Institute (ANSI) established Accredited Standards Committee (ASC) X12 as its standards developer for EDI transmissions. The resulting standards have been endorsed by most U.S. industry groups and there are currently over one hundred transactions (a transaction corresponds to a typical business document) that are either American National Standards, Draft Standards for Trial Use, or under development. Current North American construction efforts have used ANSI X12 transactions exclusively.

The International Standards Organization (ISO) has recognized the need for international EDI standards and set up ISO-156 to standardize EDI in the international arena. This development effort is currently being undertaken through what is known as UN/EDIFACT (United Nations EDI for Administrative, Commerce and Transport). UN/EDIFACT's role as a producer of EDI standards is increasing now that many nations see the significance of standard electronic business transactions on the world economy. UN/EDIFACT was created in 1985 and is under the auspices of Working Party 4 (WP.4) of the UN Economic

Commission of Europe (ECE). ECE is a misnomer in that there is worldwide involvement in UN/EDIFACT at this date. Rapporteurs (liaisons) are currently assigned to coordinate the implementation of the UN/EDIFACT effort in Pan America, Western Europe, Eastern Europe, Australasia (Australia/New Zealand) and Asia (Japan/Singapore). At present, Pan America includes Brazil, Canada and the United States, with stated interest from other countries including Chile, Columbia, and Mexico.

Twenty-nine nations currently are regular participants of the WP.4 sessions. These nations include most of the major economic powers in the world. Most participants see EDI as very important in remaining competitive in the worldwide global economy. In fact, the U.S. Commerce Department has formally endorsed UN/EDIFACT and is in the pilot testing stage for EDIFACT customs messages. The UN/EDIFACT effort currently consists of 19 messages (analogous to X12 transactions) recommended for use. An additional 34 messages are in draft status for formal trial.

ASC X12 is handling UN/EDIFACT development work in the United States through its subcommittees. A standing committee within ASC X12 is the Pan American EDIFACT Board (PAEB) which coordinates between the Pan American Rapporteur and ASC X12 for message development. An ASC X12 initiative is to work toward one global EDI standard sometime in the future. Current task group efforts are directed toward this goal with special emphasis placed on coordination of future standards development between X12 and EDIFACT. The extent to which this becomes reality is currently in doubt due to political and technological issues. However, the use of either ANSI X12 or EDIFACT standards by any party, based on the situation and trading partners involved, should be no problem.

Example of ANSI X12 Translated Document

Translation of in-house business documents to EDI standards can be accomplished fairly easily through the use of software supplied by translation software vendors. The translation software package acts as a bridge between existing computer systems and the standard transaction. There are many translation software packages available in today's market (Bell and Gibson 1990). The key point is that few changes have to be made to existing hardware or software applications. The translation software can interface with mainframe, mini-, or micro-computer applications. A simple example involving a purchase order and ANSI X12 standards will be illustrated below.

A hypothetical purchase order is shown in Figure 1. Note that this purchase order could exist in a computerized materials management system or it could be paper-based. The purchase order is keyed directly into the translation package or existing work package data are converted by the translation package into the proper standard. The purchase order is translated in Figure 2 using QualEDI by APL Group, Inc. The format is ANSI X12 transaction 850, version 2, release 2.

The first line of the translated transaction contains communications transport protocol information. The two lines (data segments) beginning with ISA and IEA are the interchange control header/trailer. These segments act as the "electronic envelope" in which all transactions sent to a trading partner are packaged. The GS and GE data segments are called the functional group header/trailer. These data segments act as the "electronic paper clip" that holds together similar transactions. If more than one type of transaction is sent to a trading partner, there may be multiple GS/GE segments. The ST and SE data segments make up the transaction set header and are used with each individual transaction.

An examination of the translated document shown in Figure 2 illustrates the use of a standard format and accepted codes to identify transmitted information. For example, the

purchase order header information:

    Purchase Order ABC-101
    Date: 20 October 1989

is translated into ANSI X12 in the following line:

    BEG*00*NE*ABC-101***891020

where BEG denotes the beginning of a purchase order document, 00 and NE are codes denoting original purchase order and new order respectively, and the * symbol is used to separate data fields. More than one * is used to indicate the omission of one or more optional fields in a given data line.

ABC Construction Co.   Page 1 Of 1

Purchase Order ABC-101

Date: 20 October 1989

To: XYZ Pipe Co.   Buyer: J.T. Smith

      444 W. Elm

      Auburn, AL 36830

      (205) 844-6269

From: ABC Construction Co.   Ship To: ABC Construction Co.

       217 Harbert   Pipe Warehouse

       Auburn, AL 36849   Marne Rd. RR6

                                            Paper Mill, AL 36777

Line Number	Project I.D	Quant.	Unit	Description	Unit Price	Ext. Price
001	356942134	5	HF	1" Black Steel Pipe	200.00	1000.00
002	356342122	4	HF	2" Black Steel Pipe	400.00	1600.00
P.O. Terms and Shipping Instructions (attached)						

Figure 1:   Hypothetical Purchase Order

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There is 1 document to PREPARE

PREPARE LOG

ANSI TRANSMISSION ID. T-10 TO XYZ PIPE CO., dated 89/10/20 15:15
ISA*00*BG01.ISAO2*O1*OUT321
*ZZ*ISAO6/8..BGO3/4*ZZ*TRAMOD-2*891020*1515
GS*PO*GS02/GS03*GROUPID-32*891020*1515*2*X*002002
ST*850*2001
BEG*00*NE*ABC-101***891020
N1*BT*ABC CONSTRUCTION CO.
N1*BY*J. T. SMITH
N1*WH*MARNE RD. PAPER MILL, AL 36777
PO1*001*5*HF*200.00**VC*356342134
PID*F****1" BLACK STEEL PIPE
PO1*002*4*HF*400.00**VC*356342122
PID*F****2" BLACK STEEL PIPE
CTT*2
SE*11*2001
GE*1*2
IEA*1*000000010

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Figure 2:   PO translated using QualEDI by APL Group, Inc.

Similarly, line item 1 of the purchase order is translated into two data lines:

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PO1*001*5*HF*200.00**VC*35634134
PID*F****1" BLACK STEEL PIPE
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where PO1 and PID are headers denoting purchase order line item and description data respectively. The data element HF denotes hundred feet. VC defines the vendor's catalog as the source of the product identification number, and F denotes a free form description of the product.

However, free form descriptions usually require human intervention which is not advantageous in an EDI environment. As an option, the PID segment could be written as follows:

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PID*S*08*ST*31
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Where S denotes a structured description from an industry code table, 08 is a product characteristic code denoting product (11 would denote specification, 14 would denote finish, etc.), ST references the American Iron and Steel Industry code table and 31 denotes a specific entry in the steel industry table (31 is the code for steel pipe). Additional PID segments would be added to describe finish, inspection, and specifications characteristics. An MEA segment could be added to indicate dimensional data.

Status of International EDI Efforts in Construction

The U.S. Construction Industry has been rather slow to adopt EDI technology, but the effort has quickly gained momentum in the past two years. In contrast, since 1987 international construction organizations have also been aggressive in recognition of the advantages that EDI has to offer in the area of strategic competitiveness in the world market. The current status of both domestic and international data transmission efforts will be discussed below along with EDI implementations currently underway in the United States.

The use of EDI in construction has been the subject of much effort among European construction firms and has the support of several national organizations [Sanders 90]. Primary among the organizations is EDICON in the United Kingdom, which is an organization made up of many of the largest construction contractors, architects, suppliers, quantity surveyors, manufacturers, builders merchants, and government agencies. This self-financing organization represents the construction industry in dealing with EDIFACT transactions, as well as sponsoring educational seminars and interfacing other EDI transaction working groups within the United Kingdom. Several pilot projects have been completed and full scale implementation of UN/EDIFACT purchasing and invoicing were scheduled to begin in the first quarter of 1990 [Sanders 90].

Similar European organizations working on EDI construction applications exist in Denmark, Finland, France, The Netherlands, and Sweden. There seems to be a great interest in EDI implementation with the governments either overseeing these efforts or lending close support. The implications of UN/EDIFACT and Common Market 1992 are doubtlessly behind this push. The European Economic Community (EEC) views EDI as one of the means in which to quickly take advantage of the Continent's economic power when the 1992 unification of the markets takes place [Gindin 89]. An organization called EDIBUILD was formed in 1991 to address construction EDI with representation from the European countries mentioned above. A similar organization called the Construction Industry Information Network (CI-NET) was also recently organized in Japan for the same purpose.

The Western European Rapporteur has introduced six new messages for development within UN/EDIFACT which deal strictly with construction related documents. The messages are the following:

        CONDVA..........Construction Direct Payment Valuation
        CONPVA.................Construction Payment Valuation
        CONQVA............Construction-Establishment of Contact
        COVEST................Construction-Establishment of Credit
        CONITT......................Construction-Invitation to Tender
        CONTEN.......................................Construction-Tender

To date, the Pan American Rapporteur has deferred all development of the messages to Western Europe because no interest was shown within ASC X12 for construction standards development. However, currently there is dialog between the Construction Industry Action Group (CIAG) and the Rapporteur to become involved in development. The CIAG and current EDI efforts in the United States will be discussed below.

United States Construction EDI Efforts

A major CII construction firm began an EDI implementation program in the fall of 1989 as a pilot project for future large scale purchasing applications. The effort revolved around the purchasing activities within the overseas barge maintenance group of the firm and involved approximately 25 vendors and 1200 purchase orders in 1990.

Studies indicated that purchase order preparation time was significantly reduced, the cost of a typical twenty line PO was significantly less than postal rates and the average turnaround time from receipt of field requisition to purchase order issuance was improved by approximately 5 days. Although not quantified, errors were significantly reduced in large part due to decreased typing/writing requirements. An intangible benefit gained was the experience base that was acquired by the parties involved in implementation [Gibson 90].

The firm's management was encouraged enough by these successes to begin implementation of a purchasing effort on a multi-million dollar industrial construction project. EDI purchase orders (PO's) were placed with a large pipe, valve, and fitting supplier. In a 25 week period, 1836 PO's were processed in support of a just-in-time (JIT) delivery schedule. The PO's were batched nightly to the third party network. The supplier down-loaded the transactions each morning and the materials were ready for delivery directly to the needed location on the job-site by 8:45 a.m. Although labor productivity improvements for the project were not quantified, the participants felt that productivity was enhanced by the JIT delivery. Total EDI purchase order volume was in excess of $1 million, with a documented savings of $20,000 in surplus materials as compared to other projects (2% of order volume). Other benefits previously identified attributable to EDI have remained or improved since earlier pilot efforts. This is the first documented EDI implementation on a construction site in the United States.

Another project effort by this same firm involves interface with the client for purchasing purposes. PO's and PO change orders are sent to the client, who performs bulk purchasing transactions for the petro-chemical project. When the client receives the ordered materials, he sends a receiving advice transaction to the contractor which is integrated into the materials management system for the job. In addition to the obvious benefits of purchasing in this manner, EDI has strengthened the relationship between the two companies.

Several other CII member firms are in various stages of EDI implementation efforts. Feasibility studies and pilot projects are in works at these firms. The success of a CII member utility firm has been documented Gibson 90]. Most of the efforts to date have involved purchase orders and electronic funds transfer. However, there is currently a pilot study being performed in the Houston, Texas, area involving transfer of CAD files among several firms using the ANSI X12 841, specifications/technical information, transaction set. This transaction set allows the transfer of binary files between partners and should be extremely useful for distributed engineering and construction sites.

With the interest shown by several firms to implement EDI and with the support of the CII, the Construction Industry Action Group (CIAG) was formed in the Spring of 1991. The CIAG held its first general meeting in February of 1992 and attracted a crowd of 120 participants. There are currently 43 member firms including owner, engineer/contractors, vendors, and translation software companies. The next meeting will take place in June of 1992 and the organization has already attracted many of the leading proponents of EDI in North America as speakers and participants.

The stated goals of the CIAG are to promote EDI in the construction industry, educate the construction industry to EDI, provide EDI implementation guidelines and recommended practices, facilitate user groups, and be the Pan American focal point for EDI standards development. Programs are currently underway to facilitate these goals.

Summary

The U.S. construction industry is beginning to implement EDI on a larger scale. EDI applications in construction have the potential for very tangible cost reductions in the materials management and project control areas. Besides tangible savings, EDI has proven to be a tool that enhances trading partner relationships, as well as new construction materials management efforts such as just-in-time delivery schedules. EDI can also be used as a marketing tool when dealing with sophisticated owners.

The Construction Industry Action Group (CIAG) was recently formed to encourage Pan American construction implementation of EDI and to interface with world-wide standards development. CIAG plans to actively participate in ASC X12 and the Pan American EDIFACT Board in the area of standards development in order to verify that both ANSI X12 and UN/EDIFACT standards meet the needs of North America's construction industry in the domestic and global marketplace.

It must be emphasized that EDI is only a tool. In order to get the maximum benefit out of its use, EDI must be part of an integrated computer materials management system that meets stated business goals and promotes transaction processing, management information, and decision support systems. Its implementation requires management support and individuals dedicated to its success.

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