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THE GROWTH OF E-PROCUREMENT IN AMERICAN STATE GOVERNMENTS: A MODEL AND EMPIRICAL EVIDENCE

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ABSTRACT. This article examines the development of the Internet and electronic procurement or e-procurement in American state governments. I am interested in discerning the extent of adoption of e-procurement, especially as it relates to the use of the Internet in the procurement function. Specifically, e-procurement is examined with data from a national survey of state procurement officers. The first part of this article demonstrates an e-government growth model as a way of modeling the development of e-procurement. The second part examines the existing literature on e-procurement development and challenges associated with its implementation. The third part constructs an e-procurement index, which measures the adoption rate of electronic procurement in each of the states. This e-procurement index is tested against management, organizational, and economic predictor variables. The results of the e-procurement model indicated positive support for electronic procurement on state management capacity and IT management capacity, indicating that high performing management is a critical catalyst for e-procurement development.

INTRODUCTION

The Internet and a growing array of information and communication technologies have fundamentally modified possibilities for organizing communication, work, business, and government. They together possess a cost structure radically different from that of any other mass media technology (Fountain, 2001). Procurement is one business-to-government venture that can benefit from the Internet.

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The Internet is an extremely low cost communication medium that provides access to the Web and differs from other communication media. Digital communication is more malleable, meaning it can easily be retrieved, stored, indexed, transmitted, and revised. In fact, Gartner Group predicts that government to business e-commerce spending will expand dramatically in the next few years from $1.5 billion in 2001 to more than $6 billion by 2005 (Gansler, Lucyshyn & Ross, 2003).

E-procurement is any technology designated to facilitate the acquisition of goods by a commercial or government organization over the Internet (Davila, Gupta & Palmer, 2003). E-procurement technologies are focused on automating workflows, consolidating and leveraging organizational spending power, and identifying new sourcing opportunities through the Internet. The intent of this article is to test a model of e-procurement growth using the Layne and Lee (2001) stages of e-government and the Hiller and Belanger (2001) types of e-government relationships.

E-procurement had seen rapid development before the recession in early 2000. Although much of the initial growth has slowed, all state governments are at least maintaining a Web presence in their procurement function, and some states are participating in Internet bidding. This article examines the extent of adoption or growth of e-procurement. In particular, I focus on growth in the use of the Internet in the state procurement function. The results of a 2003 national study by the National Association of State Purchasing Officials (NASPO, 2003) indicate that there is much room for advancement in e-procurement. Less than a quarter of the surveyed states' central procurement offices conducted solicitations via the Internet.[1] The potential for economies of scale as a result of Internet procurement is profound, but obviously underutilized in state government. Part of this may be attributed to differences in management capacity in state governments. This study fills a gap in the literature by deriving and testing a management model of e-procurement growth. The existing literature on e-procurement has mostly conducted descriptive and empirical studies, without testing a formal model (see Wyld, 2001; Moon, 2002, 2003).

This article will first outline a four-stage model of e-procurement growth and survey the existing evidence for its occurrence in the U.S. The second section provides a literature review of e-procurement

development and some of the issues and trends in the field. The third section presents the database and descriptive statistics used to measure state government adoption of e-procurement. The fourth section presents the results of a model of e-procurement growth. The last section concludes by providing an assessment of e-procurement at the state level and identifies how these governments can enhance their e-procurement prospects.

AN E-PROCUREMENT GROWTH MODEL

The e-procurement function is located in the government-to-business relationship of electronic commerce. According to Hiller and Belanger's (2001) model, this type of relationship has different stages of integration. While businesses can receive many online services from government, a major portion of online transactions between the government and businesses involves procurement. E-procurement can use different levels of technology in this relationship and different levels of sophistication. Hiller and Belanger (2001) describe a five-stage model of e-government growth, which is applicable to this study of e-procurement. We will briefly outline each of the stages of development as they pertain to e-procurement.

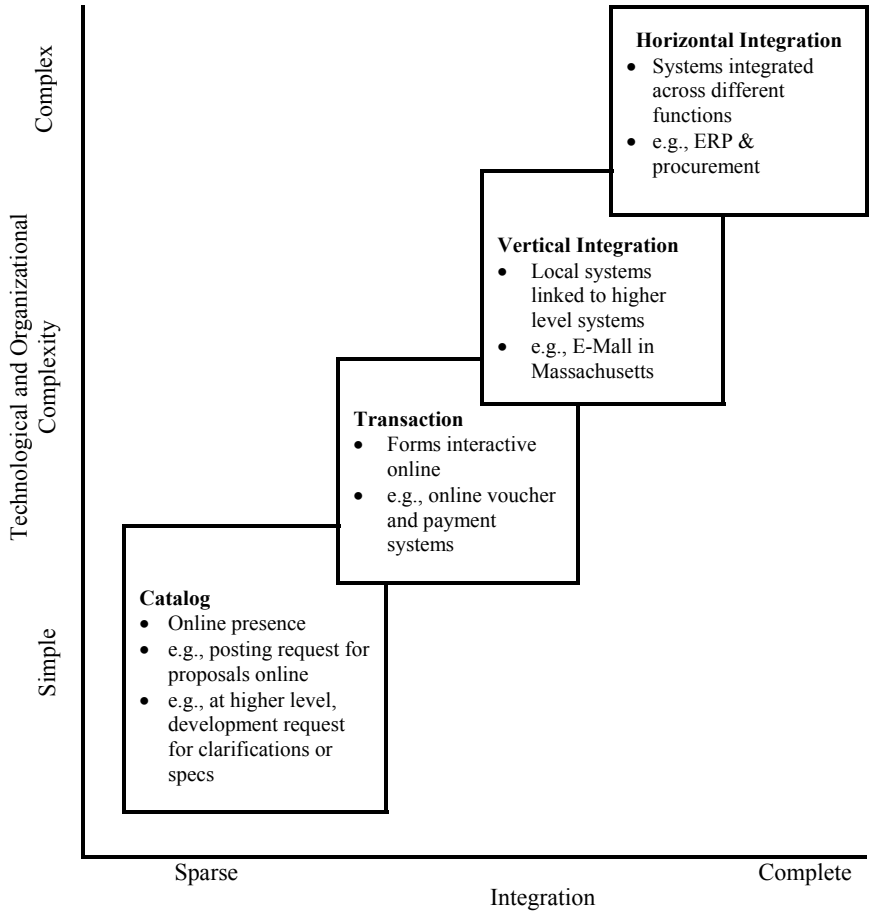
The first stage is information dissemination. This is the most basic form of e-procurement, where the procurement office simply posts information on Websites for suppliers. The biggest challenge for the procurement office is to ensure that the information is available, accurate, and timely. For example, posting requests for proposals online would be part of the information dissemination stage. The second stage is two-way communication. In this stage, e-procurement Websites allow suppliers to communicate with the government and make simple requests and changes. At a simple level, procurement officers allow online requests on their Website where suppliers can fill in information requests. The information is not returned immediately online but sent by regular mail in paper form or returned by email (e.g., a request for clarifications on specifications). The third stage is the transactional stage. The procurement office at this stage has a Website available for actual transactions with suppliers. Suppliers interact with the procurement office and conduct transactions completely online, with Web based self services replacing public servants in these cases (e.g., online vouchers and payment systems, digital signatures, and so forth).

The fourth stage is where all procurement services and functions are integrated. This can be accomplished with a signal portal that suppliers can use to access the department or agencies they need no matter which agencies or departments offer them. A marketplace for vendors is prevalent in this stage of integration. For example, *E-Mall in Massachusetts* and *GSA Advantage!* used by the federal government are found in this stage. The Hiller and Belanger (2001) business-to-government relationship model can be translated into a growth model, which we are going to test in this study.

This article adopts the Layne and Lee (2001) model of e-government growth and applies it to e-procurement development. There are four stages of growth: (1) cataloging; (2) transactions; (3) vertical integration; and (4) horizontal integration (Figure 1). The four stages can be explained in terms of complexity involved and different levels of integration and are applied to the e-procurement growth. There is some noticeable overlap of the Layne and Lee (2001) model with the Hiller and Belanger (2001) model.

In Stage one – cataloging - the efforts of state e-procurement offices are focused on establishing an online presence for the government in the procurement function (Figure 1). In this stage, there is an online presentation of procurement information by the central procurement office. Initially there is the presence of a Website for the e-procurement function. Toward the end of this stage, governments develop more functionality with the central procurement office posting solicitations on their Web page and posting contract award information. Governments create an e-procurement Website mostly due to the pressure from suppliers and other stakeholders to get on the Internet. At this stage, procurement offices do not have much Internet experience and they prefer to minimize their exposure by doing a small project. Parts of the office's non-transactional information are put on the Website. One reason that procurement officers would want to establish a Website is that they have become more accustomed to getting information on the Web instead of flipping through paper-based catalogs. They would no doubt be disappointed if they were unable to find information about suppliers on the Internet. The Web presence is also beneficial because much government staff time is consumed in answering basic questions from suppliers about government procurement needs and procedures; the

FIGURE 1
An Internet E-Procurement Growth Model



Technological and Organizational Complexity

Web presence would increase businesses' convenience and reduce the workload of procurement staff. In terms of functionality, the least amount of Web presence occurs when the e-procurement Web page has a description of the department, contact information of the procurement officer or staff, and some links to other pages. It establishes the procurement office's presence as opposed to providing service access

points to the supplier. The next step is to organize by service, creating a one stop portal with a comprehensive list of forms to be downloaded by the supplier, no transactions take place electronically, but forms can be filled out offline and sent in by fax or mail.

The second stage of the e-procurement model focuses on connecting the procurement sources to online interfaces and allowing them to transact with government electronically (Figure 1). This is called the transaction-based e-procurement and it consists of putting live databases' links so that suppliers, for example, can bid for contracts over the Internet. As procurement Websites evolve, officials come to realize the value of Internet as a service channel for suppliers. Electronic transactions offer improved efficiency for both the supplier and procurement office other than simply cataloging information. It will also provide a more democratic process by holding interactive conservations with suppliers that are geographically disbursed. This stage empowers suppliers to deal with their governments online anytime, saving hours of paperwork, and the inconvenience of traveling to a government office. While the cataloging stage helps businesses in the fact-finding process, the transactions stage of e-procurement presents government on the other side of the Internet as an active respondent. It is now a two-way communication, and business transactions with the procurement office are conducted fully online by filling out forms and government responds by providing confirmations, receipts, and so forth. More importantly, the procurement function moves from a passive to active role; suppliers can complete forms interactively online rather than downloading forms and mailing them to the procurement office.

The last two stages will be briefly mentioned but are not tested in this study due to the lack of evidence for their occurrence in the states (Wyld, 2001; Moon, 2003). Integration can happen both vertically and horizontally (Figure 1). Vertical integration refers to local, state, and federal governments connecting different functions or services of government. For example, Massachusetts has actively pursued a regional procurement consortium, called E-Mall (Fountain & Osorio-Urzua, 2001; Moon 2003). A supplier of one level of government can get connected to other levels of government through a common portal.

Horizontal integration is defined as integration across different functions and services. An Enterprise Resource Planning (ERP) system

is an example of horizontal integration. ERP brings together the functions of an organization such as accounting, budgeting, payroll, and procurement. Therefore, a department could order supplies without the approval of the purchasing department and could simultaneously check for the availability of funds from accounting.

In defining the stages of e-procurement development, vertical integration across different levels within similar functional areas should precede horizontal integration across different functions within government since the discrepancy between different services of government is greater than the discrepancy between levels of government (Fountain, 2001).

The overriding theoretical reason for wanting to institute e-procurement can be found in the transaction costs literature (Williamson, 1985). Croom (2001) believes that the use of open information systems can provide greater levels of information to buyers, thereby opening up greater competitiveness between providers. In simple terms, electronic markets provide conditions approaching the economic model of perfect competition. This is primarily the result of information asymmetry between buyer and sellers (Essig & Arnold, 2001). Dealing with the problem of restricted information means contracts are unavoidably incomplete. Since contracts can never cover all possible future developments, e-procurement can be a useful instrument to gain this additional information. Transaction costs increase because information is not a free good in imperfect markets. E-procurement helps to lower these transaction costs by making a wide range of information available to buyers and saves precious resources.

The theoretical literature on e-procurement illustrates that: (1) e-procurement can be modeled as a multi-stage construct, combining the government-to-business relationship with an e-government growth model; and (2) informational asymmetry between buyers and suppliers in transaction cost theory helps to explain why government would want to engage in e-procurement. The following section outlines the literature on the development of e-procurement.

E-PROCUREMENT ISSUES, TRENDS, AND GROWTH

If electronic government has taken hold anywhere, it is in the area of government procurement (Edmiston, 2003). By contrast, traditional

procurement is a paper-based process that often is characterized by fragmented purchasing, off-contract buying, and lack of control over expenditures (Mitchell, 2000). The paper-based procurement process has managers spending most of their time chasing paperwork rather than managing their supplier base or negotiating better prices. This section reviews the major issues in e-procurement, the benefits and costs associated with this method, the existing empirical evidence for its occurrence, and prospects for future development.

Online Bidding, Digital Signatures, and Reverse Auctions

For public sector organizations, the first step to online procurement is to send out solicitations and receive bids for government contracts electronically (Holmes, 2001). Requests for bids or proposals can be placed on the Web or emailed to contractors, eliminating the need for traditional postal waiting periods, which often take up to four weeks, between the announcement of a contract and the acceptance of bids. Bidders can be notified immediately by email.

Technologies such as digital signatures are becoming well established making it safer to procure over the Internet. A digital signature is an electronic means of signing electronic documents that provides sender authentication using public-key encryption (Laudon & Laudon, 2001). Digital signatures support e-procurement and e-commerce by facilitating online financial and document transactions. The authentication procedure of digital signatures includes: (1) combining private keys and specific documents; and (2) computing the composite (key + document) and generating a unique number – the digital signature (Moon, 2003).

Online reverse auctions (descending prices) present a major departure from the standard public procurement process in which contracts are awarded on the basis of sealed envelopes and companies have only one chance to make a winning bid. In a reverse auction the buyer sets up an auction to receive bids from suppliers (Wyld, 2001). In online auctions, bidders typically make several submissions over the course of an hour or two. A reverse auction is a supply-aggregating event that lowers the price of goods for a buyer. Through a pre-qualification process, all issues are generally settled between the procuring organization and potential suppliers before the auction. The only remaining issue to be settled is the price.

Some of the chief benefits of reverse auctions are: (1) increased numbers of potential suppliers; (2) reduced procurement cycle times; and (3) lowered purchase prices (Wyld, 2002). One drawback of online auctions is that they remain focused on the market of buying indirect goods. Another drawback is that the entire process works against some of the key value principles of procurement and new public management (MacManus, 2002). Furthermore, it is difficult to predict prices, and each day may bring a completely different set of bid responses. In addition, because of the emphasis of an auction on price alone, it makes it difficult for suppliers to maintain any close relationship with the buyer. Issues concerning collaborative design, quality assurance levels, and delivery dependability are often much more important in the procurement of direct goods than price alone (Neef, 2001).

Benefits and Costs of E-Procurement

There are several benefits achieved through the implementation of e-procurement practices. A government can lower its administrative costs associated with procurement by reducing the number of people and time associated with the procurement process. For instance, in a typical manual system, users would first have to find a supplier, obtain the appropriate paper catalogue, select the item, and seek and obtain management approval. After review and approval of the requisition by the procurement professional, a purchase order would be faxed to the supplier. This fax would be followed up with a phone call to verify receipt, and then copies would be sent to shipping and receiving, accounting and finance, and department managers. This paper-based system is sequential, prone to errors, encourages the carrying of excess inventory, and makes enterprise-wide integration very difficult. With e-procurement, the process is significantly different and more efficient. Employees can access approved vendor catalogs from their personal computers, identify and compare needed items, and order them. Product availability and delivery information is readily accessible, and payments can be made electronically. Rule-based software can either provide automatic approval for routine orders or route the request to an available manager for approval (Gansler, Lucyshyn & Ross, 2003).

Costs for manually processing a purchase order range from $125 to $175. E-procurement can reduce those costs to $10 or $15 by eliminating faxes, phone calls, document preparation, and approvals

(Gansler, Lucyshyn & Ross, 2003). E-procurement can also significantly reduce the price of materials and supplies. Buyers can more easily identify the best value when they have access to more suppliers. This not only results in increased competition, but new visibility also creates opportunities for small businesses that were previously unavailable. Using online reverse auctions, buyers and sellers can quickly exchange information and bids, which often results in significant savings. Digitized transactions provide a complete, instantaneous, and far more accurate audit trail that allows management to track the status of orders, and identify and fix problems sooner. This data collection also allows organizations to monitor off-contract purchasing, a significant target for cost-cutting improvements. These maverick purchases are out of compliance with the organization's volume purchase agreements (Gansler, Lucyshyn & Ross, 2003).

The use of the Internet to deliver all government services is a significant barrier because of the digital divide (Holden, Norris & Fletcher, 2003). However, this barrier is not as much of a problem for e-procurement, as all vendors and government procurement officers have access to the Internet (Thai & Grimm, 2000). Small business owners, however, feel that they are disadvantaged in the e-procurement process because of their lack of technical expertise and education on the government's multiple procurement Websites (GAO, 2001). MacManus (2002) makes the argument that one of the most serious inclusive issues facing government procurement officers today is the minority business owner's digital divide. As many large sized businesses use the Internet, minority entrepreneurs (many small business owners) are struggling to harness the power of information technology and e-procurement.

The General Accounting Office (2001) did a study of the General Services Administration "*GSA Advantage!*" system. This is a multi-vendor Internet-based purchasing site, sometimes called an "electronic mall". This is where government buyers can search listings, compare prices, and purchase items online much as a private individual might purchase an item from an online retailer. The GAO report was a response to a concern from small businesses about their participation in government online procurement programs. The report indicated that in terms of contract dollars awarded small businesses successfully participated in online procurement programs such as Advantage. However, officials from organizations representing or working with

small businesses still report that they face obstacles in conducting electronic procurement with government.

The costs and benefits of e-procurement can be summarized (also see Neef, 2001; Wyld, 2001; Moon, 2003). The positive aspects of e-procurement generally cited in the literature include the following: (1) lowered transaction costs; (2) faster ordering; (3) greater vendor choice; (4) more efficient and standardized procurement processes; (5) more control over procurement spending (e.g., less maverick buying) and employee compliance; (6) more accessible Internet alternatives for buyers; and (7) less paperwork from fewer repetitive administrative procedures.

The costs for e-procurement can be summarized as: (1) technical complexity – privacy, security, standardization and so forth; (2) legal issues such as Web information as a public notice, digital signatures for procurement documents; (3) method of payment for potential initial developmental costs and operating costs; (4) maintaining relationships with online vendors and application service providers; and (5) the digital divide for small and minority owned businesses. The empirical studies on government e-procurement should also be mentioned.

E-Procurement Growth Empirical Studies

Moon (2002) conducted a study of e-government development at the local level using a dataset from the International City/County Management Association (ICMA) "2000 Electronic Government Survey." In terms of online purchasing, the data indicates that the level of e-procurement in purchasing was 723 out of 1260 responding municipal governments; this implies that almost 60 percent of surveyed municipalities purchase products over the Internet. In addition, online request for proposals was represented by 359 out of 1260 respondents, or around 28 percent. Moon found that in terms of e-procurement many of the responding municipal governments appear to be in stage one, and a few were in stage two of the Layne and Lee (2001) model. Overall, it appears that few governments have taken proactive approaches to Web-based transaction services, but many are purchasing products over the Internet.

The results of a study by Davila, Gupta, and Palmer (2003), indicated that 168, mostly for profit but some nonprofit U.S.

organizations in 2001, are still in their early stages of e-procurement development - cataloging information on the Web. In particular, non-profit organizations are primary users of market exchanges and purchasing consortia – 62 percent of market exchange and 61 percent of purchasing consortia users, a similar finding to Moon (2002). The majority of those surveyed (around 70 percent) are taking a wait and see approach. These organizations are aware of the developments, but are not committing resources. They are investing selectively until the best e-procurement strategy can be identified. Therefore, the experimentation with e-procurement technologies is run on indirect supply processes such as office supplies and computers (Davila, Gupta & Palmer, 2003).

For state and local agencies, e-procurement adoption has been even slower because agencies' budgets, including allotments for technology spending, are reduced as a result of the recession in early 2000. Online procurement is best suited for commodity type products such as pens, pencils, paper, and other supplies that government consumes regularly (Neef, 2001). These low dollar items keep online procurement totals from substantially rising. Online buying is not well suited for more costly and complex items such as high-end computers, servers, or office equipment, since the various alternatives and multiple configurations of those items often require personal contact with vendors (Matthews, 2001). The literature also points out that management capacity is critical for e-procurement development.

Management Capacity and E-Procurement Growth

A committed senior leadership is critical for achieving a transformation and integration of the government's supply chain, and to overcome existing legislative, regulatory, and organizational barriers (Gansler, Lucyshyn & Ross, 2003). As governments attempt to cut costs, they increasingly look to information technology to improve their supply chains by automating and digitizing their procurement processes (Neef, 2001).

According the Neef (2001), e-procurement continues to enhance the breakdown of traditional silos and to shift management's focus toward horizontal processes and the empowerment of individual employees, a movement into stage four of the e-procurement growth model (Fountain, 2001). In the past, the purchasing process was seen as a set of separate activities and functions, controlled centrally or departmentally, often

focused narrowly on silo-based incentives rather than on total cost. E-procurement systems facilitate (direct) Maintenance, Repair, and Operations (MRO) procurement of materials for finished goods as all part of a single, fully integrated process, extending from forecasting and planning through the entire supply chain. For (indirect) Operating, Resources, Management (ORM) materials, e-procurement systems allow for a far greater level of individual empowerment as pre-approval and purchasing is handed over to individual employees (Ho, 2002).

Neef (2001) believes that part of the problem is that in most organizations the procurement process is still seen as tactical rather than strategic, as a cost rather than a benefit to the organization. The e-procurement function for many governments is still limited to occasional and uncoordinated shopping online for office supplies. Other issues are security and trust. Unknown vendors make procurement officers hesitant to give up their cumbersome paper-based process conducted with long-time and trusted suppliers. The management issue here is how to train personnel to use online procurement tools and to retrain those workers displaced because of e-procurement (GAO, 2001)

In the traditional bureaucratic model, public managers focus on internal productive efficiency, functional rationality and departmentalization, hierarchical control, and rule-based management (Ho, 2002). In contrast, under e-procurement, public managers shift from emphasizing producer concerns, such as cost efficiency to focusing on user satisfaction and control, flexibility in service delivery, and network management with internal and external parties. The new paradigm stresses innovation, organizational learning, and entrepreneurship so that government can continue to reinvent itself (Fountain, 2001).

The lack of effort towards e-procurement in government could be explained in part by the preoccupation with the Year 2000 (Y2K) concerns (Neef, 2001). It is most likely also due to the lack of private sector incentives that have been driving e-procurement among businesses, and the change management problems that often plague government. Creating an enterprise initiative can be virtually impossible given the overlapping and often competitive power interests (MacManus, 2002).

Ho and Smith (2001) used the Y2K problem as a case study to gain a better understanding of how governments plan for IT. These authors did a survey of Y2K planning of local governments financial administrators in cities and counties from October 1998 to November 1999. They used this data to test several hypotheses on IT strategic planning against characteristics of cities and counties. The results indicated that the overriding factors that explained the effectiveness of IT planning depended on senior management's attitude towards information technology. The more concerned these officials are about planning the more likely they are going to participate in IT planning.

Moon (2003) argues that moving toward e-procurement from traditional paper-based processes also brings great challenges to procurement officers. They need new technical and managerial skills, such as managing electronic catalogs; building relationships with online vendors and independent Application Service Provider (ASP) (or portal site providers), and developing strategic team based purchasing with other purchasing entities. To sustain the development of e-procurement, state governments must provide appropriate technical training and assistance to procurement officers and develop closer working relationships with vendors and various government buyers (Neef, 2001).

Several states with ambitious e-procurement initiatives have recently seen their efforts stall or completely collapse. For example, in 2002 South Carolina's e-procurement system was terminated, followed by the announcement from NIC Inc., a major e-procurement company, that they were exiting the e-procurement business in the U.S. Soon after these announcements, the auditor from the State of Virginia found that only 1.5% of the state's purchases were transacted using the state of the art $14.9 million procurement system. In addition, the City of Los Angeles' new $11 million procurement and inventory management system ran into a series of glitches resulting in billing problems, late payments, and inventory shortages. E-procurement problems lie with government's inability to muster the political and managerial will to mandate the use of e-procurement by both agencies and suppliers, and its unwillingness to manage institutional change as procurement systems are converted from a manual process to an electronic one (Newcombe, 2001). Because of the current fiscal problems that many states face, some have proposed an enterprise-wide solution to bundle costs.

Enterprise Resource Planning and E-Procurement

One solution to the current slow down in development of e-procurement is Enterprise Resource Planning (ERP) that has become the new catchword for e-procurement reform. ERP brings together the business practices of an organization's, accounting, budget, payroll, and procurement functions (Laudon & Laudon, 2001). ERP focuses on tying together IT systems, thus gaining economies of scale through the coordinating purchasing of interoperable management systems.

By making e-procurement part of the ERP package, purchasing departments have found that funding technology is no longer something they have to shoulder on their own (NECCC, 2000). Instead, it's an enterprise issue that requires state funding, usually in the form of money taken from general appropriations. By designing an enterprise wide solution that leverages the existing electronic systems that govern a broad range of agency activities, an advanced e-procurement solution could be realized that saves money, improves vendor satisfaction and is sustainable (Newcombe, 2001).

The following section examines the database used and the descriptive statistics of the dependent and predictor variables. In this section, we develop a model of e-procurement growth.

DATABASE AND DESCRIPTIVE STATISTICS

The database used to measure the adoption of e-procurement was the National Association of State Procurement Officers (NASPO) 2003 Survey of State Government Procurement Practices. This survey was administered in 2002. The questions and frequency of responses of Internet e-procurement are presented in Table 1. Ten questions from the survey specifically correspond to the use of the Internet and e-procurement. For instance, 43 of the states that responded to the survey state that the central procurement office has an Internet Website (seven states did not respond to this question). Forty-one states have the central procurement office posting solicitations/bids on the Web. However, when it comes to digital signatures only eight states use them as legally binding signatures on procurement documents. Only eleven states have the state central procurement office conducing bids via the Internet. Nine states have conducted reverse auctions, which is where providers of

TABLE 1
NASPO E-Procurement Questions and Frequency of Responses

E-Procurement Questions	Frequency	Percent of States	Percent Respon-ding States
Does the central procurement office have an Internet Website?	43	86	100.0
Is the central procurement office posting solicitations on the Web?	41	82	93.2
Is the central procurement office posting contract award information on the Web?	32	64	74.4
Has the state enacted digital signature laws?	24	48	58.5
Does the state have rules promulgated regarding digital signatures?	17	34	44.7
Does the state use digital signatures to route and approve documents internally?	7	14	16.7
Is the state accepting digital signatures as legally binding signatures from the vendor community on procurement documents?	8	16	18.6
Has the state central procurement office developed procedures or have statutes governing Internet bidding?	16	32	37.2
Has the state central procurement office conducted bids via the Internet?	11	22	26.8
Has the state central procurement office conducted reverse auctions?	9	18	20.5

government products or services bid against one another and the lowest price wins the contract. From the data in Table 1, there appears to be a Web presence of central procurement offices, but there is not as much development into digital signatures and Internet bidding.

The e-procurement database is presented in Table 2. The e-procurement index is compiled by simply adding up the "yes" responses for each state to the questions in Table 1. Each "yes" answer gives the state one point and the highest possible score for a state is ten. Table 2 indicates that Kentucky and Texas had the highest scores of nine out of

TABLE 2
E-Procurement Database:
E-Procurement Index is the Dependant Variable

State	E-Procure-ment Index	Manage-ment Capacity	IT Mana-gement Capacity	Tax Capacity	IT Spend	Internet Access	GSP Per Capita
Alaska	6	2	5	2	1	64.1	44.2
Arizona	3	3	4	2	3	51.9	30.4
Arkansas	2	2	1	2	2	36.9	25.3
California	2	3	4	1.7	4	55.3	39.7
Colorado	6	3	2	1.7	2	58.5	39
Connecticut	5	2	3	2	2	55	46.8
Delaware	6	6	5	3.7	1	52.5	46.3
Georgia	5	4	3	2.3	4	46.7	36.1
Idaho	7	4	5	2.7	1	52.7	28.6
Illinois	5	5	3	1.7	4	46.9	37.6
Indiana	3	4	4	2.7	3	47.3	31.6
Iowa	5	6	5	2.3	2	51	30.6
Kansas	4	5	7	2.3	2	50.9	31.6
Kentucky	9	6	6	2	3	44.2	29.3
Louisiana	3	4	4	2	3	40.2	30.8
Maine	6	4	4	2.3	1	53.3	28.2
Maryland	8	6	5	2.3	3	57.8	35.1
Massachusetts	4	3	2	2.3	4	54.7	45.0
Michigan	3	7	7	2.7	4	51.2	32.7
Minnesota	4	5	5	2.7	4	55.6	37.6
Mississippi	5	3	3	1.7	2	36.1	23.7
Missouri	7	6	7	2.7	3	49.9	32.0
Montana	3	3	2	2.0	1	47.5	24.1
Nebraska	3	4	3	2.3	1	45.5	32.8
Nevada	4	2	1	1.0	1	52.5	37.4
New Hampshire	4	2	2	2.3	1	61.6	38.6
New Mexico	6	3	3	2.7	2	43.1	29.9
New York	5	3	5	2.3	4	50.2	42.1
North Carolina	7	5	6	2.3	4	44.5	35.0
North Dakota	1	4	4	3.0	1	46.5	28.5
Oklahoma	3	2	4	2.0	2	43.8	26.7
Oregon	2	3	2	2.3	3	58.2	34.7
Rhode Island	2	2	0	2.0	1	53.1	34.7

TABLE 2 (Continued)

State	E-Procure-ment Index	Manage-ment Capacity	IT Mana-gement Capacity	Tax Capacity	IT Spend	Internet Access	GSP Per Capita
South Carolina	8	6	5	2.0	2	45.0	28.3
South Dakota	5	3	5	3.0	1	47.6	30.7
Tennessee	5	4	6	1.3	3	44.8	31.4
Texas	9	5	4	1.7	4	47.7	35.6
Utah	8	7	8	2.7	2	54.1	30.7
Vermont	3	4	3	2.7	1	53.4	30.2
Virginia	8	6	7	2.0	4	54.9	36.9
Washington	7	7	8	2.3	4	60.4	37.3
West Virginia	2	2	1	2.0	2	40.7	23.4
Wisconsin	4	4	4	2.7	3	50.2	32.3
Wyoming	1	2	1	2.7	1	51.0	39.1

ten. While the lowest scores were found for North Dakota and Wyoming, they only had a Website presence (of a score of one out of ten). Six states did not respond to these questions in the NASPO survey.

There are several independent variables used as predictors of e-procurement growth. Three of them address performance, specifically management capacity, IT management capacity, and tax capacity. A very important measure is management capacity issues, because successful e-procurement is very dependent upon the performance of management (Neef, 2001; GPP, 2002). The management capacity variables were taken from Government Performance Project (GPP) (2002) and *Governing Magazine* ("The Way We Tax," 2003) providing 2002 data on the tax capacity of the 50 states.

The existing qualitative literature supports the hypothesis that strong management capacity leads to more effective e-procurement development (Neef, 2001; Gansler, Lucyshyn & Ross, 2003; Moon, 2003). With respect to tax capacity, states that are more fiscally stressed, should have higher e-procurement development as a way to cut costs (Newcombe, 2001; Moon, 2003). The existing literature supports the hypothesis that having more resources implies greater IT development (Ho & Smith, 2001). Internet access represents the so-called digital

divide that small businesses face in e-procurement. Small businesses may not be as Web savvy as larger businesses when it comes to e-procurement (Thai & Grimm, 2000; MacManus, 2002). The last independent variable is IT spending. It is predicted that as a state spends more on information technology it should be more developed in e-procurement (Holden, Norris & Fletcher, 2003).

These independent variables were chosen over other possible predictors since they represent a management model of e-procurement. In this article, we are addressing if management capacity has a bearing on e-procurement growth. The existing work in information technology planning (Ho & Smith, 2001) and descriptive studies on e-procurement (Neef, 2001; Moon, 2003) demonstrate that management does play a critical role.

In the grading systems of management and tax capacity, higher scores indicate greater development in these areas. The maximum scores for management capacity and IT management capacity was eight, and the highest score for tax capacity was four. The average scores for management capacity and IT management capacity were 4.0 and for tax capacity 2.2 (Table 3). Therefore, all capacity scores were in the middle range. Especially critical to this study is the impact of information technology, which has emerged as an increasingly critical part of overall management (Barrett & Greene, 2001). It is hard to imagine a state with an antiquated underperforming IT system being identified with high management performance. We anticipate positive coefficients for the measures of management capacity and IT management capacity. A negative coefficient is expected for tax capacity, because fiscally stressed states are more likely to engage in e-procurement as a mechanism to reduce administrative costs.

Some of the other independent variables tested against e-procurement are the amount of IT spending by the state ("*State and Local Source*," 2003) (see Tables 2 and 3). There are four possible choices here with the score of four representing $390 - $3,900 million of state IT spending, three is $290-$389 million, two is $120 -$289 million, and one is $30 to $119 million in IT state spending. Generally, the more populous states spend more on IT than the smaller states. We anticipate that an increase in IT spending will have a positive bearing on the

TABLE 3
Descriptive Statistics of Variables and Anticipated Impact on the E-Procurement Index

Variables	Number of Obs.	Min	Max	Mean	Std. Deviation	Anticipated Impact on E-procure-ment
E-Procurement Index	44	1	9	4.7	2.2	NA
Management Capacity	50	1	7	4.0	1.6	(+)
IT Management Capacity	50	0	8	4.0	2.0	(+)
Tax Capacity	50	1.0	3.7	2.2	0.5	(-)
IT Spending	50	1	4	2.5	1.2	(+)
Internet Access	50	36.1	64.1	50.2	6.3	(+)
GSP Per Capita	50	23.4	46.8	33.7	5.8	(+)

development of state e-procurement. In addition, another independent variable is the state percentage of households with Internet access ("*State and Local Source*," 2003) (see Tables 2 and 3). The lowest score was 36.1 for Mississippi and the highest Internet access was recorded for Alaska at 64.1 percent. The average score of Internet access was 50.2%. Gross State Product (GSP) per capita, a broad measure of affluence, was on average $33,000 for the states ("*State and Local Source*," 2003). We anticipate positive impacts for these variables; the wealthier a state the more investment in e-procurement, and greater Internet access should increase e-procurement as well. In addition, more IT spending by the state should enhance e-procurement growth.

The following section presents the results of the tests of the e-procurement index against the predictor variables.

MODEL RESULTS

The results of the tests of the e-procurement model are presented in Table 4. For this model we have an adjusted-R^2 of 50 percent, the model seems to fit the data well. The F-statistic for the overall model was 6.06, which is significant at the one percent level. The results in Table 4

demonstrate that the most important predictors of e-procurement growth were the management and tax capacity variables, not the traditional economic explanation such as GSP. In terms of management capacity there was a positive impact of 0.52 at the five percent significance level. This implies that as management capacity increases by one point there will be an increase in e-procurement by more than half of a point. IT management capacity also has a positive impact of 0.36 at the ten percent significance level. Therefore, as IT management capacity increases by one point there will be over one third of a point increase in e-procurement growth. Finally, as tax capacity increases by one point there will be a decrease of e-procurement by around one third, implying that more fiscally stressed states are more likely to engage in e-procurement because they have fewer resources to spare and need to find a mechanism to reduce administrative costs. There was no statistical evidence that GSP per capita, Internet access, or IT spending had an impact on e-procurement growth. Therefore, the overriding influence on e-procurement growth was from the management and tax capacity variables.

TABLE 4
OLS Regression of Internet E-Procurement: E-Procurement Index as the Dependent Variable

Independent Variables	Beta Coefficient	t-statistic	Prob. Significant
Constant	2.95	1.22	0.23
Management Capacity	0.52**	2.52	0.02
IT Management Capacity	0.36*	1.85	0.07
Tax Capacity	-0.34**	-2.55	0.01
IT Spending	-0.23	-1.51	0.14
Internet Access	-0.09	-0.52	0.61
GSP Per Capita	0.27	1.55	0.13
Model Diagnostics			
F-statistic of Model		6.06**	0.00
N	44		
Adjusted R^2	0.50		

Notes: * significant at the 0.10 level and ** significant at the 0.05 level.

The following section summarizes the research findings of this article and provides an overall assessment of the key attributes of states that are more developed in e-procurement.

SUMMARY AND CONCLUSION

This article has examined the growth of e-procurement in the U.S. states. The results show that there appears to be the most development in the cataloging phase of e-procurement. Since all the states have a Website, over 90 percent of the states post solicitation on the Web, and three quarters of the states post contract award information on the Web. However, when it comes to the development into the transaction phase of e-procurement there seems to be ample room for improvement. For instance, only eight states are accepting digital signatures as legally binding signatures from the vendor community on procurement documents. Only eleven states have central procurement offices conducting bids via the Internet, with Kentucky and Texas having the highest e-procurement scores of the states surveyed. North Dakota and Wyoming were in the very early stages of e-procurement development, only having a Web presence. The mean value for the e-procurement index was almost five out of ten, just past the initial stages of cataloging and into the early transaction phase.

When the e-procurement index was modeled against the predictor variables of management and tax capacity, there was strong support that highly managed states increased e-procurement growth and a similar situation was applicable for IT management capacity. States that have a high tax capacity are less likely to be as developed in their e-procurement function because they do not have the cost constraints that fiscally stressed states do. These quantitative results support Neef's (2001) descriptive study of e-procurement, where that author argues that the overriding determinate of successful e-procurement development is management capacity. If the top leadership does not strategically support e-procurement, then the system will ultimately under-perform.

The evidence found in this study in support of management capacity is similar to that found in the existing qualitative work on e-procurement (Neef, 2001; Moon, 2003). In essence, high management capacity of state governments is an indication of greater growth in e-procurement. The existing empirical work on e-government growth comes to a similar

conclusion that management capacity is vital for success (McNeal, Tolbet, Mossberger & Dotterweich, 2003). In addition, states that are more fiscally stressed should be more developed in e-procurement compared to non-fiscally stressed states (Gansler, Lucyshyn & Ross, 2003). Fiscally stressed states need to find a mechanism to reduce transactions costs and e-procurement is one mechanism to save precious resources.

Some of the potential pitfalls of this study should be mentioned. First, this study is missing data on Internet e-procurement for six states: Alabama, Florida, Hawaii, New Jersey, Ohio, and Pennsylvania, which did not respond to the NASPO survey. Another pitfall is that we have used a rather narrow definition of e-procurement since we did not consider non-Internet based transactions such as EDI and purchasing cards (Moon, 2003). We focused upon Neef's (2001) definition of e-procurement, which considers the Internet as the main catalyst for e-procurement development.

Another potential avenue for future e-procurement development is for states to bundle e-procurement into their existing ERP systems, an organization-wide solution should more easily be able to secure legislative appropriations. A future study might want to investigate the effect of bundling e-procurement with an ERP system.

NOTES

1. Another broader definition of e-procurement is provided by Moon (2003). He defines e-procurement as a comprehensive and systematic process in which governments either establish agreements for the acquisition of products/services (contracting) or purchase products/services in exchange for payment (purchasing), using IT systems. According to Moon's definition, e-procurement uses tools such as electronic ordering, purchasing cards, reverse auctions, and automatic accounting systems. We focus in this article upon the use of the Internet and procurement.

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