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A web-based architecture for implementing electronic procurement in military organisations

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Abstract

In recent years, the vital development of the Internet offers increasing opportunity for electronic commerce. E-commerce attracts much attention from enterprises, not only to get connection with others and make a profit from their product/service, but also to reduce the costs of internal and external operational procedures. Procurement is a very critical task because it is a matter not only of making a profit, but also of staying in business in a highly competitive environment. In the government sector, procurement is sometimes the source of corruption, scandal and abuse of public resources. Besides inadequately qualified personnel, "transparency" of the procurement environment becomes another source of problems in procurement procedure. This paper investigates a case study of e-commerce in the Taiwanese military organization by diagnosing and preventing procurement faults, constructing a transparent procurement environment, and enhancing military procurement efficiency, and is an attempt to establish an e-market environment via web-based architecture on e-procurement procedure. The design of a relational database is introduced and system implementation is presented. Also, efficiency and benefits of the proposed system are discussed.

Keywords: Electronic commerce; Electronic procurement; Military organization procurement; Web-based architecture; Digital government

1. Introduction

To maintain the national defense, the government of Taiwan spends a large amount every year to acquire new weapons and military materials. For example, military procurement funding reached US$2.5 billion in the year 2000 (National Defense Report, 2000). In order to avoid corrupt practices, procurement must be conducted by operational procedures (Government Procurement Law, 1998). However, on December 6, 1993, the death of a Naval colonel exposed not only a US$2.5 billion Lafayette-class frigate procurement scandal, but also turned an originally simple procurement case into an internationally complicated political incident, which revealed serious problems in military procurement in Taiwan. Thereafter, the military in Taiwan has taken a series of reform measures, including the reorganization of its procurement system and organization, educational training for buyers, and the amendment of procurement regulations.

In recent years, use of the Internet and e-commerce has subverted the traditional way of running business, thoroughly changed the channel of enterprise transactions and influenced the majority of enterprises (Shaw et al., 1997). Technology performance has shortened transaction time and lowered costs, enabling enterprises and individuals to possess the capabilities to quickly react the change in global business development (Zhang, 2000). E-commerce uses communication networks to share enterprise information, maintain enterprise relations, and conduct enterprise transactions (Zwass, 1996), and is a modern way for enterprises to satisfy the needs of customers to increase the qualities of products and services so as to expedite delivery service flows. Meanwhile, e-commerce plays the role of a medium to convert digital input into value-added output (Kalakota and Whinston, 1997). Therefore, commodity and service activities performed by means of electronic communication are commonly regarded as e-commerce (NIST,

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1999), which can be divided into five areas: enterprise resource planning, global e-commerce architecture, supply chain management, channel linkage, and customer relationship management. The supply chain comprises product sources, product information collection, procurement flow management, supplier management and account payable management.

From the standpoint of economics, information technology (IT) can be applied to integrate two value-added activities; one is the Electronic Market and the other is the Electronic Hierarchy (Malone et al., 1989). The so-called electronic market provides buyers and sellers with a multi-organizational information system to exchange price and product information (Bakos, 1990) Through an electronic market, buyers and suppliers have less reliance on brokers and have more opportunities to choose their potential partners or to cut costs during the process of selecting products (Malone et al., 1989). An e-market can also help customers to reduce the cost of acquiring the price and product information they need and choosing different suppliers, and also to reduce the cost of conveying product characteristics and price information to customers. An e-market changes enterprise organizations, and its development increases its effect on the structure of organizations (Strader and Shaw, 1997). In pursuit of potential interests, enterprises will progressively develop from the integration of the minority Internet and inter-organizational exploitation to the limited selective local integration, and then to the full local integration (Poon, 1997). Currently, some research papers concerning the application of e-market instances into governments and enterprises have been issued (Heezen and Baets, 1996; Zimmermann, 1997; Goh and Lau, 1998; Leidner, 1999; Määttä and Pesonen, 2000; Zhang, 2000).

As procurements by military organizations proceed, the popularity of e-commerce has provided new ways of structuring that process. In the past, procurements by military organizations in Taiwan were conducted by clerical operations, which, due to the shortage of qualified personnel or the lack of legal and moral restrictions, were subject to irrational individual bias factors. Therefore, human deficiencies and faults easily led to corrupt practices. This paper investigates the problems with the current military procurement operations and proposes solutions to these problems. First, this research presents documents from 1993 to 1998 concerning the reclamation and impeachment proposed by Control Yuan against the military procurement scandals of the Ministry of National Defense (MND). These data are analyzed and the problems are classified. Then, in that light, current military procurement procedures are discussed so as to seek problems in military procurement operations and put forward the architecture of the digital procurement procedures. Second, the theory of e-commerce is implemented into the military procurement operations, and an e-commerce Business-to-Business (B to B) model, together with a web-based architecture, are integrated to build an e-procurement system for procurement procedure. The e-procurement system is expected to provide an effective e-market environment and more channels for military procurement, to streamline military procurement procedures, make the bidding more transparent, and reduce the cost of procurement transactions and military material acquisition. By doing so, efficiency in procurement could be increased and corrupt practices could be decreased. Finally, related knowledge concluded from this paper is presented for discussion and conclusion.

2. Military procurement in Taiwan

2.1. Hierarchy of the military procurement organizations

The procurement bureau of the MND, charged with the authority for military procurement in Taiwan, has seven subordinate first-class military organizations including the HQs of the Army, the Navy, the Air force, the Logistics, the Military Police, the Coastal Patrol and the Chung-Shan Institute of Science and Technology (Fig. 1). Each of them has its own procurement department in charge of their own procurement affairs. The amount of the procurement budget determines what military organizations are in charge of the procurement works. Currently, any procurement transaction more than US$1 million is charged to the procurement bureau of the MND, while those less than US$1 million are charged to the MND's subordinate first-class military organizations. This paper is directed at the procurement operations conducted by the MND.

2.2. The military procurement operational procedures

In Taiwan, both the MND and its subordinate first-class organizations divide the procurement job into three phases (Fig. 2): project procurement, invitation for bids

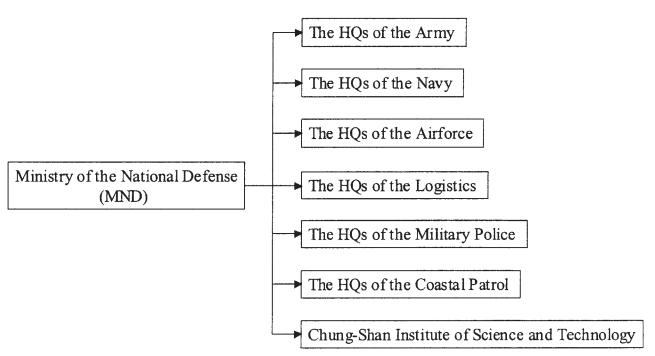

Fig. 1. Hierarchy of the military procurement organizations.

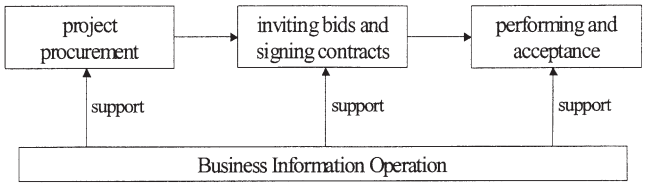

Fig. 2. Flowchart of the procurement operation.

to get with contracts signing, as well as performing and acceptance. Project procurement refers to the job flow from project formulation to project resolution and approval. Invitation for bids means the process from the approval of procurement projects to awarding a bid and signing a contract. Performing and acceptance refer to the process of performing contracts to delivery acceptance and to the end of the transaction. All of the three phases must interact with the procurement market. During the process of procurement procedures, the buyers have frequent contacts with the sellers, and, therefore, improper interests easily arise and corrupt practices easily occur, especially during the bidding process. Accordingly, this paper investigates the bid-invitation procurement operation flow.

In order to show the military procurement problems, a flowchart (Fig. 3) listing the process of inviting bids and signing contracts conducted by the military organizations is depicted. (Integrated Program Office of Control Yuan, 1999). The operational steps are detailed as follows:

Step 1: The organization in charge of inviting bids and signing a contract will formulate bidding documents based on the content of the approved procurement projects.
Step 2: The organization in charge of inviting bids and signing a contract will publish the bidding notice on the Internet, gateways and the government procurement bulletin for makers and distributors.

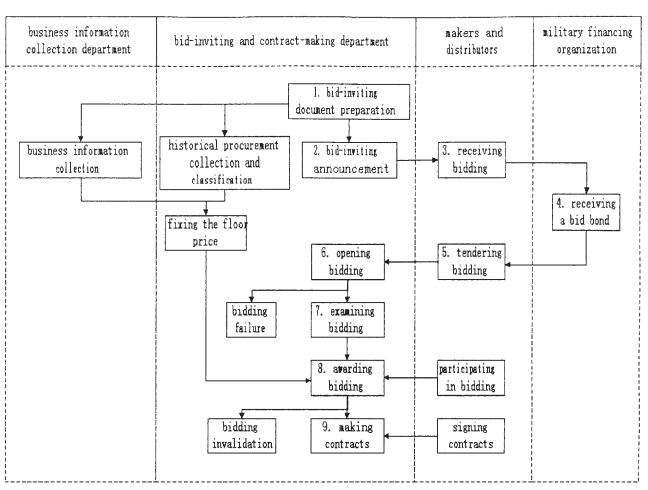

Fig. 3. The procedure of conducting bids and contracts in military organizations.

Step 3: Based on the announcement, customers who wish to tender a bid may go to the procurement organizations to obtain the bidding forms.
Step 4: Customers who wish to tender a bid must go to the designated financing organizations to pay the earnest money before bidding deadlines, and present the invoices to the procurement organizations for the examination.
Step 5: Customers must deliver official bidding documents before the deadlines.
Step 6: When bids are opened, the bid-inviting organization will examine the bidders. The legal number of bidders must be reached; if not, then the bidding is invalid, and if it does, the bidding examination will be conducted.
Step 7: The bid-inviting organization and all other related organizations will examine the content of the documents provided by the bidders to see if they are qualified.
Step 8: When the examination is finished, the chairman and supervisors will perform price comparisons. If the floor rate comes to two or more bidders, the winner goes to the bidder who offers the lowest price. If no bidders give the floor rate, on-the-scene reduced-rate action will be taken, and the winner will go to the bidder who first gives the floor rate and the lowest price. The reduced-rate action will be taken three times, and the bidding will be revoked if no bidder reaches floor price. The floor rate is decided based on the information of the historical procurement records and markets.
Step 9: The bid-awarding result must be made public, and contract signing must be completed within the legally prescribed period.

2.3. Military procurement items

Military procurement items are divided into two main categories: military and non-military materials. The MND classifies military materials into ten items, including food and feed, secondary equipment of the formation and assignment table, fuel and petroleum, construction materials, personal utilities, ammunitions, the main equipment of the equips and assignment table, medical material, parts and other military materials. The Executive Yuan in Taiwan classifies the non-military materials into fifteen items (Public Construction committee of the Executive Yuan, 2000), including electronics and engineering, architecture, journals and maps, sports and entertainment, music and films, chemicals, public facilities, hardware and tools, medical supplies, transportation, labor and service, public construction, computer products, office and school appliances and others (Fig. 4). In addition, due to its specialized field and complexity, the acquisition of important military material, such as new weapons, is conducted by special units of military organizations.

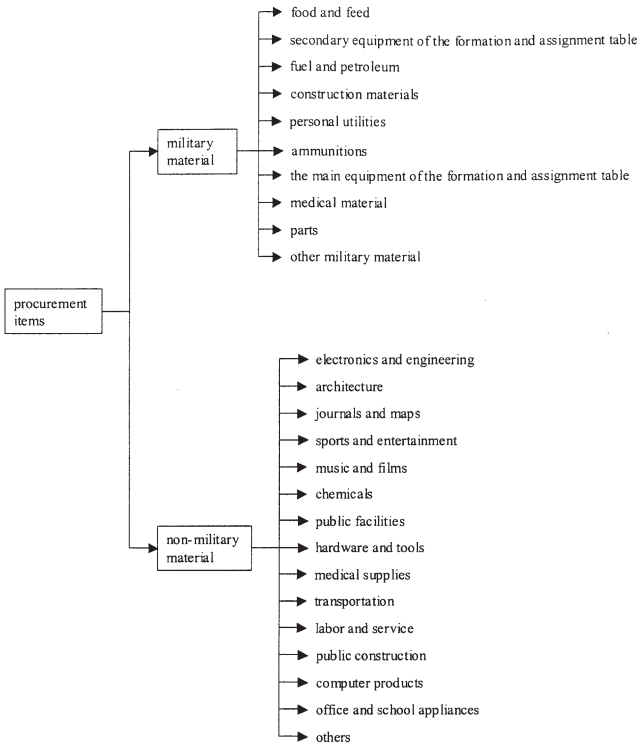

Fig. 4. Military procurement items.

2.4. The essence of military procurement problems

In the above-mentioned procurement procedures, corrupt practices were often observed, which has led the Control Yuan to impeachment and claims against military procurement and engineering faults, and the Audit Department has come up with some suggestions and improvements to the MND. According to statistics, from 1993 to 1998 the Control Yuan proposed 7 impeachments and 18 reclaim cases. In addition, the Audit Department proposed 16 improvement suggestion cases. A total of 293 people had been reprimanded, among whom 276 were admonished, 1 relegated, 2 half-paid, 3 degraded and 11 removed from their offices for prosecution. The errors are detailed in the following Table (Table 1) (Integrated Program Office of Control Yuan, 1999):

In addition, this paper analyzes the faults of the military procurement and procurement procedures, as shown in Table 2. Comparing the faults of the three phases shows that the faults in the project procurement phase reaches up to 74 (35.24%), inviting bids and signing contracts 86 (40.95%), performing contracts and acceptance 50 (23.81%), among which inviting bids accounts for the highest percentage of procurement faults of military organizations in Taiwan.

Accordingly, this paper, based on the Business-to-Business model, investigates the possibility of implementing e-commerce into the procedures of military organizations for electronic procurement, and developing a web-based architecture to build an e-procurement system for inviting bids and signing contracts. The e-procurement system with the e-market environment is expected to extend from domestic markets to international markets, making the military procurement procedures easier and bid-invitation operations more clear thus reducing cost, enhancing procurement efficiency, and reducing corrupt practices.

2.5. Design of the electronic procurement procedure

This paper examines the current bid-invitation and contract-signing flow (Fig. 3) in combination with the government regulations to design electronic procurement operational procedures for military organizations (Fig. 5), in order to bring the whole procedure into the electronic environment. In Fig. 5, thin-line frames refer to operations that must be conducted by personnel; thick-line frames mean operations that can be implemented via e-environment; and single-line-ellipse frames deal with the operation-needed information acquired by e-procedures, while their operational processes are handled by means of clerical operation. Arrow-symbol diagrams refer to the designated direction of the work procedures. The e-procurement procedure are illustrated as follows:

Step 1: A bid-invitation organization converts a procurement project transmitted by the bidding organizations into an electronic bid-invitation document.
Step 2: A bid-invitation organization sends an e-invitation-bid document to the e-procurement system for makers and distributors.
Step 2a~2b: After passing the online authentication of the certificate management organizations, makers and distributors enter an e-procurement system to browse the bid-invitation announcement.
Step 3: Makers and distributors who wish to submit a bid may download an e-invitation-bid form.
Step 4: Makers and distributors who wish to submit a bid can pay earnest money by means of an e-transfer.
Step 5: Makers and distributors send electronic bid-inviting document via the Internet before the deadline to complete the bid-invitation operation.
Step 6: During the bid-opening period, bid-invitation organizations download relevant information from the database of makers and distributors and examine the bidders. If the legal number of bidders is not reached, the bidding is invalid. If the legal number of bidders is reached, then the bids are examined.
Step 7: Bid-invitation organizations and other related organizations download electronic bid-inviting documents provided by makers and distributors, and examine the content to make sure they are consistent with the original bid-invitation document, which will be used as the basis of participation.

Table 1
Statistics of errors in military procurement from 1993 to 1998

Items	Year 1993	1994	1995	1996	1997	1998	sum (personnel/times)
Improper project	4	11	5	6	17	1	44
Untrue floor price	1	2	2	1	3	1	10
Giving out contracts illegally	1	3	9	2	8	2	25
Improper alter and surcharge	6	10	2	8	19	3	48
leakage	1	1	1		2	2	7
Taking bribery and receiving	3	2	2		2	2	11
Illegally profiting some companies	1	1	4		4	2	12
Unhealthy system	1	2	1	1	3		8
Half-baked supervision	8	12	10	5	8	2	45
Sum (personnel/times)	26	44	36	23	66	15	210

Table 2
Statistics of faults of military organizations on procurement procedure

Fault phases Items	Project procurement	Inviting & making bidding	Performing contracts and acceptance	Total
Improper project	44			44
Untrue floor price		10		10
Giving out contracts illegally		25		25
Improper alter and surcharge	26	4	18	48
leakage		7		7
Taking bribery and reception		10	1	11
Illegally profiting some companies		11	1	12
Unhealthy system		5	3	8
Half-baked supervision	4	14	27	45
Sum (personnel/times)	74	86	50	210

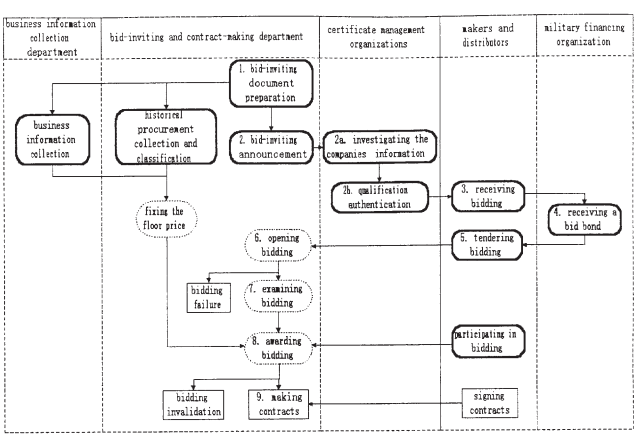

Fig. 5. The electronic procurement procedure.

Step 8: Bid-invitation key persons and supervisors examine valid bidding forms to conduct price comparisons, and those who give the floor price will win the bidding. If two or more makers and distributors offer the floor price, the one who offers the lowest price wins the bidding. An online bidding competition will be conducted when an opening price fails to reach the floor price, and the principle of the price competition is similar to that of the original operational procedures. The business information and historical procurement data regarding the decision of the floor price can be obtained via an e-procurement system.

Step 9: After awarding a bid, the results must be made public and contract signing must be completed within the legally prescribed period.

2.6. Benefits of e-procurement procedure

Comparing Fig. 3 with Fig. 5, the six benefits of the new e-procurement procedures are as follows:

1. The current flow is performed using paper while the new flow is performed via the e-procurement operations.
2. Although the current bid-inviting announcement provides makers and distributors with the latest procurement information via the Internet, the announcement delivers simple procurement data, and if makers and distributors want to get a bidding form, they still must get it on their own. Using the new e-procurement operation, the detailed procurement data will be

posted online for makers and distributors to consult and download immediately, thus simplifying the process.

3. The current operational procedure requires makers and distributors to prepare relevant documents for bid-invitation organizations in order to investigate if they are qualified. Using the e-procurement operations, a new certificate-issuing organization is established in which makers and distributors can be certified. Bid-invitation organizations can, therefore, examine the qualification of the makers and distributors from the database of the certifying organizations; the certifying organizations should be held by an equitable third party to avoid disputes.
4. Currently, makers and distributors must personally go the military financing organizations to pay the earnest money, but with the help of the e-procurement operation system, paying earnest money can be done by means of funds transfer.
5. The current operational procedure requires bidders to deliver or mail related documents to bid-invitation organizations, when, using e-procurement operation, it can be implemented via the Internet.
6. Currently, makers and distributors wanting to join on-the-scene price competition must go to bid-inviting organizations before the deadline, whereas through e-procurement operation, a virtual market is provided for makers and distributors to participate in online bidding, and they can conduct online price competition.

3. The system process

The system process shown in Fig. 6 is based on a web-based database architecture whose users can be divided into two groups: one, the military procurement organizations, and the other, makers and distributors who wish to tender a bid. By means of a password control mechanism, users with different positions have different access authorities. When procurement organizations want to carry out procurement works, they can search for previous similar cases by checking an index. In addition, related products on the market and procurement document samples are also available. Buyers can use the above three pieces of information for reference and can choose a way for new procurement based on its real demand.

As a new procurement is implemented, makers and distributors can take part in tendering a bid, and a new procurement case will generate new information and users' opinions different from previous ones. When a procurement case is completed, the procurement organization will see it as a case study being stored in the system database to accumulate new knowledge and experience. In addition, makers and distributors may provide the latest product information in real-time via this system, enabling this system database to constantly provide the latest information for procurement organizations.

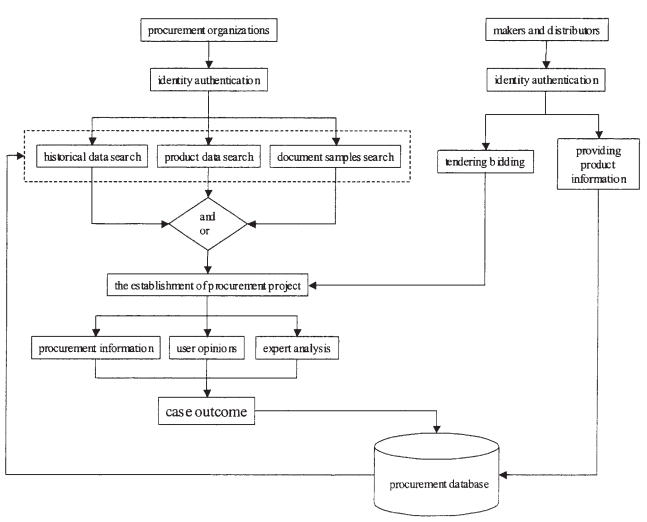

Fig. 6. The process of electronic procurement system.

4. System architecture

4.1. Database

Based on the electronic procurement system process (Fig. 6), the system architecture is designed and established as in Fig. 7. The system database is made up of the following four sub-databases.

The first is the users' database containing basic infor-

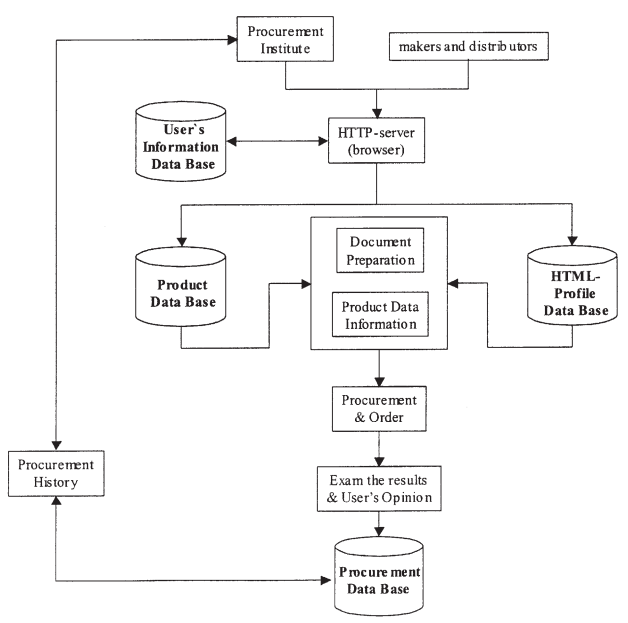

Fig. 7. The architecture of electronic procurement system.

mation regarding procurement organizations and makers and distributors, such as name, address, commander-in-chief, contact point, telephone number, invoice number, service items and so forth. On top of these, there is system management information including account number, password, and access authorities. The second is product database in which there are product names, types, number and specifications. Products can be divided into two groups according to Fig. 2: 10 categories of military material and 15 categories of non-military material.

Third is the HTML-format database in which there are various procurement document samples, including inviting, tendering bids, contracts, financial contracts, labor service contracts, bid-inviting instructions, price-making lists for inviting bids, records for opening bids and so forth.

Fourth is the procurement database — a single case database based on "a typical single case that basically contains three parts: problem, solution and result". (Kolodner, 1993). The single case statement in this research is stated according to Table 3, in which the name, specifications and quantity of the purchase items are a single case problem. Raw-data downloading, which offers users detailed information of bid inviting documents and contracts, is a single case solution. User opinion, investigating records from supervising organizations, and opinions from purchase experts are the single case results. In addition, the procurement case number and name, procurement organizations, completion date for individual phases, and purchase items are offered for users reference.

The proposed use of the index is to reduce search time in the database, simplifying the acquisition of a single case (Watson and Marir, 1995). Case number, case date, procurement name and specifications in this paper are used as the index content.

4.2. Users' functions

System users can be divided into two groups: one, military procurement units, and makers and distributors who wish to tender bids. These two groups can link up to the HTTP server of this system via the Internet, and can browse related information stored in the database. The access rights of users can be decided by matching

Table 3
Description of procurement case

Case number: HH89013P013 Case name: Information equip. purchase case Procurement unit: National Defense Management College Procurement method: Bid-inviting announcement Company winning bids: HuanXeang information Co. Ltd.					
Bulletin date: 1999/8/30	Deadline: 1999/9/23		Opening-bid date: 1999/9/23		
Awarding bid date: 1999/9/23	Contract date: 1999/9/30		Delivery date: 1999/10/30		
Acceptance date: 1999/10/30	Guarantee duration: 2000/10/30				
Product name	Product	Specifications	Quantity	Unit price	Users' opinion
PC	Celeron 667MHz PC100 64MB SDRAM 20GB Hard drive 1.44MB FDD; 50X CD-ROM 56Kbps Fax/Modem, 10/100Ethernet built-in '97 PCI interface and 16-bit Sound Blaster compatible card, operating system Microsoft Windows Me		10	25000	64MB RAM capacity too low, affecting the operational speed.
Laser Printer	A3 size, 16 pages/minutes. Fine mode 1200×1200 dpi; manual paper slot 100 sheet, multi-slot 250 sheet, toner 5,000 sheet capacity		1	30000	
Color ink jet printer	Monochrome: 9 pages per min.; color: 7.5 pages per min.; monochrome: max. 600dpi , 27,000 colors , 2400dpi print mode; A4/Letter/Legal/A5/Executive; 4MB RAM. IEEE- 1284 compatible parallel, USB general sequence ports.		3	5000	Price of inkjet too high.
Records from the supervision units: Inadequate business survey information. Acceptance method without listing system connection testing, imperfect testing method.					
Opinions from purchase experts: This is a general computer procurement case, so joint supply contract method may be adopted to meet prescription.					
Raw materials downloading					

their account number and password stored in the database.

When a procurement organization wants to conduct a procurement case, it can communicate with the system via the user interface by searching for similar cases in the procurement database in terms of referencing historical case data. As users need to search for related knowledge, the system index can find historical case data and users from the case database. Through this process, related knowledge can be produced for users, then products which customers want to purchase can be selected from the product database; finally, proper document samples can be obtained form the HTML document database. Buyers can integrate the above-mentioned three pieces of information to create a new procurement case, based on the actual procurement requirements, referring to historical reference or integrating relevant business information.

A procurement case is officially established when a new procurement case is transmitted to the database; meanwhile, the system will automatically implement the procurement case. Following the establishment of a procurement case, buyers, via the user interface, can open, examine, award bids and sign contracts, and at the same time the system will update and implement the latest purchase data. Meanwhile, makers and distributors, through the user interface, can enter this system to browse bid-invitation announcements, to obtain bidding forms, to tender a bid and participate in bidding. In addition, supervising and auditing organizations can enter the system to investigate the whole state of the procurement case.

When a procurement case is closed, all its data becomes historical, and can be used as a new single case. A single case itself is a form of knowledge because people usually use previous knowledge as solutions to problems. Thus, data is processed in codified knowledge format, and knowledge then can be handled by means of a single case. When the existing problem is solved, some difference is produced, which indicates that solving a problem brings about new knowledge, and a new problem-solving method will be stored in the case database by case index. As there are more problems solved, there will be more cases in the case database, which indicates that the system has more power to solve problems and more knowledge in military procurement.

In addition, when the procurement case is closed, acceptance is completed and users in military organizations employ the military material, then buyers and users conduct an overall assessment and examination of the whole transaction. Therefore, users' assessment opinions are generated, which will be stored in the database and used as assessing services and product qualities provided by makers and distributors who award the bidding. The knowledge and experience of makers and distributors who award the bidding can help other procurement organizations to refer to information regarding good or bad companies, and also increase knowledge and experience in the procurement database.

5. System implementation

5.1. Design of system database

The database is a relational database, which, based on the system architecture (Fig. 7) of the electronic procurement system, can be divided into six data tables of the procurement organizations: companies, product type, electronic catalog, procurement requirement, procurement host file and procurement detail form. The relational databases are shown as Fig. 8. The user database consists of both procurement organization and company data tables. The product database is made up of product type and electronic catalog data tables. The procurement database consists of procurement requirement, procurement host file, and procurement details form data tables. In addition, the HTML document database includes only six document samples of inviting and tendering bids, contracts, financing contracts, labor service contracts, bid-tendering instructions, bid-tendering price sheet and opening-bid records. In view of the limited document samples and infrequent changes, the design is adopted using a file hyperlink.

5.2. The prototype system

This section presents the process of the prototype system based on the steps of the e-procurement system procedure (Fig. 6). After keying in the web page address, users may enter the portal site of the system (Fig. 9).

The system will separate different users into two major groups: "procurement organization" (left-hand-side hyperlink) and "makers and distributors" (right-hand-side hyperlink). The former allows procurement organizations to conduct bid-inviting and contract-signing tasks, and the latter is to assist companies in issuing electronic catalogs, tendering bids and participating in bidding.

5.2.1. Procurement organizations

Military procurement organizations may link to the web page of the password management of military procurement organizations. Users can enter the front page of the procurement organization (Fig. 10) only when they have acceptable organization designators and passwords.

Historical data inquiry: This web page allows users to search for information using five indexes, including procurement case number, procurement product name, specifications, model and procurement date (Fig. 11). If users are unsatisfied with the above-mentioned infor-

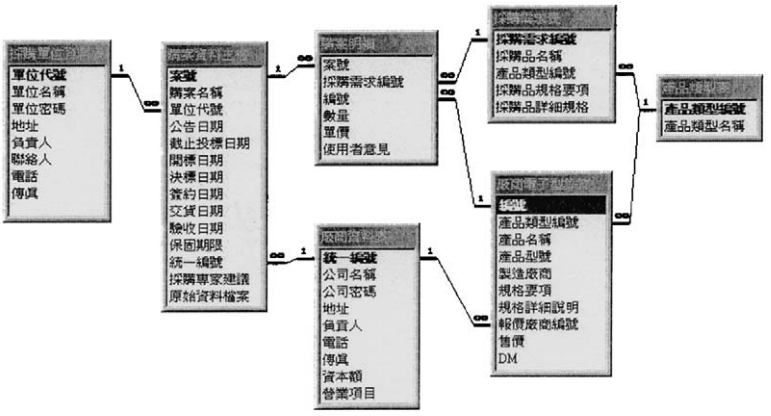

Fig. 8. Relational database of the data table.

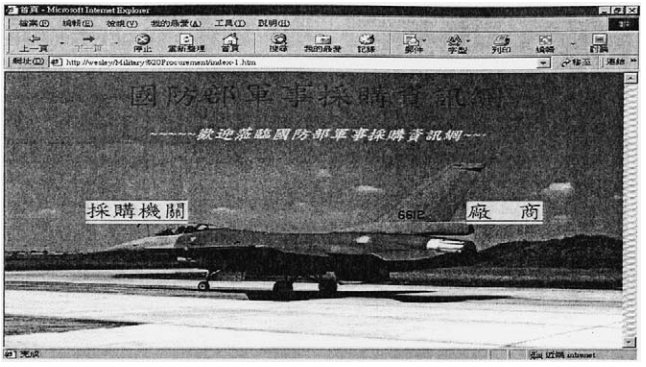

Fig. 9. The front page of the system.

Fig. 10. The front page of the procurement organization.

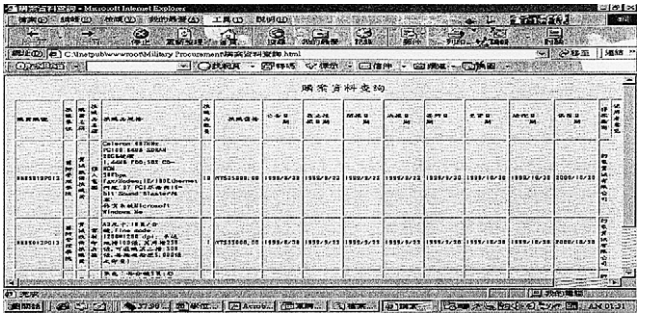

Fig. 11. The results of the procurement case inquiry.

mation, they can download the raw files of the case to get more information.

Business information inquiry: This web page provides users with related information, divided into 10 military materials and 15 non-military materials (Fig. 12).

Document sample: This web page provides document samples of inviting and tendering bids, contracts, financing contracts, labor service contracts, tendering-bid instructions, tendering-bid price sheet and opening-bid records. Users can browse this web page and download the document samples they want.

Bid-invitation operation: Buyers may input related messages of a new procurement case into this web page and upload a detailed bid-inviting document. Related information will be stored in the database immediately, and the procurement case will be published in the area of “procurement information announcement”, concluding the electronic bid-inviting process.

Awarding-bid operation: This web page offers two functions. The first is “downloading a bidding form by companies”, whereby procurement organizations can open the electronic mailbox dedicated to procurement cases to download bidders’ relevant information, through which the status of awarding bids can be known. If the bids fail to reach the floor price, it comes to the second function, “online price competition”, which provides a virtual chat room (Fig. 13) so that participating bids

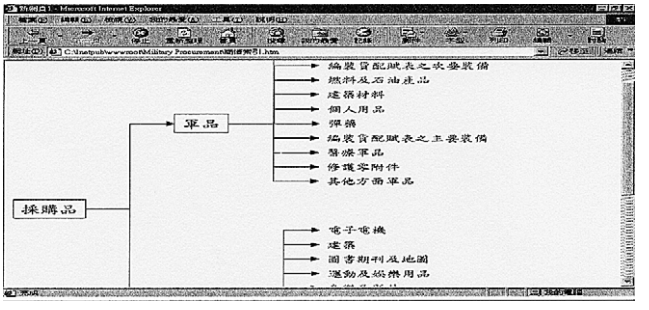

Fig. 12. The category of the business information inquiry.

Fig. 13. The frame of online price competition.

among bidders can be conducted, while abiding by the government procurement regulations.

Putting a closed case data into the database: This provides procurement organizations with a database in which related procurement information can be stored.

5.2.2. Makers and distributors

If users are the makers and distributors, they can connect to the log-in control frame from the front page. Users can log onto the area of makers and distributors (Fig. 14) only when they give the right designators and passwords to implement the procurement operations. The functions of the area of makers and distributors are explained as follows:

Addition and modification of electronic catalog: Clicking on the "addition and modification of electronic catalog" button, one may enter the web page of the appropriate web page, which offers both the functions of "adding to electronic catalog" and "modifying electronic catalog".

Procurement information announcement: This web page offers procurement case number, type and procurement date of three indexes to users so they can inquire about related announcement data (Fig. 15). If users want to participate in the bidding, they can enter the "bid-invitation message downloading" web page to download detailed information.

Bid-invitation operations: This area of the system will ask users for the procurement case number in which they want to participate. When the bid-invitation procurement case number is keyed in, the system will hyperlink to the dedicated electronic mail mailbox, and the bidders can send e-mail with electronic files attached to complete the bid invitation operation (Fig. 16).

Online participating in bids: The companies who wish to participate in a bid can participate in the bidding with other companies via the virtual negotiation room of the system (Fig. 17).

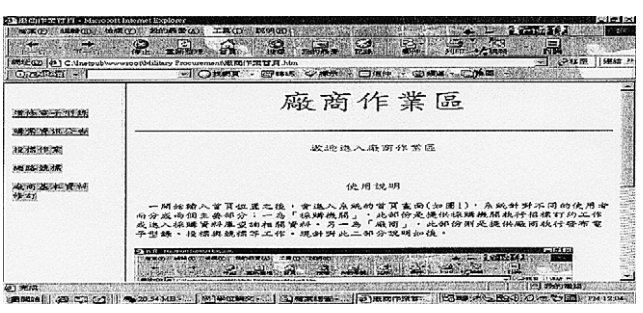

Fig. 14. The frame of makers and distributors.

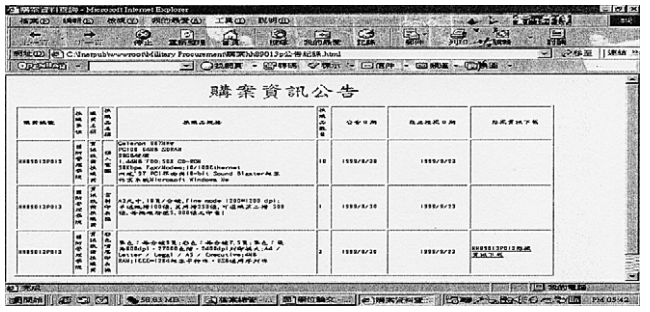

Fig. 15. The frame of procurement case announcement inquiry.

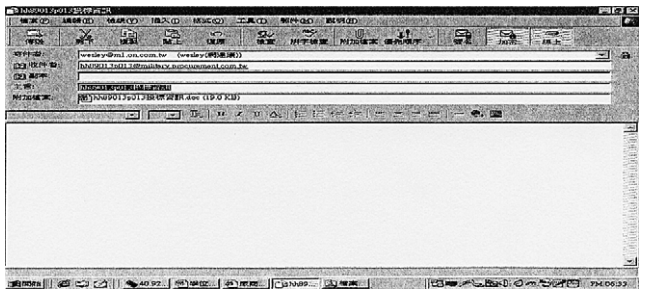

Fig. 16. Electronic mailbox for inviting and submitting a bid.

6. Discussion

6.1. Analysis and comparison of the system efficiency

(1) Certificate management organizations: Both buyers and sellers must conduct transactions online, so a third party is entrusted to conduct users' identity certi-

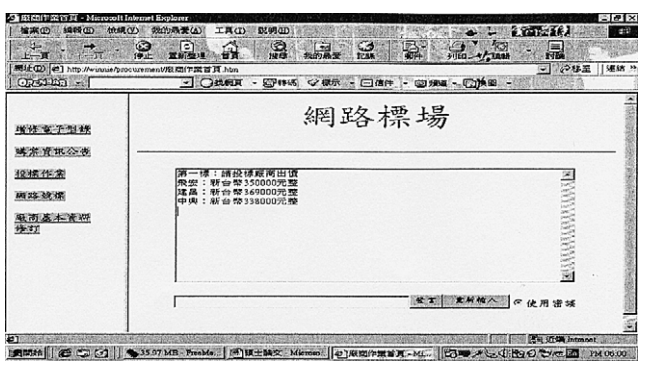

Fig. 17. The frame of the online participating-in-bids.

fication. Although certificate management is an additional circuit, in the original framework all companies must go to the procurement organizations to conduct pre-qualification, whereas in the electronic process, companies go to the certificate management organizations to conduct the certification only once. The latter bid-invitation operations can be implemented through the virtual electronic certification, which can enhance the operational efficiency of company pre-qualification among the bid-invitation and contract-making procedures, and restrict companies whose bid-inviting rights are suspended from continuing to tender a bid.

(2) Tightly coupled job flow: Comparing Fig. 4 with Fig. 5, it is found that new procurement flow has made the majority of the procurement job electronic. Among the non-electronic parts, except for the contract-signing item, all others are all involved with the job of bid-invitation and contract-making organizations. The electronic procurement flow can simplify the message-delivery process, which still relies on paper, making the job flow more smoothly.

(3) Procurement data management: The items and the amount of military procurement materials are complicated and large, so faced with such a challenge, buyers need both complete procurement knowledge and cumulative experience. As for the procurement operation of military organizations, different personnel will encounter different problems, processes, solutions, results and influence, which are all valuable knowledge for other military buyers. In the original procurement flow, historical bidding data are preserved on paper, making related data difficult to share and to search. However, using the electronic flow and the establishment of procurement knowledge database, relevant data can be systematically organized, accessed and controlled in a bid to effectively accumulate the procurement knowledge. In the future, military procurement organizations could establish Data Warehouses to effectively manage increasingly more procurement forms with different formats. On the other hand, the Department of Defense (DOD) could implement Data Mining to audit the procurement budget of military organizations on the Internet.

The e-market established in this paper is in an attempt to extend the sources of the military procurement makers and distributors via the Internet; that is, companies who wish to provide military material can conduct transactions via this system. Therefore, the circulation of business information will be faster and the degree of competition will be increased, which will cut the cost of the transaction of military procurement organization and military procurement cost. Meanwhile, due to the transparency of business information and the increasing number of companies accessible by the web, the possibility of rigging bidding may be decreased.

6.2. Analysis and comparison of the system benefits and military procurement faults

(1) Untrue floor price: In the original operational flow, the business information is collected and sorted out by business information organizations. However, their business information is not shared and historical data are difficult to find because they are not electronically managed, causing their business information to mismatch the current situation. The establishment of the product and procurement database can make the acquisition of historical data and the latest product data faster, more complete and more accurate.

(2) Improper alteration supplement: According to statistics of Table 2, the faults often shown in paper during the bid-inviting and contract-signing phase take place when items in the contract mismatch those in the bidding form. Through electronic data transmission, because only one document is stored in the database, the inconsistent operational faults can be improved.

(3) Improper procedures to give out contracts, information leaks, taking bribes and improper benefits for some companies: These four faults are related and often arise during the bid-inviting and contract-signing phase. This is because, in order to get inappropriate interests, buyers adopt abnormal procedures to benefit some companies or to divulge the floor price of a bidding to some companies in advance. In the electronic operational flow, all biddings must be conducted through standardized and fixed electronic procedures, which reduces the opportunity for human interference in bidding procedures. Using network transmission operation to fix the floor price can reduce the possibility of information leaks during the document delivery. In addition, the online bid-invitation environment provides companies with fair competition opportunities and reduces the opportunity for exorbitant profits, which will make it more difficult for companies to offer bribes and indirectly reduce the opportunity of the above-mentioned faults.

(4) Careless supervision: Using the e-procurement flow, all procurement cases can be consulted and reviewed so as to expedite supervising organizations to audit and investigate the process and progress of the procurement. Furthermore, the support of the procurement database enables the supervising organizations to quickly determine possible faults from similar procurement cases so as to avert the reoccurrence of the same problems, and further enhance their supervision abilities.

(5) Resource distribution: Any military procurement is a distribution of the national defense resources. This system embraces not only the functions of the e-market transaction environment and transaction records in databases, but also the auditing functions of the national defense budget for military procurements, the distribution of the national defense resources and the assist-

ance with the national defense budget arrangement and planning.

7. Conclusions

In recent years, the vital development of the Internet offers increasing opportunity for e-commerce. Currently, most clients of e-commerce are in the business model of B (Business) to C (Customers) or B (Business) to B (Business). These procurement cases among military organizations can also be considered B to B. In Taiwan, due to inadequate qualified personnel in the military organizations, lack of operational control mechanism and overall systematization tools, corrupt military procurement practices caused by human operational procedures have taken place. These not only waste the national defense resources, but also affect the establishment and maintenance of the military forces.

This paper investigates a case study of e-commerce in a military organization by diagnosing and preventing procurement faults, as well as enhancing military procurement efficiency, and is an attempt to establish the e-market environment via web-based architecture. Furthermore, the system, due to the limit of cash flow and certification functions, remains to be further developed. However, when it is well developed and put into action, it is expected to streamline the military procurement operational procedures, make the bid-invitation environment more transparent and open to public inspection, enhance procurement efficiency, save military procurement costs and reduce corrupt practices.

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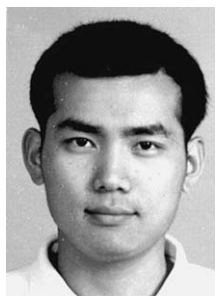

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