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Executive Summary

A main inhibitor to electronically extending supply chains is that large organizations and the majority of their smaller business partners have incompatible business systems. Big businesses' sophisticated IT infrastructures support many kinds of information integration, manipulation, and reporting, whereas many small to medium businesses (SMBs) use IT only for simple clerical tasks. Big businesses will not be able to fully exploit their huge investments in internal integration capabilities until they can extend IT integration capabilities to the majority of their supply-chain partners.

The case study in this article² describes how Petroleum Development Oman (PDO), a large oil and gas exploration and production company, electronically integrated its complete vendor³ base through e-procurement. The key to success was outsourcing both the delivery of the e-procurement solution and vendor-relationship management to a third party. This approach avoided the need for huge upfront investment and provided support for vendors from day one. PDO's experience shows that relatively IT-immature SMBs can successfully adopt e-procurement in a reasonably short time. The four main lessons from this case are: (1) address vendors' negative perceptions of competitive bidding, (2) share the benefits with vendors, (3) make the system simple, easily accessible, and familiar, and (4) overcome public infrastructure constraints by focusing on service and substituting one technology with another.⁴

E-PROCUREMENT CHALLENGES

Following the “dot com” bust in the early 2000s, many businesses became reluctant to adopt e-commerce because they realized they first needed to establish sound IT infrastructures. As a consequence, they made huge investments in enterprise resource planning (ERP) systems that allowed different business functions to communicate with each other for the first time. However, much of this integration stopped at the boundary of the organization. The goal for many businesses in the post-ERP era has been to extend system boundaries beyond the enterprise to both vendors and customers, which has led to a surge of customer-relationship management (CRM), supply-chain management (SCM), electronic marketplace and enterprise portal implementations.⁵ The challenge with these systems has been to link different types of business processes and IT infrastructures across companies that often operated in different environments.

E-procurement—the use of IT to support the purchasing process between buyers and vendors—is an effective way to create inter-organizational integration capabilities.

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1 Cynthia Beath is the accepting Senior Editor for this article.

2 The authors would like to acknowledge the organizations featured in this case study for their generosity in devoting the time to describe their experiences and respond to many questions. The authors also appreciate the valuable comments by the reviewers.

3 We use vendor instead of supplier. Although the latter is more common in the MIS literature, vendor is widely used to refer to goods and service providers in the practitioner community, particularly in Oman and the surrounding region.

4 This paper won first prize in the Society for Information Management's 2006 Paper Awards Competition and was presented at the SIM Annual Conference, SIMposium, in Dallas, Tex., on September 19, 2006.

5 Daniel, E. M., and White, A. “The Future of Inter-Organisational System Linkages: Findings of an International Delphi Study,” *European Journal of Information Systems* (14:2), 2005, pp. 188-203.

However, for an electronic network of buyers and vendors to be effective, all parties must be committed to adopting new technology and related changes in business processes.

E-procurement networks are often initiated and championed by a large business, either a buyer or a vendor. A large business with a high volume of procurement transactions can gain substantial economies of scale by implementing an e-procurement system—hence the commitment of large businesses to e-procurement. The key roadblock to successful adoption of e-procurement is the small and medium size businesses (SMBs) in the supply-chain network. Five main barriers prevent them from adopting e-procurement:⁶

- High setup costs
- Fears of competitive bidding
- Inadequate technology infrastructure
- Immature business processes
- Lack of trust between supply chain partners.

Other barriers, particularly in developing countries, include lack of policies regulating online business operations and inadequate public infrastructure. Until these barriers can be overcome, e-procurement initiatives costing millions of dollars will often fail.

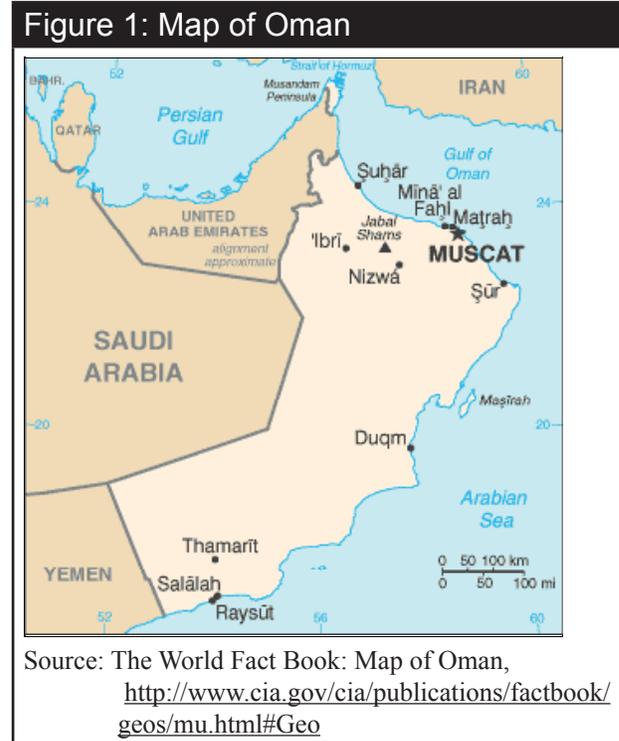
IMPLEMENTATION OF E-PROCUREMENT AT PETROLEUM DEVELOPMENT OMAN (PDO)

The business of Petroleum Development Oman (PDO) is the exploration, production, development, storage, and transportation of hydrocarbons in the Sultanate of Oman.

The Economic Environment in Oman

The Sultanate of Oman lies at the eastern corner of the Arabian Peninsula, between Yemen, Saudi Arabia and the United Arab Emirates⁷ (see Figure 1). It comprises 12,460 sq km (7,742 sq miles) and has a population of around three million. The country has a strategic position on the Strait of Hormuz, a vital transit point for crude oil. Until the discovery of oil, in 1964, the

country was economically dependent on agriculture and fishing.



Oman is a member of both the Arab League and the Gulf Cooperation Council (GCC). The Arab League is an association of 22 countries whose populations (approximately 300 million) mainly speak Arabic.⁸ The league was established in 1945 with the objectives of strengthening ties among member countries and coordinating policies. The GCC was founded in 1981 with the aim of promoting coordination among the neighboring oil-rich countries of Saudi Arabia, Kuwait, Bahrain, Qatar, United Arab Emirates, and the Sultanate of Oman.⁹

The increasing price of oil since the start of this decade has led to exponential growth in the GCC region as member countries have invested their huge revenues in diverse mega-million-dollar projects. The main restriction to even greater growth is the scarcity of human resources. The local population is relatively small compared with development opportunities and there is a shortage of local skills. This shortage is being addressed through a heavy emphasis on all levels of education (schools, higher colleges of technology, universities, professional development, training, etc.)

⁶ Hsiao, R. L. and Teo, T. S. H. "Delivering on the Promise of E-procurement," *MIS Quarterly Executive* (4:3), 2005, pp. 343-360.

⁷ For more information about Oman, see "The World Factbook," Central Intelligence Agency (CIA). Retrieved November 2007 from <https://www.cia.gov/library/publications/the-world-factbook/geos/mu.html>.

⁸ For more information on the Arab League, see "Profile: Arab League," BBC, March 10, 2006. Retrieved June 2006 from http://news.bbc.co.uk/1/hi/world/middle_east/country_profiles/1550797.stm#facts.

⁹ For more information on GCC countries, see "GCC Countries," Sheikh Mohammed, 2005. Retrieved June 2006 from http://www.sheikhmohammed.co.ae/english/history/history_arabia.asp.

and will eventually be resolved as younger generations come into the workforce.

At present, though, GCC countries rely heavily on expatriate workers. The percentage of expatriates varies across GCC countries, but Oman is making better than average progress with workforce localization or “Omanization.” The percentage of Omanis compared with expatriates in the workforce continues to rise annually.

Having a large expatriate population has both advantages and disadvantages. Although expatriates bring a wealth of skills that facilitate rapid development, a significant amount of knowledge is lost when they return home. To stabilize the workforce and ensure work continuity, skilled jobs are filled through generous tax-free salaries and employment packages. Manual or handyman jobs are mainly filled by expatriates from Southeast Asian countries, due to the high unemployment in their home countries. For these reasons, a key responsibility for many GCC governments is to engage local enterprises in developing the economy whenever appropriate and feasible.

About PDO¹⁰

Oil exploration in Oman started in 1937 but was not discovered until 1963 because the hostile desert environment, mountainous inland areas, and political unrest made exploration very difficult. Exploration and production operations were run by PDO, which originally had five shareholders: Royal Dutch Shell Group (23.75%); Anglo-Persian Company, now, British Petroleum Company, (23.75%); Compagnie Française des Pétroles, a predecessor of today’s TotalFina-Elf, (23.75%); Near East Development Company, a subsidiary of today’s ExxonMobil, (23.75%), and Partex (5%). Some of these shareholders had given up by the time oil was discovered. The first export of Omani oil, which consisted of 543,800 barrels valued at \$1.42 a barrel, took place on July 27, 1967.

The current ownership of PDO has been unchanged from the mid-1970s when the government of Oman took a 60% share, with foreign interests holding the remainder (Shell 34%, Total 4%, and Partex 2%). At that time, daily production averaged 341,000 barrels, rising to 400,000 barrels a day in the mid-1980s when Oman’s oil reserves were estimated at 3.8 billion barrels. By the mid-1980s, PDO had also become

involved in natural gas production for industrial purposes.

The fall in the price of oil in the mid-1980s meant PDO had to reduce costs and increase production. To achieve these goals, it focused on both innovation and experimentation, breaking its own records for drilling wells in the shortest time and for drilling the longest horizontal wells. By 2000, daily oil production had risen to over 840,000 barrels and a new liquefied natural gas plant, costing \$1.2 billion, had been opened. However, Oman does not have the immense oil resources of some of its neighbors, and oil production has recently declined to 780,000 barrels a day. This, in addition to the rising cost of production (due to Oman’s complex geology), caused PDO’s revenue to fall, putting much pressure on the company to devise innovative solutions, particularly in using technology to improve efficiency. One area PDO focused on was e-procurement.

Procurement Activity at PDO

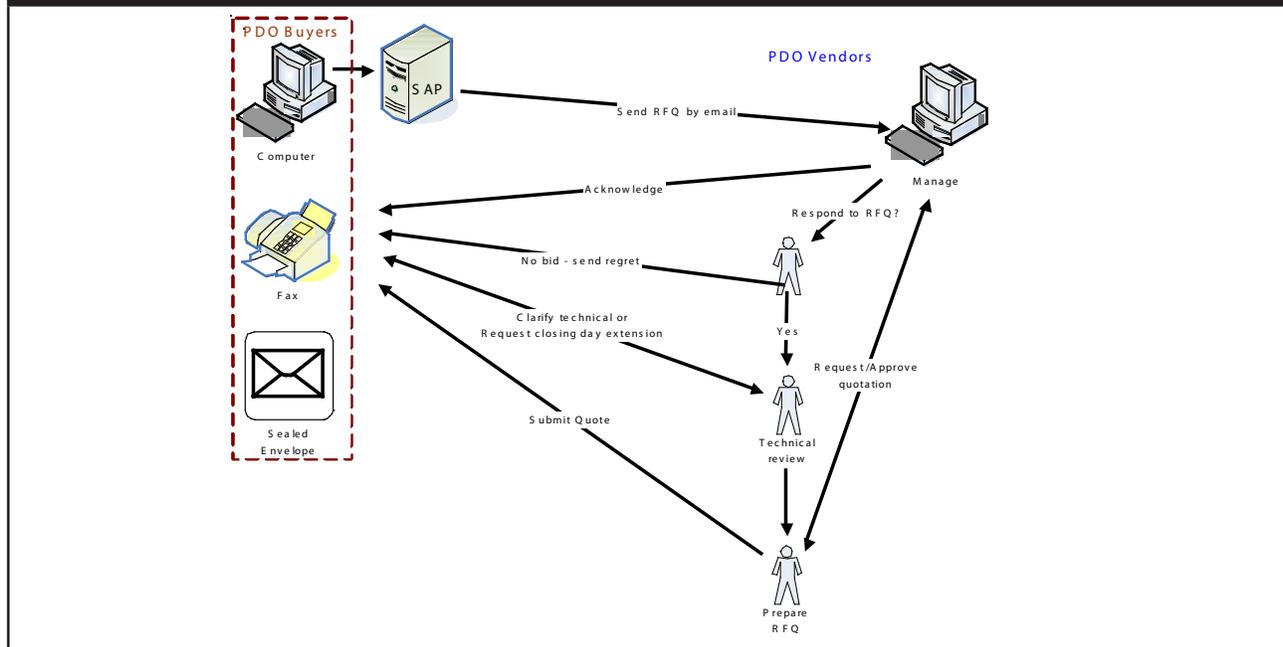
The oil and gas recovery business involves a huge amount of purchasing activity. Hence PDO spends a significant amount of money on procurement. It needs control systems to ensure compliance with both company procedures and governmental policies.

PDO’s procurement activities mainly involve identifying, negotiating, and sourcing goods and services in both the direct (i.e., primary) and indirect (i.e., maintenance, repair, and operations [MRO]) categories. PDO has a wide range of vendors covering the diverse operations of the oil and gas business. Approximately 90% of PDO’s 3,000 vendors are SMBs. In Oman, everything is sold locally through agents, so global companies are represented by vendors that act as their local agents. PDO’s procurement reach is global, but all purchasing activities are channeled through local businesses.

With the government as the majority shareholder, PDO places great emphasis on honesty, integrity, and fairness in conducting its business. Its contracting and procurement policy is based on open and competitive bidding, with transparent procedures and equal opportunities for all qualified contractors and vendors. PDO’s employees are expected to exercise the utmost care to avoid putting themselves into a position where they, directly or indirectly, accept or repay favors. The company’s statement of business integrity emphasizes the need for transparency in all its transactions, which must comply with the strictest accounting principles.

10 For more information on PDO, see “PDO Company History,” *Petroleum Development Oman (PDO)*, 2006. Retrieved June 2006 from <http://www.pdo.co.om/PDO/AboutPdo/History/>.

Figure 2: PDO's SAP-based procurement process



As part of its community responsibility, PDO endeavors, whenever appropriate and feasible, to promote the local economy by buying from local enterprises. PDO must therefore balance competitive bidding requirements with accessibility to local vendors.

IT Integration with SAP

Starting in 1997, PDO carried out an extensive study to streamline its business operations. It formed an internal taskforce and recruited supply-chain management experts as needed. The taskforce created a blueprint of existing business operations and supporting IT systems, identified limitations in the systems, and made recommendations for overcoming them. As in most businesses structured around functional silos, the key limitation was inefficiencies resulting from a broken supply chain. Many variations of each process existed, with approximately 108 interfacing IT systems. The company classified only five of these as “major.”

The two-year feasibility study identified six strategic themes in supply-chain management—financial transparency, process visibility, process simplification, standardization, automation, and workforce competency. These themes subsequently guided the implementation of SAP's ERP business solutions software.

The decision to adopt SAP was made in October 1999. Design commenced in February 2000 and the

system went live in January 2002. PDO minimized customization by using SAP's best-practice capabilities to redesign the business processes around the six strategic themes. As with many major ERP implementations,¹¹ PDO's experience with SAP was problematic. Users joked that SAP stood for “Submit And Pray—you push the enter key and pray the system won't crash!”

Prior to implementing SAP, separate purchasing and contracting departments had been responsible for procurement, the former for goods and supplies and the latter for services. With the implementation of SAP, these two departments were combined into an integrated procurement organization. This created a single, integrated end-to-end business process for procuring goods and services across the supply chain. SAP reduced the cost of issuing a purchase order from US\$103 to US\$43 and a request for quotation (RFQ) from US\$309 to US\$129.

Limitations of PDO's SAP-Based Procurement

With SAP, RFQs were issued through e-mails, and quotations were received through a variety of media, some electronic and some hard copy. Figure 2 depicts

11 Markus, M. L., and Tanis, C. “The Enterprise Systems Experience—From Adoption to Success,” *Framing the Domains of IT Research: Glimpsing the Future through the Past*, R. W. Zmud (ed.), Pinnaflex Educational Resources, Inc, Cincinnati, Ohio, 2000, pp. 173-207.

the SAP-based procurement process. To track the status of procurement documents sent, PDO turned on the request-receipt option in Microsoft Outlook. This showed that approximately 2,000 documents were being generated each day. Given that some documents (e.g., RFQs) were sent more than once, PDO buyers received around 6,000 acknowledgement e-mails a day. Tracking these responses and linking them to the originating RFQs became difficult and time-consuming, and was often overlooked.

The huge number of e-mails became such an administrative nightmare that PDO switched off the request-receipt option. Even with SAP in place, the buyers had to revert to their pre-SAP situation of relying on paper documents to manage procurement—they had no information about the status of RFQs. The vendors frequently complained about not receiving pricing invitations, and PDO's buyers could not prove whether or not this was true—and if it was true, what caused the lack of an invitation. In the words of PDO's supply chain manager:

“We didn't know where anything was and the vendor would love it. They saw it as their chance to get back into PDO and would say ‘Why didn't you send us that RFQ? Where is

that purchase order? What happened to my receipt?’ We just stepped back 24 months to where we were previously. We had to find a solution to this problem.”

To mend its broken supply chain, PDO needed to find a way to integrate its systems with those of its vendors. But inter-organizational IT systems were not designed for SMBs and many required considerable upfront investment. The majority of PDO's vendors were SMBs whose information systems comprised one or a few standalone PCs with common off-the-shelf software. Such systems might have been adequate for SMBs, but they were a major problem for large buyers like PDO that had invested heavily in ERP systems and wanted to use them to their full potential.

Evaluating E-procurement Options

To bridge the gap separating it from its vendors, and to fully exploit its investment in SAP, PDO investigated the available e-procurement solutions. It identified and evaluated five solutions—Bolero, iX2, Singapore TradeNet, Tejari, and Trade-Ranger (see Figure 3).

Figure 3: E-procurement options evaluated by PDO

E-procurement solution	Description
Bolero	Bolero, a digital document exchange (DDE), was originally set up in 1998 by the international banking community. Created as a neutral third-party exchange, Bolero developed standards to enable global cross-enterprise business integration, particularly in banking and finance.
iX2 by Oman TradaNet (OTN)	iX2, also a DDE, was developed by OTN, a local startup e-procurement company in Oman. iX2 was designed with simple yet easy-to-implement functionality that was based on the PDO model.
Singapore TradeNet	Established in 1989, Singapore TradeNet provides electronic trading in the form of structured messages between network subscribers in Electronic Data Interchange (EDI) format. This electronic messaging service was previously known as Singapore Network Services. The trading community uses TradeNet to submit documents electronically to government bodies that, when approved, are returned electronically to the sender. The system uses the mailbox concept, sorting and directing mail into the relevant mailbox.
Tejari	Tejari is the Middle East's first business-to-business (B2B) online marketplace that allows companies to buy and sell goods and services online. Established in 2000, Tejari supports e-procurement through cataloging, e-tendering, and reverse auctions.
Trade-Ranger	Trade-Ranger, a joint initiative between some of the leading energy and petrochemical companies, was launched in July 2000. Founding members included BP, Dow Chemical, Royal Dutch/Shell, and Total. Set up as an e-procurement marketplace serving the oil and gas, and chemical industries, its main features are the standardization of procurement and catalog processes, and global membership. Trade-Ranger was acquired by cc-hubwoo in May 2005 and was transformed from a consortium privately held by customers to an independent e-procurement hub.

These solutions reflected different e-procurement approaches and included two of the three widely recognized e-procurement business models.¹²

E-procurement business model #1: An independent marketplace. Bolero,¹³ iX2 by OTN,¹⁴ Tejari,¹⁵ and Singapore TradeNet¹⁶ are all independent marketplaces. The main advantage of such a marketplace is its neutrality—all participants, both buyers and vendors, have equal influence on the development of the exchange. For such a marketplace to be sustainable, it must cater to the essential needs of the majority of its participants.

E-procurement business model #2: A trading consortium of organizations in the same line of business. Trade-Ranger¹⁷ is an example of this e-procurement business model.

E-procurement business model #3: A private marketplace. PDO did not shortlist any solutions in this category because it considered them to be high risk, especially since the company had just finished its SAP implementation. Tension was high among the employees who were learning how to work with SAP. Furthermore, senior management would not have been receptive to further heavy investment in IT, especially because the timing coincided with the aftermath of the dot com bust.

PDO Selected iX2 from OTN

Selecting the e-procurement solution took six months. PDO regarded both iX2 and Tejari as plausible solutions but decided that iX2 was the best option, primarily because of its simplicity. iX2 had simple and easy-to-implement functionality that was geared to the exchange of information between PDO buyers

and the company's vendors. For PDO, the key iX2 functionally was support for:

- PDF file format
- Trace and track by both buyer and vendor
- XML standards
- SMS text messaging.

Of these four, Tejari supported only XML. Furthermore, iX2 had one single point of entry—the Internet, which made it universally accessible. In addition, the price model was easily understood by all PDO's stakeholders as only the sender pays.

OTN provided two areas of differentiation over the other possible solutions. The first was strategic influence, which meant PDO could work collaboratively with OTN to enhance iX2 to suit its own supply-chain goals. The second was support. OTN would not only provide the technical solution for managing transactions electronically but would also facilitate the adoption of iX2 by the vendor community. Both of these areas provided satisfactory answers to the key question PDO kept raising when evaluating e-procurement solutions: "What's in it for the vendors?"

PDO had two main concerns about Tejari. First, was the cost. Joining the exchange would involve considerable upfront investment by each participant in the form of an annual subscription fee. Participants would also have to invest significant amounts in developing catalogue item entries. Given that most of PDO's vendors were SMBs, adoption risk was quite high. A one-person business would likely not be able to afford these costs. Second, PDO was concerned about the level of skills and experience participants would need. SMBs were at the low end of the IT maturity scale. While many had computers, these were used mainly for office applications such as word processing and spreadsheets, and, at that time, some did not have Internet access (e-mail). Getting vendors involved with Tejari would not be easy and might be impossible, given the level of effort needed to develop e-catalogues and keep them up to date.

Bolero was rejected because, although it was established as an independent marketplace, its main focus was on paperless trading for the banking and logistics industries. Also, from PDO's perspective, Bolero had two technological limitations—lack of support for SMS text messaging and for the pdf file format needed for sending RFQs and purchase orders.

Singapore TradeNet's focus on moving documents was attractive to PDO, but the company saw the EDI

12 For definitions of these three E-procurement business models, see Bakos, J. Y. "A Strategic Analysis of Electronic Marketplaces," *MIS Quarterly* (15:3), 1991, pp. 295-310; Wise, R., and Morrison, D. "Beyond the Exchange: The Future of B2B," *Harvard Business Review* (78:6), 2000, pp. 86-96; and Day, G. S., Fein, A. J. and Ruppertsberger, G. "Shakeouts in Digital Markets: Lessons from B2B Exchanges," *California Management Review* (45:2), 2003, pp. 131-150.

13 For information on Bolero, see "Bolero Home Page," Bolero, 2006. Retrieved June 2006 from <http://www.bolero.net/>.

14 For information on iX2, see "OTN: Digital Information Exchange," Oman TradaNet LLC, 2004. Retrieved June 2005 from <http://www.ixnet.com.om/>.

15 For information on Tejari, see "Tejari: Middle East Online Marketplace," Tejari, 2006. Retrieved March 2006 from <http://www.tejari.com/English>.

16 For information on TradeNet, see "TradeNet: The One-Stop E-Platform for Trade Declaration," TradeNet, 2004. Retrieved June 2006 from http://www.tradenet.gov.sg/trdnet/index_home.jsp.

17 Trade-Ranger was acquired by cc-hubwoo in 2004. For information on cc-hubwoo, see "cc-hubwoo Business Streamlined" cc-hubwoo, 2005. Retrieved June 2006 from <http://www.trade-ranger.com/>.

platform as a major obstacle for adoption by local vendors.¹⁸ As a proprietary technology, EDI was costly, requiring significant upfront investment, not only in the technology but also for standardization and training.

Initially, Trade-Ranger seemed to be a viable solution because it was aimed at businesses similar to PDO. Its key limitation, though, was that buyers and vendors needed to make substantial investment. Each would have to pay a registration fee based on company size, a yearly membership fee, and a charge for each document sent or received. Participants would also be charged for the Trade-Ranger software needed to operate the e-marketplace. Other limitations of Trade-Ranger were:

- It was too sophisticated for vendor use, particularly local vendors
- It did not support widely used standards for moving documents (e.g., Raw Data Interchange [RDI] files¹⁹)
- It focused mainly on goods, not goods and services.

Supply-Chain Integration with iX2

Once PDO had decided that iX2 was its preferred e-procurement solution, it then took a further six months to get approval from PDO's executives responsible for procurement policies, mainly because e-procurement would require changes in internal business procedures. Before e-procurement, for example, the RFQ process required several supervisory signatures but none are needed with e-procurement. Responsibility is now delegated to PDO's buyers. Within six months of approval being given, PDO—in collaboration with OTN—had electronically linked some 3,000 vendors, mostly SMBs, via the iX2 Web-based software. PDO now requires all its vendors to be registered with OTN.

iX2's charging structure. Vendors do not pay upfront charges to sign up, and in the iX2 charging structure, PDO pays for all outgoing communications to vendors as it would when sending faxes, e-mails or post. Thus vendors receive and read all incoming communications for free. They are charged only if they decide to respond with quotations. Payments are made

through the OTN exchange using OTN credits that can be purchased by vendors in the same way “pre-pay” mobile phone cards are purchased. These credits simplify the payment process for PDO and eliminate the cash-flow problems associated with invoicing for OTN.

iX2's E-procurement process. PDO and its vendors use iX2 to transmit five types of documents: RFQs, quotations, purchase orders, service entries, and smart invoices. Apart from service entry documents (implemented in March 2006), all document types were available from the start. Other e-documents, such as notifications, reminders, and acknowledgments, are not counted by OTN as separate documents, so they incur no charges. Purchase orders, service entries and smart invoices are structured documents that vendors cannot change, while RFQs are semi-structured. Vendors complete the specified fields in the RFQ before they submit their quotations through iX2.

Figure 4 depicts the iX2-based E-procurement process. An RFQ sent by PDO through the exchange is accessible by all vendors. Vendors' replies, sent via iX2, can be either a notice of no-bid or submission of quotation details. iX2 sends text update messages (e.g., that a new RFQ has been issued) to the mobile phones of vendors that do not own a PC or don't have a permanent Internet connection. These vendors can then use an Internet café or any OTN office to log-in to iX2 and access a digital copy of the RFQ free of charge.

Quotation details are held securely in the system until the bid due date, when they are released to the issuing PDO buyer. This process removes the possibility of fraud, because the current lowest bid cannot be transmitted to other vendors so that they can re-bid at a lower price.

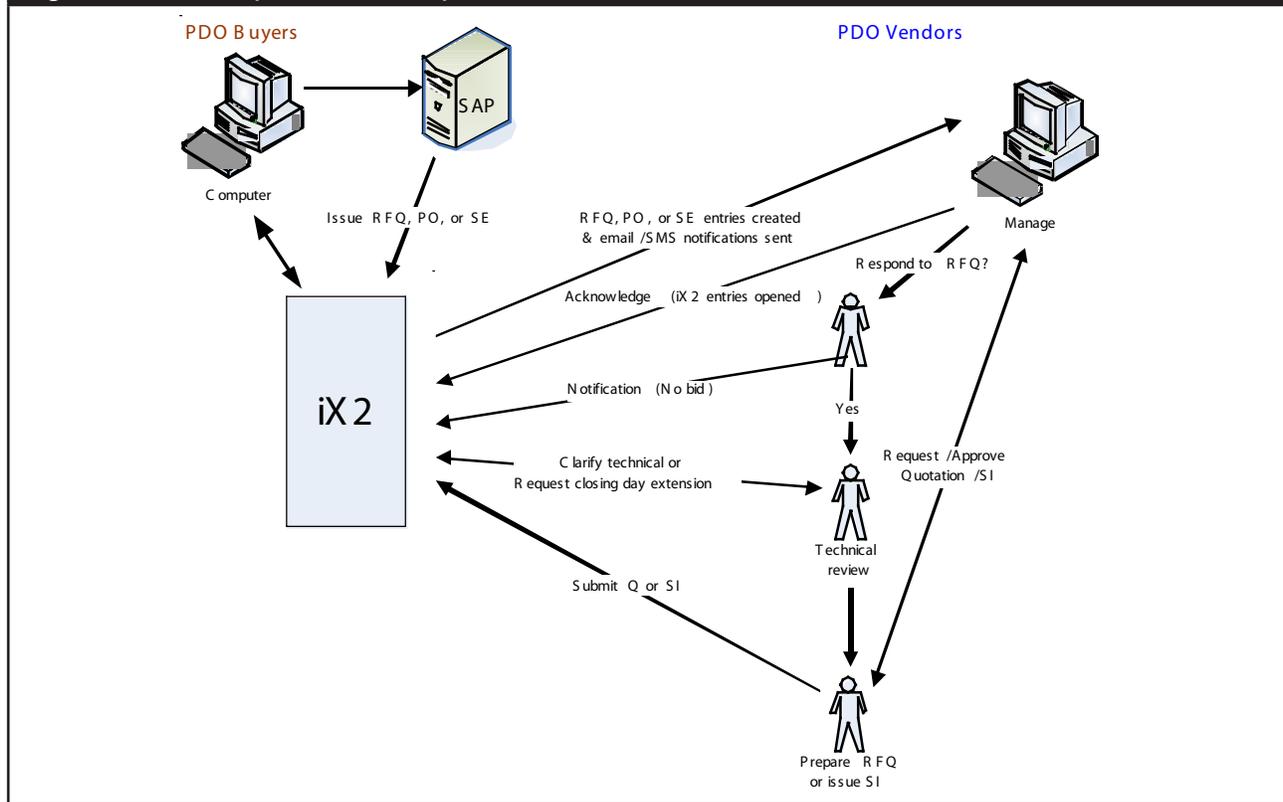
The PDO buyer analyzes all the quotations and issues a purchase order to the winning bidder through iX2. When the order has been completed, the vendor sends PDO a “job completed” notice together with the price from the purchase order. PDO then confirms this notice and sends a service entry document to the vendor through iX2. The vendor then issues a smart invoice to PDO through iX2.

Managing the vendor community. To facilitate adoption by vendors, PDO outsourced the management of the vendor community to OTN. Free ongoing training sessions were offered to vendors. OTN continuously verifies vendors' contact details and checks no-response bids. Many vendors in

18 For information on EDI's unsuitability to SMBs, see Christiaanse, E. “Performance Benefits Through Integration Hubs,” *Communications of the ACM* (48:4), 2005, pp. 95-100.

19 The Raw Data Interchange (RDI) format is used to send data without any formatting. This data is then mapped into the respective form on the exchange (i.e., RFQ, purchase order, or service entry). The advantage of sending data in this format is that it cannot be read or understood if intercepted by a third party.

Figure 4: PDO's procurement process with iX2



Oman and the other GCC countries register with the large oil companies even if they are not interested in bidding for their business. Being registered and having approved-vendor certificates gives them credibility and provides an advantage when they bid for business elsewhere. As a result, many of PDO's registered vendors were not active—they had never responded to RFQs. Additionally, some vendors were incorrectly classified by PDO, so they were sent irrelevant RFQs. These dormant and wrongly coded vendors were an administrative and cost burden to PDO, but these inefficiencies were gradually eliminated once OTN took over the ongoing process of verifying vendor details and checking no-reply bids.

System implementation timeline. Figure 5 summarizes the timeline for implementing the SAP and iX2 systems. PDO also uses two other major systems for its e-procurement activities. The first is the Public Open Tendering (POT)²⁰ system, also operated by OTN, which was implemented in November 2004. The second is the reverse auction system provided by FreeMarkets Ariba²¹, used since February 2002.

20 For information on POT, see "PDO: Online Public Tendering System" Oman TradaNet LLC, 2004. Retrieved June, 2006 from <http://www.pdotenders.com>.

21 The reverse auction solution PDO has been using since 2002 was known as FreeMarkets before the merger with Ariba in 2004. For

E-PROCUREMENT BENEFITS

The main benefit of using an electronic marketplace is the cost reduction resulting from huge gains in procurement efficiencies. The purchasing business, in particular, benefits from reduced search and product costs. Vendors benefit from reduced communications costs.

E-procurement Benefits for PDO, the Buyer

PDO has gained substantial benefits from using the OTN exchange for procurement. As Figure 6 shows, the cost per purchase order decreased from US\$103 in the pre-SAP era to US\$18, while the transaction cost for sending an RFQ decreased from US\$3 to approximately US\$1.50 (see Figure 7).

Figure 8 describes the other e-procurement benefits gained by PDO and relates them to the six supply-chain strategic themes identified in the feasibility study.²²

information on Ariba, see "Ariba Spend Management" Ariba Inc., 2006. Retrieved June 2006 from <http://www.ariba.com>.

22 For a comprehensive review of E-procurement benefits, see: Bakos, J. Y. "A Strategic Analysis of Electronic Marketplaces" *MIS Quarterly* (15:3), 1991, pp. 295-310; Hsiao, R. -L., and Teo, T. S. H. "Delivering on the Promise of E-procurement" *MIS Quarterly Executive*

Figure 5: Timeline for implementing main PDO systems

Month/Year	Event
1997	Start of SAP feasibility study
October 1999	Decision to adopt SAP
February 2000	SAP design team kickoff meeting; members later became part of the SAP implementation team
January 2002	Initial SAP system went live
February 2002	FreeMarkets, an online reverse auction system, was implemented
January 2003	SAP Business Warehouse went live
July 2003	iX2 went live with four electronic documents: RFQs, quotations, purchase orders, and service entry
November 2004	Public Open Tendering (POT) went live
March 2006	iX2's fifth electronic document, smart invoice went live

Figure 6: Cost comparison of standard procurement processes

	Old System (2001)	SAP (2002)	iX2 (2003)
Purchase order	US\$103	US\$43	US\$18
RFQ¹	US\$309 (3x\$103)	US\$129 (3x\$43)	US\$54 (3x\$18)
Invoice²	US\$34	Not available	US\$12.50

¹ Three competitive quotations are required.

² The figure of US\$34 is based on the benchmark in the Aberdeen Group, Invoice Reconciliation and Payment Benchmark Report, June 2004.

Note: Details of service entry transaction costs are not available.

Figure 7: Cost comparison of standard RFQ transactions

	Media			
	Hardcopy	Fax	E-mail	iX2 ¹
RFQ unit cost	US\$3	US\$2.67 (OMR1.025)	US\$1.63 (OMR0.625)	US\$1.43 (OMR0.550)

¹ iX2 price includes outsourced vendor management; price quoted as of June 2006.

Note: Omani Riyal (OMR) = US\$2.60078 (Source: <http://www.x-rates.com/d/OMR/table.html>, June 10, 2006)

E-Procurement Benefits For PDO's SMB Vendors

SMB vendors benefited in four main ways from PDO's e-procurement initiative.

1. Timely and relevant information. Many SMBs are under-resourced and hence tend to focus on operational rather than administrative tasks. Their employees are out and about doing the job rather than in the office. Sending RFQ notifications to their mobile phones helped PDO increase the bid response rate and

also helped SMBs identify opportunities they would have otherwise missed. PDO also uses iX2 to send SMS notifications to vendors to inform them about extensions of time or breakdowns in Internet services.

2. Confidentiality of bids. With iX2, SMBs are guaranteed that their bid information is stored securely until bid closing time. In the past, vendors frequently submitted their bids "just in time," either in sealed envelopes or by fax. Many suspected that early bids would be communicated to other vendors, who would take advantage of this information and lower their bids. With iX2, vendors can submit early knowing that their bids will be secure. This security enables them to better manage their submissions and submit early,

(4:3), 2005, pp. 343-360; and Minahan, T. "The E-procurement Benchmark Report: Less Hype, More Results," *Aberdeen Group*, 2004. Retrieved January 2006 from http://www.aberdeen.com/summary/report/benchmark/eProcurement122904b_TM.asp.

Figure 8: Procurement benefits realized by PDO

Benefit type	Supply-chain strategic themes	Application to PDO
Reduced costs	Process simplification, standardization, and automation	Substantial cost reductions in both transaction and procurement process management costs.
Enabling the buyer to locate vendors that better match needs	Standardization and automation	Because vendor details were often not updated, PDO buyers frequently sent irrelevant RFQs to vendors. Now that OTN is keeping vendor information up to date and verifying the categories each vendor is capable of handling, PDO is more effective in reaching qualified vendors.
Reducing requisition-to-order time cycles for both buyers and vendors	Automation and process simplification	Two examples of how cycle time has been reduced for both parties are vendors' instant access to RFQs once they are posted and the elimination of signatures that were previously needed by PDO buyers to issue RFQs.
Extending and/or consolidating the vendor base	Process visibility and automation	PDO used OTN to consolidate its vendor base. Many vendors had registered with PDO only to get credibility when applying for jobs elsewhere. OTN's handling of the vendor relationship helped PDO to identify no-response vendors and verify vendor data. This reduced the number of active vendors by around 30%. Furthermore, PDO used the POT system to extend its vendor base. No pre-qualifications are required by vendors, who can now download all tender-related documents directly from the portal without the need to visit PDO physically.
Increasing process visibility across the supply chain	Process visibility and process simplification	An interesting example of process visibility arose when a flood of old purchase orders was generated after an SAP upgrade. OTN identified this problem after noticing the abnormal traffic and informed PDO before vendors noticed the problem. Working closely with OTN, PDO was able to inform vendors of the problem early enough to avoid any negative publicity. PDO later found out that this was not an isolated incident; many other companies upgrading SAP experienced the same problem. Unfortunately, few of them had sufficient visibility in their supply-chain processes to be aware of it.
Increasing spend visibility	Process visibility	Spend visibility is improved through better vendor profiling, procurement decision auditing, and spend analysis. This type of benefit is limited, maybe because iX2 did not have the cataloguing capability hence did not provide a drill-down feature into spend categories.
Enhancing relationships between buyers and vendors	Workforce competency	By outsourcing vendor relationship management to OTN, PDO's buyers kept their focus on the core process of procurement. OTN deals with all other vendor-related enquiries, especially those related to using iX2 and no-response bids.
Enhancing corporate governance	Financial transparency and process visibility	E-procurement helped PDO reduce off-contract "maverick" spending, thus increasing compliance with its strict purchasing policies. Since all submitted quotations held in iX2 are not released until the bid-due date, vendors don't have to wait until the last minute to submit bids to protect their details from competitors.
Increasing professionalism through the adoption of best practices	Financial transparency, process visibility, and workforce competency	There is an increased level of accountability both for PDO's buyers and for vendors as the whole procurement process is configurable and traceable by both parties. A buyer chooses not only the vendors s/he sends the RFQ to but also the employee responsible for the specific type of purchase. The vendor can either manage received RFQs centrally by one person who opens all RFQs and delegates them to different divisions, or can configure iX2 to send all RFQs directly to the appropriate division.

Figure 9: Common barriers to successfully implementing e-procurement for SMBs

Category	Barrier
Economic	Little benefit to vendors
	Vendors' concerns about costs
	Vendors' fear of competitive bidding because of its adverse effect on price
	Insufficient internal resources to support e-procurement
Operational	Vendors' concerns about required changes in work processes
	Lack of skilled personnel, particularly when the vendor is required to populate, update, and monitor electronic product catalogues
Environmental	Ineffective public infrastructure
	Restrictive or lack of regulations from domestic governments
	Differences in language, culture, and legal systems
Technological	Low or different levels of IT maturity among vendors
	Lack of technical and data exchange standards
	Lack of supporting IT infrastructure
	Vendors' concerns about the security of e-procurement transactions
Relational	Lack of trust between buyer and vendor
	Vendors' skepticism of motives behind supply-chain management practices
	Lack of buyer influence on vendors

rather than run the risk of missing the deadline because of a telecommunications problem (for faxes) or a traffic accident (delaying the delivery of an envelope).

3. Better administration of communications with PDO. All of a vendor's communications with PDO now go through iX2. The system gives instant feedback on both active and inactive RFQs. It also allows vendors to update their contact details.

4. Visibility to other buyers and ability to take on the role of buyer. Each iX2 member has access to all other members. Unless vendors request that their details be hidden, any iX2 member can take on the role of buyer and send RFQs to other members. Furthermore, every large buyer that joins the iX2 exchange will create new opportunities for existing members to expand their business.

SIGNIFICANCE OF IX2 AND LESSONS LEARNED

The iX2 exchange targets a "re-formed"²³ market, which means it supports an existing business by

23 A re-formed market is one where "technology does not change the basic structure, functioning, and purpose of the market. Instead, these markets form around technologies that enable cost reductions or improvement to existing ways of doing business." For more information on classification and problems of B2B electronic exchanges, see Day, G. S., Fein, A. J., and Ruppertsberger, G. "Shakeouts in Digital Markets:

providing considerable opportunities for improving efficiency. However, four inherent obstacles dissuade adoption of this type of market:

- Users are not always receptive to change.
- Considerable constraints slow down the exchange's ability to capture value.
- There is no first-mover advantage.
- Non-traditional pricing structures are not acceptable.

A strong degree of collaboration between the solution provider and its key members is necessary to sustain²⁴ this type of market. The collaboration between OTN and PDO proved to be a significant factor in the successful implementation of iX2 because OTN created value for PDO by packaging the exchange solution with the vendor-support process.

PDO overcame the common barriers to implementing e-procurement with SMB vendors. Recent studies of successes and failures of electronic exchanges have found that value accumulates by combining the management of e-transactions with managing part of the e-procurement process.²⁵ By

Lessons from B2B Exchanges," *California Management Review* (45:2), 2003, pp. 131-150.

24 Sustainability is reported as one of the direct causes of failures of electronic exchanges (ibid.).

25 Wise, R., and Morrison, D. "Beyond the Exchange: The Future of B2B," *Harvard Business Review* (78:6), 2000, pp. 86-96.

working closely with OTN, PDO overcame common barriers to the successful implementation of B2B electronic exchanges that include SMBs (these barriers are listed in Figure 9).

Economic barriers are related to increases in operational costs or decreases in product or service prices resulting from using e-procurement. *Operational* barriers are related to the need for improvements in vendor organizational capabilities that must be addressed in order to adopt e-procurement; some of these may require changes in existing work processes. *Environmental* barriers arise from the external systems, both formal and informal, that govern business operations—poor business and IT infrastructure, differences in legal systems, culture, language, and regulatory gaps all fall into this category. *Technological* barriers are rooted in weak technological capabilities of vendors and their concerns about the security of exchanging data electronically. *Relational* barriers stem from a buyer having a lack of trust in or influence on vendors. Concerns about the underlying motivation of the large buyer could also hinder SMB vendors from participating in an e-procurement system.

The main lessons from this case focus on how the collaboration between PDO and OTN helped to overcome these barriers and provide insights into the strategies large buying organizations can use to overcome them²⁶.

Lesson #1: Address Vendors' Negative Perceptions of Competitive Bidding

The failure of E-procurement initiatives is often attributed to vendors' concerns about the imposition of competitive bidding that does not take into account established procurement practices. Recently, the buyer-vendor relationship has started to play a major role in purchasing decisions. Factors other than price, such as time, quality, and service, are considered important. In Oman, vendors are most concerned about getting a fair chance when bidding and are fearful of "dirty tricks." In 2005, Oman's Corruption Perception Index

26 For extensive discussions of E-procurement barriers, see: Angeles, R., and Nath, R. "Business-to-Business E-procurement: Success Factors and Challenges to Implementation," *Supply Chain Management* (12:2), 2007, pp. 104; Hempel, P. S., and Kwong, Y. K. "B2B E-Commerce in Emerging Economies: I-Metal.Com's Non-Ferrous Metals Exchange in China" *Journal of Strategic Information Systems* (10:4), 2001, pp. 335-355; Stockdale, R., and Standing, C. "Benefits and Barriers of Electronic Marketplace Participation: An SME Perspective" *Journal of Enterprise Information Management* (17:4), 2004, pp. 301-311; and Tan, J., Tyler, K., and Manica, A. "Business-to-Business Adoption of Ecommerce in China" *Information & Management* (44:3), 2007, pp. 332-351.

was 6.2²⁷ and it was in the top 20% of the least-corrupt countries. (This index ranges from 0 [highly corrupt] to 10 [highly clean].) While Oman's rating is good, it is far from ideal and suggests there is some dishonesty, which, if not controlled, could disadvantage vendors.

To ensure fair play, PDO and other governmental organizations in Oman are under continuous government scrutiny to ensure strict compliance with purchasing guidelines, particularly concerning transparency. iX2 facilitated the enforcement of these guidelines to the benefit of both PDO and its vendors. PDO can ensure it remains compliant and vendors are promised guaranteed competitive bidding. PDO's buyers cannot see the bids until bid closing time. Bidders can therefore be certain that a PDO insider cannot pass on their bid information to competitors.

Lesson #2: Share The Benefits with Vendors

Studies have shown that a major cause of E-procurement failures is that these systems provide little benefit to vendors. SMB vendors invest substantial amounts of time and resources to use an electronic exchange. If they do not gain benefits to justify their investment, they will not have the incentive to continue using the system, especially during the early stages of adoption. Lack of perceived benefits will likely cause vendors to find workarounds and excuses to override the system and revert to old practices.

The PDO case study shows how benefits to vendors were a major consideration right from the start. These benefits include more relevant RFQs, improved administrative practices, on-time updates, and fair play.

The process of registering vendors in the exchange helped to create more accurate vendor lists, as many old entries were duplicates, inconsistent, or incorrect. The data-cleansing and updating process not only increased the efficiency of PDO's operations but also benefited vendors because they now receive only relevant RFQs. RFQs are not only delivered to companies specializing in the sale of items sought but are also directed to the relevant person or department. In the past, PDO's buyers reported numerous instances of poor vendor matching—for example, where catering companies were sent RFQs for the supply of pumps.

²⁷ For further details on this index, see Transparency International "Corruption Perceptions Index" Transparency International, 2005. Retrieved June 2006 from http://www.transparency.org/policy_research/surveys_indices/cpi/2005.

Vendors now have a single point of access and an archival record of all their dealings with PDO. This is especially useful for tracking previous contacts with PDO. SMBs can analyze historic information to identify bids won and lost, and larger vendors can identify the personnel managing bids for the purpose of performance evaluation or feedback.

Vendors now receive timely reminders from PDO about newly released RFQs, as well as changes to current RFQs (e.g., changes in specifications or bid closing dates). This information is delivered both through the iX2 Web interface and as SMS text messages to mobile phones. Since many of the vendors' personnel are out and about, duplicating communications improves reliability.

Lesson #3: Make the System Simple, Easily Accessible, and Familiar

Some E-procurement initiatives fail because the business model is too complex. This can happen if the companies running an exchange fail to create a distinct offering because they did not put enough time and effort into evaluating users' priorities. The main strength of OTN's exchange offering is that it is simple, easily accessible, and familiar. Although iX2 automated only about 20% of PDO's procurement processes, these processes deliver 80% of the value of e-procurement to PDO's vendors. Information supporting the automated processes is easily accessible, both through the iX2 Web portal and as SMS messages. iX2 also incorporated many aspects of the manual business processes, which made the system familiar to vendors. To achieve this familiarity, OTN carefully studied PDO's needs and tailored iX2 to address both its technology and business process needs.

Lesson #4: When Public Infrastructure Is Not Effective, Focus On Service and Substitute One Technology With Another

Telecommunications in Oman, as in other GCC countries, is regulated by the government. Currently, fixed-line and Internet services are provided by Omantel, which is state controlled. There are no plans for liberalizing these markets in the near future. In contrast, mobile services are provided by two companies—Oman Mobile (controlled by Omantel) and Nawras (controlled by Qatar Telecom).

Some researchers have noted that a regulated telecommunications environment with little competition will hinder the successful implementation of e-procurement.²⁸ PDO's buyers and OTN staff mentioned many instances of interrupted Internet connectivity at bid closing times. However, through OTN's scrupulous monitoring of iX2 service levels and continued communications with PDO's buyers, this problem has been overcome by extending closing dates and informing all vendors.

Although the level of Internet service in Oman may be inadequate, mobile phone service is not. A critical success factor for iX2 has been the use of SMS messages to reach vendors anywhere and anytime.

PDO HAS SUCCESSFULLY EXTENDED E-PROCUREMENT TO SMB VENDORS

PDO's e-procurement solution—OTN's iX2—has been operating successfully since July 2003. Tailoring the solution to SMB vendors' needs was key to enabling PDO to leverage its investment in SAP and become more effective and efficient in handling procurement activities. Advances in Internet-based B2B solutions to manage procurement have mainly targeted large businesses, leaving SMBs with little or no opportunity to get "a bite of the cherry." But PDO's e-procurement solution enables SMBs to receive up-to-date and relevant communications from buyers, streamline both their internal and external business processes, receive unbiased evaluations from buyers, extend their reach, and capitalize on their local knowledge. Doing business with PDO via iX2 has helped SMBs to reduce their costs and increase their revenues.

Governments of many countries in the Gulf region direct companies to keep as much business as possible local, and larger businesses are often rewarded when they purchase locally. PDO's success in forging electronic links with local SMB vendors is a key step toward complying with such a directive. Oman has greatly benefited from being a testing ground for e-procurement in the region. PDO has proven that e-procurement can work very well with local SMBs. Similar solutions based on regional exchanges in Egypt, Qatar, and the United Arab Emirates are now getting under way.

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²⁸ Hsiao, R. -L., and Teo, T. S. H. "Delivering on the Promise of E-procurement," *MIS Quarterly Executive* (4:3), 2005, pp. 343-360.