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E-Government, E-Procurement, and E-Payments: Data Sharing Issues Associated with an Appreciating Database

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ABSTRACT

The U.S. government has recently passed legislation to encourage government-to-business (G2B) transactions to be conducted over the Internet. As a result, the U.S. Treasury initiated a series of pilot projects in support of e-procurement and e-payments. One of these initiatives, the Internet Payment Platform (IPP), is currently nearing the end of its pilot test which is scheduled to end summer, 2004. In this paper, we present an overview of the technical, data utility and data security issues inherent in the IPP. Some of these issues result from the unique relationships forged when government agencies interact with for-profit businesses. Other issues stem from the adoption of a system architecture in which transaction-related data is accumulated in an “appreciating database.” The paper provides a comprehensive review of the benefits and problems that an appreciating database can bring about.

Keywords

database, data quality, e-government, e-procurement, e-payments

INTRODUCTION

The trade press is replete with examples of successful and failed attempts at supporting buyer-seller relationships through the creation of information intermediaries, online exchanges, electronic marketplaces and portals (Ulfelder, 2004). These information intermediaries, such as UCCNet, maintain a central database of product/price information (and more) for trading partners (Petrie and Scott, 2003). The design and use of this database is a critical element. The location of the database depends in part upon the architecture of the online exchange. Moon (2002) cites three architectural models for e-procurement. These include one-to-many seller-side systems, one-to-many buyer-side systems, and many-to-many systems that match many buyers with many sellers. In the case of government procurement, the seller-side model allows government agencies to search a vendor’s site. In the buyer-side model, a government agency makes its purchases from a collection of electronic catalogs supplied by many vendors. Many-to-many systems utilize an independent portal. The nature of the arrangement dictates ownership and location of data, as well as mechanisms for accessing and manipulating it.

This paper reports on a pilot test of the Internet Payment Platform (IPP), which combines an innovative payment mechanism with a system that supports U.S. federal agencies and their suppliers in the purchase-to-pay cycle. The U.S. Treasury Financial Management Service (2002) described the Internet Payment Platform as follows:

“The IPP is designed to provide web-based access for payees and payers to view data in the centralized database, manage the workflow associated with that data, verify the identity and authenticity of users and

accounts, settle credit ACH transactions, and provide robust reporting and access to the database. The key is that the database continually receives and aggregates data throughout the lifecycle because it is the hub to the entire transaction exchange.”

We view the IPP as a hybrid model in the Moon classification, with some characteristics of a buy-side one-to-many model and some characteristics of an independent portal. This is because of its unique context. The federal government can be seen as a single “buyer,” since all vendors participating in the IPP pilot communicate with participating agencies through the IPP. Yet, since all participating agencies use the IPP, which is a portal hosted by a third-party applications service provider and funded by the U.S. Treasury, it can also be seen as a quasi-independent portal. This hybrid aspect may have given rise to unique implementation issues related to data storage and stewardship, as seems evident in the case study findings.

E-PROCUREMENT AND INTERORGANIZATIONAL INFORMATION SHARING

Attempting to emulate success stories in the private sector, U.S. federal and state agencies have recently begun to invest in Internet-based Government-to-Business (G2B) systems, aimed at reducing costs and improving business processes. This was motivated in part by such legislation as the Government Paperwork Elimination Act of 1998, which encouraged federal agencies to automate their business processes. In addition, President George W. Bush’s “President’s Management Agenda” included “Expanded Electronic Government” as one of five government-wide initiatives. In response, the Financial Management Service of the United States Department of the Treasury funded a number of Payment Application Modernization initiatives, including the IPP.

A hosted web-based service, the IPP captures data associated with a purchase order, its associated invoice, and subsequent payment in the IPP appreciating database. The IPP consists of a secure online payment mechanism combined with some procurement functions and data capture. This unique design addresses a concern identified by Peffers and Ma (2003), who observed that many modern payment systems strip off valuable transaction information. They state (p 1): “The growth of electronic commerce may be impeded because payment systems designed for offline commerce have been adapted for online use, but without all of the information contained in physical meetings among transaction parties. Resulting problems add costs to transactions and affect profitability.” In this paper we examine participants’ perspectives on implementation issues associated with the decision to capture purchase data in the IPP appreciating database and related invoice and payment data, and give trading partners access to data related to those transactions in which they participate.

Few studies have reported on implementation issues in G2B systems thus far. One survey of adoption by state governments listed several impediments associated with e-Procurement technologies (Moon, 2002): 1. lack of financial resources and flexible funding mechanisms; 2) lack of technical skill; 3) collaboration difficulties; 4) legal and accountability issues; and 5) management and communication shortcomings. Field research examining how these issues play out or are overcome has not yet been done.

Previous studies of EDI use for business-to-business (B2B) transactions reported that interorganizational systems can reduce transaction costs (Barua and Lee, 1997) and strengthen buyer-seller relationships (Bakos and Brynjolfsson, 1993; Grover, et al., 2002; Konsynski and McFarlan, 1990; Subramani, 2004). Other studies convey that the diffusion of EDI has been impeded both by high initial cost and by distrust among potential information exchange partners (Gregor and Johnston, 2000; Hart and Saunders, 1996). And, while many studies examined the strategic implications of EDI and interorganizational systems (see, for example Lee, et al., 1999; Mukhopadhyay et al., 2002), few studies have examined implementation issues. Data models for B2B or G2B information sharing have been proposed (see for example Jukic, et al, 2002), along with research agendas (March, et al., 2000) but these have not reported actual experiences.

This study seeks to further understanding of adoption or implementation issues related to the storage and stewardship of transaction data in G2B systems. It appears that increasingly these systems (both B2B and G2B) are being designed with a single central database that is shared by multiple trading partners. According to Petrie and Scott (2002) this choice is driven by a desire to reduce data inconsistencies between trading partners, which in turn is expected to reduce friction in inter-organizational processes. If indeed the shared database model is gaining ground, then it becomes important to understand the technical and organizational issues in its implementation.

This study provides insight into these issues based upon a case study of the IPP by the United States Department of the Treasury and three federal agencies. Face-to-face or telephone interviews (ranging in length from 30 minutes to 2 hours) were conducted with more than 20 individuals who worked in participating organizations – including the software vendor,

managers in the Financial Management Service of the United States Treasury, and purchasing, finance, and IT managers at the three participating federal agencies. All interviews were taped and professionally transcribed, and in addition a variety of archival documents were examined to triangulate on key facts and perspectives. The IPP design is outlined next.

THE INTERNET PAYMENT PLATFORM

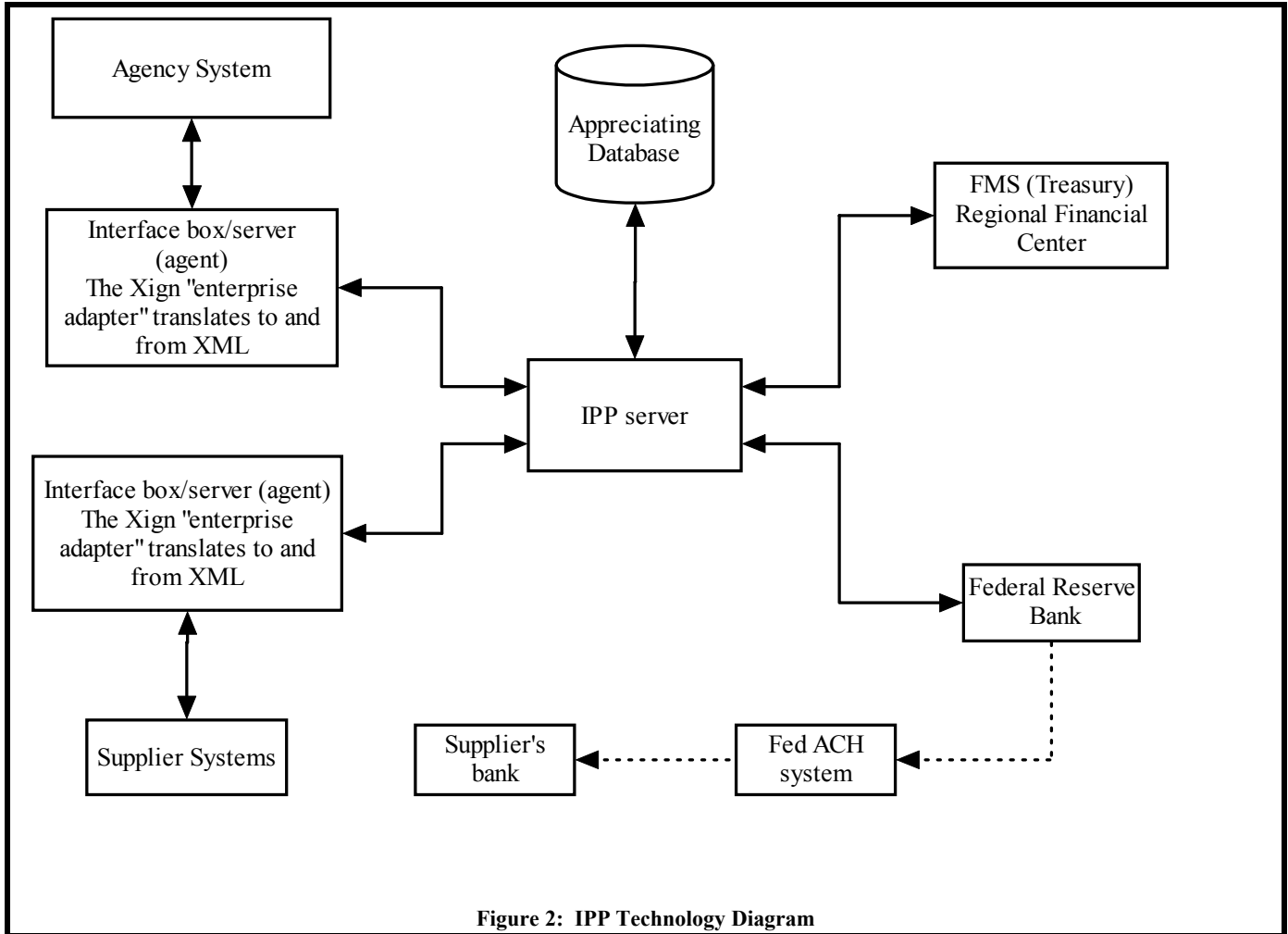
Figure 1, which depicts an entire generic procurement process, highlights those process steps which are currently supported by the Internet Payment Platform: creation and issuance of the purchase order, creation and submission of the invoice, and payment execution. Future versions of the system could be designed to capture data at other steps in the procurement process (such as at the Negotiation stage, which at present is partially supported by IPP, and during Fulfillment, which currently is not supported).

Search	Qualify Buyer/Seller	Negotiate Terms	Issue P.O.	Submit Invoice	Fulfill Order	Receive Product	Remit Payment
			IPP	IPP			IPP

Figure 1: Internet Payment Platform Support within the Procurement Process as of February 2004

E-procurement and e-payment systems are quite complex, with transaction information being passed back and forth frequently among trading partners. The major IPP process flows, illustrated in Figure 2, are summarized as follows:

1. Purchase orders (POs) are sent from a government agency purchasing system to a server that converts the PO into a format for posting to the IPP server.
2. The translated PO is posted to the IPP server and central “Appreciating” database.
3. Agency suppliers log on to IPP, read their POs and respond to them by providing goods or services.
4. Once goods or services are delivered, suppliers log on to IPP and “flip” the PO into an invoice.
5. Once invoices are posted to IPP and payment is due, the buying agency generates a payment instruction file (PIF) and transmits this file to IPP. At the same time, the agency issues an e-mail notification to an agency certifying officer (CO). The CO logs on to IPP to approve the payment file. A disbursing officer (DO) at the FMS Regional Finance Center (RFC) logs on to IPP to approve the payment file. Optionally, an Auditor at the RFC may also be required to approve the payment file. Smartcards with a thumbprint reader are used by COs and DOs executing these approvals.
6. Following approvals, the IPP generates an Automated Clearing House (ACH) file from the PIF, which is then sent to the Federal Reserve Automated Clearing House system (FedACH).
7. FedACH then settles the payment by debiting the U.S. Treasury account at the Fed, crediting the accounts of the supplier’s bank and the supplier at the Fed, and notifying the supplier’s bank of these credits.
8. The supplier’s bank then credits the supplier’s account.



THE APPRECIATING DATABASE

We refer to the database in the IPP system as an “appreciating database” to reflect that the data from the cycle of procurement transactions—PO, invoice, and payment—are retained, linked together, and available for inquiry as needed. Appreciating data is in contrast to the loss (or “depreciation/degradation”) of data observed by Peffers and Ma (2003). While solving the depreciation problem, the appreciating data concept leads to some interesting issues for IPP users. Table 1 summarizes those issues by focusing on the data issues inherent in the process flows outlined previously. In the table, the first column identifies a step in the process, and the second column discusses the data issues faced by one or more parties to the transaction.

Table 1: IPP Data Sharing Issues

Step	Issue and Discussion
Supplier enrollment	A record for each supplier is created in the IPP appreciating database with data such as name, address, and bank account. A single supplier record can be used to do business with multiple agencies. This single repository of supplier data in the IPP database is similar to the Central Contractor Registry that is being implemented across the Federal government. The single record concept reduces the administrative burden on a supplier. Also, a single record, stored on a government server but maintained by the supplier, reduces the number of times that correspondence and payments to suppliers is misdirected. The Fed reports hundreds of thousands of "Notifications of Change (NOC)" that are sent through the ACH network every month, as a result of inaccurate payee information. By making the supplier/payee responsible for their data, by reducing the burden on them to keep it current, and by using this data as the authority for payments, misdirected payments and NOCs should be substantially reduced.
Create and issue the PO	Agency procurement systems create a PO and send it electronically to the "enterprise adapter" for translation into XML and posting to the IPP server. A PO record now exists on both the agency system and the IPP appreciating database. The agency and vendor can view these records on the IPP database.
Modify the PO	Agency procurement officers may modify an existing PO by making a change to the PO in the agency procurement system that is then transmitted to the IPP in the same manner as the original PO. A PO change order is recorded on the IPP database (presently implemented as a copy of the PO with a modification number). A modified PO record now exists on both the agency system and the IPP appreciating database.
NOTE: As of February 2004, POs couldn't store a legal digital signature, so agencies must also send a signed PO through the mail. Also, the text fields on POs are limited to a thousand characters. Some POs have substantially more commentary and must be mailed.	
Read the PO	Suppliers are notified via an IPP-generated e-mail that a PO or PO change order has been issued. The supplier logs on to the IPP to read and act on the PO. Suppliers may enter this PO into their order entry systems. If they do, it would duplicate the PO that is in the IPP database. As of February 2004 the IPP cannot create an E-File to automate the transfer of the PO into the supplier's system. This capability is desired by several suppliers in order to further automate the G2B process.
Record the receipt	Agencies record the receipt of goods into their procurement/inventory systems. No record of the receipt is recorded on the IPP appreciating database.
Create and submit the invoice	Suppliers may log on to the IPP to "flip" the PO into an invoice (should there be partial delivery of a PO, the supplier can issue multiple invoices against a single PO). Since the PO is used to create the invoice, they must match. In one participating agency, workflow has been implemented to route invoices for approval before being sent to the agency. Alternatively, the supplier's billing system may create an invoice and send it to the "enterprise adapter" for creation of a so-called E-File of invoices, which is sent to the IPP. As of February 2004 this option has not been adopted by any supplier. Pre-implementation testing and validation against agency criteria are designed to minimize the possibility of E-File invoices being inconsistent with POs in the IPP appreciating database.
Dispute resolution	Agencies and suppliers can view the appreciating database to resolve billing disputes. However, with the "PO flip" feature these are significantly reduced. The appreciating database, with a complete record of the purchase order and invoice, can be used to quickly resolve disputes that do arise.
Record supplier invoice	In agencies where the procurement and accounts payable systems are integrated, and the three-way match among the PO, receipt, and payment can take place automatically on the agency's system, (a fourth match with a record of inspection of the receipt may be required), the IPP sends an electronic file of invoices to the "enterprise adapter" where they are translated from XML into the format required by each agency's accounts payable system.

	<p>For those agencies with separate procurement and accounts payable systems (or those agencies that may choose this option), the IPP workflow module may be employed to route invoices to appropriate agency personnel for approval. Once approved, the IPP sends an electronic file of invoices to the “enterprise adapter” where they are translated from XML into the format required by each agency’s accounts payable system.</p> <p>In both cases, a record of the supplier invoice now exists on both the agency system and the IPP appreciating database. The agency and the vendor can view these records on the IPP database. The supplier can review the status of the invoice in the appreciating database as it moves through the payment generation process. These steps are “Pending Approval,” “Scheduled for Payment,” “Paid,” and “Rejected.” Either party can drill down from the invoice to the PO.</p>
Create the payment	From approved invoices, agency accounts payable systems generate a payment instruction file and send it to the IPP (through the “enterprise adapter”).
Approve the payment	Before payments can be made they must be approved by a Certifying Officer (CO) in the agency, the Disbursing Officer (DO) from the FMS Regional Finance Center (RFC) in Kansas City and, optionally, an Auditor approval at the RFC. The CO and DO digital signatures are entered using smart cards with fingerprint readers. Because these approvals are recorded on the IPP appreciating database, they can be entered anywhere there is a PC equipped with a Web browser and smartcard reader.
Execute the payment	Once payment is approved, the IPP creates an ACH file from the payment instruction file and sends it to the Federal Reserve Automated Clearing House system (FedACH) where the payment to the supplier’s bank (and supplier’s bank account) is completed. The IPP notifies the supplier via e-mail that a payment is coming and the supplier can review the payment (and related invoice and PO data) on the appreciating database. These records of payments should reduce the number of inquiries received by FMS regarding payments not received or payments that cannot be associated with an invoice.
NOTE: One agency estimates that with full implementation of the IPP they could double the number of discounts taken for early payments. They attribute this to timely invoicing and ability to approve and execute payments more quickly.	
Record the payment	The IPP can send remittance data to the supplier’s cash receipts system in a variety of formats and via a number of transmission methods. As of February 2004 we are unaware of any supplier who has chosen this option.

Table 1: Internet Payment Platform Data Sharing Issues

DATA ISSUES IDENTIFIED IN THE IPP PILOT

Several categories of issues result from a careful analysis of the case interviews, and can be culled from the process as described in Table 1 and throughout the interview transcripts. These include technical issues, data utility issues, and data security issues.

Technical Issues

Technical issues include accessing the appreciating database and construction of bridges or interfaces to/from legacy systems in partnering agencies and businesses. Interestingly, the nature of an appreciating database both resolves and creates data problems. The appreciating database improves the ability to match invoices with POs since the IPP performs the updates and “flips” POs into invoices directly. Because all data are accessible by all parties to the transaction, suppliers can track the payment process (in a manner similar to tracking a Fedex shipment). This allows a supplier to ascertain whether the government considers a particular invoice to be complete and that, therefore, it can be paid.

The IPP appreciating database also places limits on the data it stores. Compared with typical business purchasing contracts, government purchasing contracts can be many pages long, and agencies want that information to stay linked to the PO. But so far, the IPP design has only been able to accommodate a small amount of textual information in the PO (about 1000 characters).

The system handles change orders awkwardly. Agencies want a complete audit trail from the original PO through all changes to the PO – they see this as an essential aspect of an appreciating database. But the IPP treats change orders as new POs, and does not automatically link them together. The IPP does not retain the updates -- it only overlays and maintains a single PO image, then issues an email notification to the supplier (with no change information on it -- just the fact that a PO has been loaded/changed). So a supplier does not know, or cannot ask the IPP, what changed and when. This in turn creates problems with the PO-to-invoice “flip.”

It is not easy to apply commercial business software to government legacy systems, although the use of XML facilitates this process somewhat. Many government agency accounting systems are old and some have been extensively customized. The software producer has designed the IPP to be able to integrate with common commercial ERP software such as SAP, Oracle, and PeopleSoft. While offering an EDI interface, they did not anticipate a significant need to integrate with older software, or to systems that don't use a relational data base, and there may not be sufficient incentive for them to include capabilities to integrate with software and databases that many would consider to be obsolete.

Data Utility Issues

Data utility issues pertain to data degradation and/or aggregation, data analysis, data entry error reduction, and transaction history tracking. The IPP pilot was specifically designed to improve upon issues of data utility that had been identified as having a negative impact on its precursor, eCheck, a payment mechanism that was piloted by the Treasury (Gelinas and Gogan, 1997 and 2002; Gogan, Gelinas and Rao, 2004). Chief among these was the problem of data degradation, wherein information got lost or disassociated from other pieces of the record as it was transferred and pushed through the system. The IPP preserves the information within the data record, and increases its value (or utility) by providing browser-based access to all parties. With the shared use of the appreciating central database, it is now theoretically possible to look at supplier data in aggregate (across agencies) to negotiate better terms based upon purchase amounts. Also, agency comparisons of procurement process metrics will be easier. It might also be possible to detect fraudulent activity.

The next data utility issue is error reduction, in this case, and primarily, occurring at the point of data entry or because of multiple data entry into incompatible systems. The ability to track a transaction through its entire history, by “drilling” down into the transaction history offers the kind of data utility that agencies and suppliers value. The value derives from time saved and reduced frustration in reconciling discrepant information about payments or purchase orders. This explanation takes the agency's perspective on data utility in the IPP's transaction tracking capability.

Data Security Issues

Data security issues cover who gets access, and how data is protected in the appreciating database. Agencies participating in the IPP pilot test expressed concern as to whether the hosting vendor has adequate access controls, backup and recovery procedures, long-term viability, and the like. Some of this concern might be resolved if the U.S. Treasury assumed the role of host, instead of contracting this function out to a third party. Perhaps because of this concern, agencies have the option of uploading POs into the IPP, downloading invoices from the IPP and uploading payment instruction files, which gives them a copy of each transaction within their own, in-house systems. Other data file transmissions are also supported by the IPP, but are not yet in use by suppliers.

Although digital signatures are encouraged in government, various procedures need to be specifically authorized before they can be considered legally binding in specific electronic documents. The commercial software that is being adapted for the IPP does not utilize a digital signature/certificate for every level of authorization that the government requires. So, for now, every IPP electronic PO has a matching conventional paper PO with all the necessary conventional signatures.

CONCLUSIONS AND FUTURE RESEARCH

The IPP pilot is still being evaluated by the U.S. Treasury and participating agencies and suppliers. As is seen through the discussion of data issues, the IPP was created to improve the federal government's purchase-to-pay process. The appreciating database is a key enabler of the restructured relationships between government buyers and business sellers. However, a number of technical, data utility and data security issues identified herein remain to be resolved before widespread adoption of the IPP can be deemed a success.

Clearly, successful e-government isn't just about innovative technical solutions. Success depends on the interaction of systems with individuals and organizations, especially given the inherent differences between for-profit businesses and governmental agencies. In our continuing study of the IPP pilot, we will also evaluate the regulatory, political, cultural, business process, and motivational issues intrinsic to the G2B space.

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