E-procurement and automatic identification: enhancing supply chain management in the healthcare industry

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Abstract: The concepts of automated e-procurement, or electronic B2B (business-to-business) trade, are grounded in the strategic leveraging of both tangible/intangible assets for successful implementation and execution of electronic trade, resulting in significant financial benefits for firms. Some of the major reasons for this growth include significant process savings from automation, compliance, and purchasing advantage; and reduced costs that organisations can experience by conducting transactions electronically. Although these are the basic benefits associated with generic e-commerce strategies, a majority of these B2B transactions have focused on the purchase of indirect materials (especially office products and travel services). In fact, more than 93% of medical supplies on hospital shelves appear to have universal product numbers on them – at least while still in their boxes and there is a great potential for huge savings in e-procurement in the healthcare field. However, other types of supply chain-related purchases, including maintenance, repair, and operating and replacement parts, and direct material purchases, are becoming more important operational management considerations. In addition, several other key considerations are: existing procurement strategy, the vendor, technology, suppliers, and total costs of ownership. Companies need to analyse their current procurement strategy before developing an e-procurement plan.

Keywords: electronic B2B trade; e-procurement strategies; Freemarkets.com; Resource-based View of the Firm; supply-chain management.

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1 Introduction: e-procurement and the health field

The healthcare procurement market is a major manufacturer/supplier factor in the equation to increase the profit possibilities by reducing costs in the $300 billion medical supply market. The widespread loss of manufacturing jobs since the tragic events of September 11, 2001 has concealed a significant shortage of highly skilled manufacturing employees. For example, this situation could undercut manufacturing competitiveness and weaken the US economy and weaken the productivity gains in the allied health field. This trend appears to be the result of converging factors, including demographic shifts, educational system failures and an outdated image of manufacturing tied to the negative stereotype of the assembly line[1]. In general, the allied health industry is increasingly looking for innovative techniques and creative management solutions to handle manufacturing/supplier processes in a competitive manner.

Strategic leveraging of e-procurement and Enterprise Resource Planning (ERP) has become a major target for such productivity gains, if properly integrated into existing systems. In 2001, North America occupied 66% of the ERP market, Europe took 22%, and the whole of Asia was 9%. As more and more companies strive to gain a competitive advantage, e-procurement and ERP implementation are the strategies of choice. Some organisations have experienced great success ranging from huge declines in inventory, breakthrough reductions in working capital, plentiful feedback on customer wants and needs, and the ability to view and manage the inner workings of suppliers, alliances, and customers. Still other large international firms have experienced very different effects of ERP implementation. Huge costs totaling over $10 million dollars have resulted from common projects associated with ERP. Some companies in their attempt to position themselves competitively have even found themselves in the midst of overall bankruptcy. The B2B (business-to-business) medical e-commerce and information industry that routinely leverages e-procurement techniques allows for interesting and mutually beneficial relationships between manufacturers and distributors supplying the domestic and international healthcare provider community. Automatic identification techniques and strategies have greatly influenced these beneficial relationships.

E-procurement firms use e-commerce tools that empower providers and suppliers to improve operational efficiency (which will be discussed in more detail later in this paper) and reduce supply costs in both provider-centric and supplier-neutral environments.

In terms of the pharmaceuticals industry, e-procurement typically allows for automated drug-inventory control, drug replenishment alerts, online purchase of drugs and related medical supplies, and reporting of existing stock levels in a clinic and/or hospital setting. For example, a Minnesota-based company, Embion (http://www.embion.com), automates the e-procurement process associated with its pharmaceuticals, medical/surgical supplies, office supplies and capital equipment, and generates reporting and analysis tools to help its customers optimise product pricing and utilisation. In addition, Embion employs more than 1,000 physician organisations, representing approximately 7,000 medical doctors, and offers a complete line of pharmaceuticals, medical supplies, capital equipment and office supplies through the corporate website to leverage e-procurement activities.

Croom (2001) suggested that major issues facing the implication of e-procurement systems deal with the following concerns: What are the current strategies relating to e-procurement and supply chain control; what are the implications for the management and structure of the supply base; its impact on distribution channels; and what are the major emphases on transactional systems versus data and information sharing systems for planning and control purposes? As noted by Goldstein (2000), e-procurement companies try to provide a wide range of products and services to healthcare organisations in a more cost-efficient manner and try to automate the purchasing process through internet technology and informational connectivity. The basic types of web-enabled exchange models to automate e-procurement processes are increasing in number and include products, services, auctions, and inventory management. In picking a web-enabled exchange model, it is important to understand that the purchasing and supply management needs and environmental constraints of physician practices are different from those of home health agencies and hospitals. 'Understanding the difference is vital to picking the right web-based procurement partners to automate your process and lower your costs' (Goldstein, 2000; p.30).

Although this paper does not attempt to answer all these concerns, it does attempt to provide insights to the automated aspects of e-procurement and some of the major strategic issues that the medical field faces in the implementation of e-procurement systems. The first major section deals with the need for developing strategies associated with automatic data identification and data capture (AIDC) techniques. This section is followed by a relatively detailed discussion of the strategic issues involved in implementing e-procurement and its intangible considerations through the Resource-based View of the Firm viewpoint. General conclusions with a suggested proposition to be empirically tested are also included.

2 Automated e-procurement in the medical field

2.1 Medical supply and information chains

Successful e-procurement strategies require implementation of automated e-procurement in medical supply and information value chains, which can be also done at any level in the medical field, both B2B and B2C (business-to-customer). For example, Personal Digital Assistants (PDA) and other mobile computers that can be held in the hand can provide a way to process and send information to caregivers in a very timely manner.

Healthcare applications of bar coding are developing at a rapid pace (Noble, 2000; Smith, 2003). Medical diagnostic products of blood analysis (Paul, 2001) can provide critical diagnostic information to healthcare professionals accurately and immediately. This can occur at the point of patient care, not weeks later. In addition, prescription writing and medication management programmes can help to decrease errors in prescription transcription, especially when there can be adverse effects due to errors. This also helps to control costs due to more accuracy of information.

All segments of the healthcare system are under pressure to conform to the widespread use of UPC (Uniform Product Codes) within their industry in terms of patient/supplier chain applications. Manufacturers/suppliers of medical/surgical and/or pharmaceutical products are also under increased pressure to apply UPC-compliant bar codes to their product. The application of bar codes can then be used throughout the supply chain, from the basic pull for raw materials right to the ultimate requirements of the patient. Hence, there must be a sustained and systematic approach for developing and implementing a UPC bar code labelling-programme within the healthcare industry. Strategies for increasing process efficiencies, improving quality, international labelling, and gaining label control are just a few of the many ramifications of healthcare applications of automatic identification and data capture technologies (AIDC). Such standardised applications are available in the market that specifically addresses coding and billing issues and this helps to alleviate the administrative load during the medical treatment process.

In general, e-procurement and AIDC-related systems integration as with any information technology system are composed of both hardware/software and personnel elements. The major elements of an automatic identification system include:

- physical object (the object or information to be processed)
- code (the type of symbology that identifies the major characteristic of the object or information to be coded)
- reader (the device that reads the code on the item and transmits that information)
- computer hardware (the device that receives the information from the keyless reader)
- software (the computer processing package(s) that organises the automatically read information into human-usable form)
- display/printer (device that displays the information read and can print reports as well as actual codes to be placed on the objects to be coded for keyless data entry),
- personnel (the human element that installs and manages the entire information flow scheme).

The major types of automatic identification can range from the relatively old technology of bar coding (Kern-Rugile, 1998) for keeping track of inventory to more high technology such as biometrics. The most common types of AIDC systems in use today include the following: bar coding, optical character recognition, magnetic stripe, voice data entry, radio frequency identification, smart cards, biometrics, and touch memory.

Bar coding technology is one of the earliest forms of AIDC technologies and has many useful applications in the allied health fields. Traditionally, bar coding technologies

have applications in ensuring accuracy and speed in time and attendance records, inventory control, document tracking, shipping and receiving, production control, and quality assurance, to name a few applications. 'There are about 225 known bar codes symbologies, but only a few – such as the UPC symbol on a cereal box or the maxicode symbol on United Parcel Service packages – are widely used' (Kern-Rugile, 1998; p.54). The potential for bar code use is evident in all aspects of transactions in human society, especially in e-procurement activities in the medical field. Bar codes are essential on every conceivable product, from machine parts to food items to tracking proper medication to patients. As with all types of automatic identification systems, bar codes are especially popular due totheir enormous savings in time and money, and guaranteed high levels of accuracy. Figures 1 through 2 illustrate common types of LAN (local area networks) and basic computer configurations associated with AIDC systems used in a variety of transactions. Figure 1, for example, illustrates typical wired LAN (local area networks) concepts for local and dedicated as well as network transmission connections found in most internet-based and AIDC-related systems. Bar code symbology basically refers to the bars and spaces encoded according to established rules for each bar code language. Essentially, symbologies are machine-readable or scannable and, thus, are examples of keyless data entry, through the use of a software wedge.

AIDC applications that were once only available on the mainframe are now as portable and accessible as a cellphone. This should improve revenues, reduce costs, and increase the likelihood of regulatory compliance – as the regulatory side of healthcare is going to get more complex in the future. This is important since it appears the bar codes are an essential component in the product identification and flow of goods and information in electronic commerce. This flow of goods and data through the supply chain and the management of this flow through electronic data interchange (EDI) systems are heavily regulated by governing agencies at the commercial and industrial levels, as illustrated by the works of the Uniform Code Council (UCC), in conjunction with its European counterpart (EAN), which provides standardisation and issues guidelines and company identification numbers. Table 1 presents common bar-code symbologies and associated applications in e-procurement activities. For example, Code 128 has many useful applications in the healthcare and related medical supply chain situations.

Table 1 Common symbologies for bar coding and industrial applications

UPC	Commercial, retailing
Code 39	Industrial, military, health
Interleaved 2 of 5	(ILF) shipping, distribution
Code 128	Distribution, healthcare
PDF 417	Portable data file was in medical records, product documentation
Data matrix	Component marking, hazardous materials
Maxicode	Shipping and distribution, high speed sorting

Figure 1 Typical wired LAN concepts for local and dedicated as well as network transmission connections found in most internet and AIDC-related systems

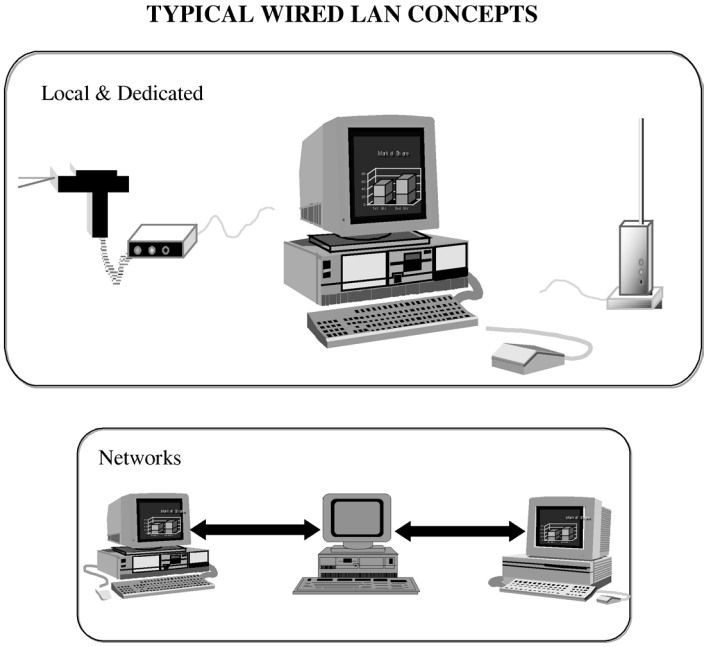
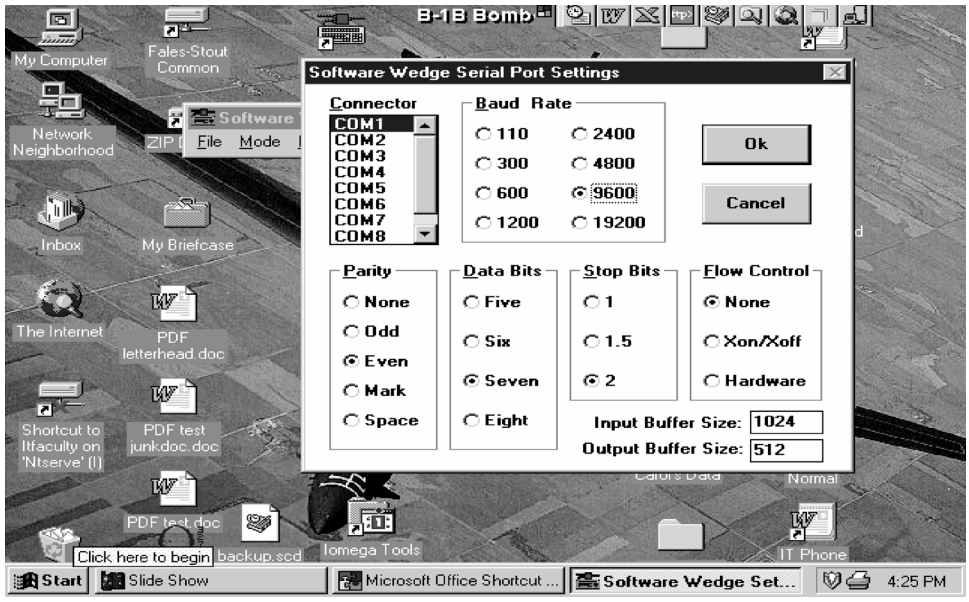


Figure 2 Typical wired setup for scanner (laser and radio frequency) and software wedge connections to a dedicated computer



3 Advantages associated with AIDC-related technologies in e-procurement

New developments are being implemented to improve customer responsiveness, via Customer Relationship Management (CRM), and increase efficiency by leveraging AIDC and e-procurement. Synapz, for example, has recently launched Eclipz, version 1.3, system^2. This system enables automotive suppliers to manage the flow of data between thousands of supplier companies. Allowing them to receive orders, confirm shipments, and send orders via the internet. Suppliers have the option of receiving e-mails when a customer firm sends e-mail for new orders. This means suppliers do not need to sign on to the internet several times a day. Companies now have the ability to print container bar-code labels for shipments. The label can include shipping notice information. This allows firms to simply scan the contents for the containers without opening them or opening up shipping forms. Efficient Healthcare Consumer Response, for example, found that $23 billion of the $83 billion-a-year healthcare purchasing market was spent on moving products from factory to hospital bedside, and $11 billion could be reduced immediately by adopting new technologies and standards such as UPNs. In fact, more than 93% of medical supplies on hospital shelves appear to have UPN on them – at least while still in their boxes and there is a great potential for huge savings in supply-chain in this sector (Becker, 2001). In addition to cost savings, computer security issues in healthcare institutions are especially sensitive to management of such IT applications.

Bristol Myers Squibb has adopted a machine-readable code called 'Snowflake', which consists of a pattern of dots that can be read using a machine vision system. Snowflake codes are reproduced using printed labels, laser etching, indenting, and hole punching (Woods, 1997). Bar coding technologies also allow companies to standardise much of the traditional supply chain activities. These applications allow companies to increase economies of scale and standardise global operations. For example, in early January 2001, Zebra Technologies (Hills, 2001), the worldwide leader in bar code printing solutions, offered to assist GM to develop label templates that can be used globally for routing all parts to and within GM plants. These labels are designed, using Zebra's expertise, to assure compliance with GMs shipping label standards. This new automatic identification system maximises the use of bar coding to streamline operations. This in turn allows these companies to improve productivity, reduce costs, and therefore increase profits.

In addition to other tangible benefits of AIDC technologies, bar coding allows companies to be more efficient in the operations side of the enterprise. It allows companies to update inventories in real time. For example, Toyota replaced a manual data entry tracking system with a system using portable bar printers and handheld wireless terminals. Before the system was implemented, it could take two weeks to enter data into a computer manually and during that time cars could not be moved. Now information can be immediately updated in real time and cars can be immediately moved. Also, the manual system was prone to error. The vehicle identification number (VIN) has 14 characters long and typically, Toyota processed 26,000 cars a year. Only missing one number on the VIN could possibly mean searching for that car for days. Bar code labels can include the time, date, and location of the scan, a five-digit tracking number, and information about the model, colour, and options. This information is automatically updated as the product is tracked. This information can be used for such functions as invoicing, loan information, and inventory control. It also allows the company to keep track of when any damage occurs to the product. Similar applications to allied health are

possible, once the medical staff becomes accustomed to leveraging the advantages of supply chain management (SCM) principles in an automated fashion. Yao and Carlson (Yao and Carlson, 1999) summarise nine areas where bar coding helps companies:

- communication systems can provide very detailed and accurate up-to-the-minute logistical information
- up-to-date screen reporting replaces batch printout reporting
- RF (Radio Frequency) terminals can be mounted on equipment and are highly portable
- information can be integrated for quality information service leading to increased profits
- standardised procedures make inventory operations easier to be managed, adjusted, and upgraded
- inspection data and quality control data can be added to the bar code labels for processing, analysing, and distributing in a matter of seconds
- management can collaborate with both suppliers and customers to make processes more efficient
- systems engineers and designers can assign grades to all tasks that involve people to make better relationships between management and labour
- the pipeline of information can be continuously studied, evaluated, and improved to effect continuous improvement in operations management

These applications can easily be extended to other industries under the general improvement of e-procurement activities. The next section deals with selected strategic considerations of e-procurement through operational effectiveness of SCM.

4 Selected SCM-related strategic considerations

4.1 Search for operational effectiveness: resource-based view (RBV) of the firm

According to Spens and Bask (2002), a major premise of SCM is that certain management components are common across intelligent business processes and SC (supply chain) members. These common components include physical and technical management, as well as managerial and behavioural components. However, all organisations that produce a product and/or service continuously strive for operational effectiveness. Porter (1996) described operational effectiveness as, 'Performing similar activities better than rivals perform them. Operational effectiveness includes but is not limited to efficiency' (p. 62). The development of internet and auto-identification technologies has created and enhanced B2B and its SCM/e-procurement systems. Despite economic setbacks, the B2B market is quickly growing into a major market andaccounted for 83% of online sales in 2002 and 88% by 2006 (Data summaries, 2002). More applications that require user authentication and transaction authorisations with a

very high level of security will especially continue to increase. The electronic trading and related manufacturing industries will probably emerge as major players in the immediate future in new product development and project team innovation. This is due in part to the increased web-enabled applications with similar security requirements that emerge as the volume of financial transactions conducted via the internet steadily increases. Hence, proper project management systems are needed to capitalise on this growing marketplace. Various market initiators, including buyers, suppliers, and third parties, are building e-marketplaces and participating in the electronic markets. The allied health field needs to become more fully engaged in this process. Unfortunately, despite their popularity and potential for extensive growth, many B2Bs are struggling to survive because they failed to attract enough participants that properly leverage electronic markets and AIDC technologies (Turban *et al.*, 2000; Whitaker, Stephens and Traham, 2001).

Hence, operational effectiveness is not limited to efficiency issues. It includes a myriad of strategic management areas such as inventory management, scheduling, human resource management, and SCM. A strategic concept that deserves merit in promoting the tangible/intangible bundle of strategic assets of a company is the Resource-Based View of the Firm (Michalisin, Smith and Kline, 1997; 2000). A firm's resources are the main determinant of competitive advantage and firm profitability, thus providing a foundation for the Resource-based View (RBV) of the firm. Under this concept, managers should be mainly concerned with selecting, acquiring and managing resources that are superior to the firm's competitors. Adherence to the principles of RBV leads into their primary assertions that there are at least four intangibles that qualify as strategic assets, and that empirical testing of strategic assets against performance 'will provide either supporting or failing to support the validity of RBVs main prescription' (Michalisin, Smith and Kline, 1997; p.389). The heart of the theory is that RBV focuses on strategic assets as intangible resources. SCM and e-procurement systems, especially in the medical field, can be defined as tangible or intangible, and are categorised as physical capital resources, human capital resources, and organisational capital resources. In order to be considered a strategic resource/asset, it must be simultaneously valuable, rare, imperfectly imitable, and non-substitutable. Since it is not always clear which resources of a firm are strategic assets, empirical testing can be difficult at best. E-procurement systems are more than just the physical components, but primarily function due to its intangible aspects. Capital (tangible) resources having physical properties would include property, plant, and equipment, which, although probably valuable, are not rare since they are readily available in the open market to anyone who has the means to purchase. Such tangible resources in SCM would also be imitable and substitutable, and therefore not strategic assets.

An intangible resource such as technology, although important to a firm's success, can quickly become obsolete or reengineered by competitors. Therefore, since it cannot provide a sustainable competitive advantage, it is also not considered a strategic asset. Although some technologies are protected by patents, trademarks, and copyrights, the concept of the idea is of strategic value rather than the product itself. However, other intangible resources as organisational culture, employee know-how, and social relationships, allow firms to exploit physical technologies in ways other firms cannot, and thus would not be imitable, satisfying the requirement to be a strategic asset.

RBV assumes that resources are asymmetrically distributed across firms having either a resource-based advantage or a resource-based disadvantage, and that those resources are immobile. RBV assumptions dispute those of the Industrial Organisation (I/O) Model

of Strategy and Porter's Five-force Model. 'According to the I/O Model, superior profitability comes from selecting attractive industries, one which have structural characteristics which suggest high profitability potential' (Michalisin, Smith and Kline, 1997; p.362). Porter's Five-force Model is a similar way to analyse industry attractiveness. The I/O model also assumes that resources are perfectly mobile and that once an attractive industry is identified, the firm can acquire all indispensable resources. 'Resources that are sources of sustainable competitive advantage and superior profits are called strategic assets' (Michalisin, Smith and Kline, 1997; p.362). These assets are non-substitutable and have no strategic equivalents. Readily available, perfect substitutes would clearly undermine the ability to generate another resource. However, perfect substitutes do not exist. If strategically equivalent substitutes did exist, but were rare, then the resource may still be of strategic importance. This is an important concept because by definition RBV is concerned with long-term performance and, thus, obtaining sustainable competitive advantage.

Michalisin, Smith, and Kline (2000; p.95–96) also performed a statistical study to test the validity of RBV constructs. The three hypotheses that were tested included: A favourable reputation will be positively associated with future performance; distinctive competencies will be positively associated with future firm performance; and organisational culture rich in attributes important to strategic competitiveness (perceptions of quality, perceptions of customer service, ability to manage change, ability to innovate, team-working ability, and participative management style), will be positively associated with future performance. The study used a qualitative-research method (content analysis) to analyse the textual data in annual reports to determine if important cultural attributes existed. The study measured as its dependent variable the relative return on shareholder's equity. The independent variables studied were reputation, employee know-how, and organisational culture. The four control variables that were also included in the study were relative prior years' performance, debt structure, organisational size and type. The results of this study strongly supported the RBV concept; with reputation and employee know-how positive having statistically-significant relationships with future firm performance. Interestingly, the negative relationship between attributes of organisational culture and firm performance probably 'indicates that the more a key organisational attribute is discussed in annual reports, the less it probably exists, and the poorer the firm's performance' (2000; p.104). In other words, a firm cannot just talk the walk and become profitable.

Thus, it can be successfully argued that SCM and e-procurement activities also deal with strategically leveraging both tangible and intangible assets. This involves answering the basic question of 'Who are our suppliers and who can we integrate into our e-commerce programme?' (Heizer and Render, 2001; p.8). Operations management within the health industry can use e-procurement to increase their operational efficiency through the purchase of inputs via the web, often at considerable savings. This, in turn, leads to an overall decrease in the cost of producing goods and services and an increase in profitability, although not considered sustainable as compared to potential competitors. For example, United Technologies Corp. was able to purchase $24 million dollars worth of circuit boards for only $18 million using the Freemarkets (www.freemarkets.com), e-procurement auction process (Heizer and Render, 2001; p.463). The cost savings allowed United Technologies Corp. to either reduce their sales price-to-grow market share or maximise profitability by holding their price constant. Also, Freemarkets was

able to deal with e-procurement problems associated with West Penn Allegheny Health System in Pittsburgh, PA, a large, integrated network of hospitals, multiple physician practice groups, and other ancillary businesses. Freemarkets worked with senior management to educate the clinical team regarding online outsourcing and system-wide supply management challenges. The results were dramatic, with $40.2 million outsourced to date (2003), with an average savings of 17.8%, and 100% of users trained on Freemarkets QS. The products and service categories included reference labs services, forms and documents management, arthroscopy equipment, spinal implants, transcription services, and various logistical services.

5 Strategic aspects of e-procurement

An organisation musttake into account several key considerations before launching an e-procurement system. This is especially true for those who are focusing on operational management in a lean (cost sensitive) environment. According to Neef (2001), pl. join the next line here e-procurement and electronic B2B trade are due to a variety of reasons. Some of the major reasons for this growth include significant process savings from automation, compliance, and purchasing advantage as well as reduced costs that organisations can experience by conducting transactions electronically. Although these are the basic benefits associated with generic e-commerce strategies, a majority of these B2B transactions have focused on the purchase of indirect materials (especially office products, disposable medical equipment, and travel services). However, other types of supply chain-related purchases, including maintenance, repair, and operating and replacement parts, and direct material purchases, are becoming more important operational management considerations in e-procurement services.

In addition, several of other key considerations must be dealt with a firm's existing procurement strategies, such as the vendors, technology, suppliers, and total costs of ownership. Companies need to analyse their current procurement strategy before developing an e-procurement plan. They must understand what they do well and what must be improved. Failure to do so can lead to an e-procurement plan that does not maximise what they do effectively and does not correct what needs to be improved.

The choice of the software vendor is extremely important as well (Smith and Rupp, 2002a; 2002b; 2002c). Companies can often commit millions of dollars to develop their e-procurement programme. This trend results in a sizeable investment not only in the product, but the vendor as well. Companies will require other services from the vendor after the programme is initiated. It is important that these vendors sustain a long-term and open relationship. Other aspects of the vendor to be considered are quality of staff, location, and whether they will provide sufficient training programmes.

The type of technology to be used is also a consideration. Does the vendor develop the software or is it from a third party? A vendor that develops their own software can customise it to the specific needs of the company. Third party software may not be done so easily. Companies must also assess the technologies ease of use. Is it complicated or relatively easy? Will extensive training be necessary before the programme can be rolled out? These items can add cost and time to the project. The location of the support team for the software is an issue as well. Is the support team based domestically or internationally? Office hours that are not the same as yours or time zone differences will affect the timely correction of a problem.

Supplier integration issues must also be addressed. Suppliers must be capable and ready for e-procurement. Those that are not prepared will not be able to participate. Moreover, those companies may be your most important suppliers.The ones that are ready must be able to use your technology and software. There must be ease of use for both the buyer and supplier; otherwise, the cost benefits projected may not be realised. In some instances, the changes that are necessary for both to use the system will ultimately increase costs rather than decrease them. In addition, a decision must be made as to who will manage the products and services' databases. Will your firm as the buyer establish a catalogue of products/services needs or will you use the suppliers' catalogue? Questions such as these must be addressed in order to realise a successful e-procurement programme. An important consideration is the total cost of the programme. There will be upfront costs for the programmes. Software, consulting, and integration costs are very expensive, as many firms found concerning Y2K upgrades. There are also ongoing costs such as fees for user licences, service fees and maintenance and support. The cost savings must offset the total costs of the e-procurement programme.

6 Online reverse auctioning

Many organisations are utilising online reverse auctions to receive 'true market' pricing for their goods and services. An online reverse auction is very similar to the well-known auctions conducted on e-Bay, except almost exclusively designed for the B2B marketplace. However, instead of bidders placing bids in upward increments for good, sellers are placing downward bids for the right to provide a good or service to the buyer. In its infancy, companies were utilising online reverse auctions for commodity-type purchases. For instance, a local municipality would present a specification to suppliers for their annual rock salt needs and conducted an auction based upon such specification. Currently, many companies are expanding the portfolio of products they are bidding through online reverse auctions (Smith and Offodile, 2002). Companies are realising thathad they been able to develop a discrete specification for a good, and even a service, they could very well conduct an online reverse auction. The main determinants to a successful event are clearly defined specifications, competitive supply bases that are willing to compete for business, a keen understanding of the specific market dynamics, and existing relationships with suppliers. With a good understanding of these factors, a company can make an informed decision to determine if a bid makes sense to conduct through reverse auctioning.

There are many advantages to utilising online reverse auctions as a tool in a company's e-procurement strategy. The first and foremost advantage, and one that always gets the most attention of executive management, is reduction in the cost of goods. With tremendous success frequently documented, most CEOs are quick to connect online auctioning to improve performance ratios. To understand the impact online reverse auctioning can have, please refer to Example 1, which demonstrates the relationship between cost savings and profits. The example demonstrates how a dollar saved is worth more than an additional dollar of revenue (please see Table 2).

Table 2 An example of aggressive outsourcing using PNCs sourcing results as of late 2001

Aggressive Sourcing's Contribution to PNC's Bottom Line in millions			
PNC's 3Q Results		*Aggressive Sourcing Results as of 10/31/01*	
3Q 2001 Total Revenue	1,353	Aggressive Sourcing's Contribution	43
3Q 2001 Net Income	298	Aggressive Sourcing's Achieved Savings	9.44
Profit Margin	22.03%		22.03%
		Contribution/Employee	2.38

Note: *Bottom Line*: In order for PNC to increase it's Net Income by $ 9,44,000, or the saving achieved by Aggressive Sourcing, the corporation would have to increase revenue by $ 43,000,000 (307.44/1396 = 22.03%) i.e., $1 obtained through cost savings is equal to $ 4.55 gained through increased revenue

Secondly, online reverse auctions are able to increase the number of bids received for a product through technology. In the old days of paper bids, it was incredibly inefficient for purchasing professionals to obtain multiple bids from multiple bidders and then analysze the bids to determine the optimum solution. With the use of online auctioning, the cycle time is compressed to hours versus days or weeks. This allows purchasing to get involved with more projects than ever before.

Lastly, online auctions create a standard format for suppliers to submit bids. Once a supplier is formally trained on the software, they can easily participate in auctions. In addition, purchasing personnel can republish previous events so that they are not recreating an auction each time they identify a particular product. On the 'flip side,' organisations need to be aware of disadvantages and/or concerns. Online auctioning is not the means to an end. It is one part of a sound e-procurement strategy. It is still imperative that due diligence is done through in developing specifications and identifying qualified suppliers. If an unqualified supplier is invited to participate in an event, specifying how value will be achieved, and in fact how money may be lost are needed. If the supplier cannot be implemented and a company needs to go back to the incumbent, due diligence is required on all parties. Another concern organisations should be aware of is that they do not strain relationships with their strategic partners. It is very easy to look short-sided at the per piece-price reduction and not consider other values that partners may bring to the table. Online auctions should be used in a company's procurement strategy but they should not represent the only avenue for their competitive bids. By following a structured sourcing process, they will capture the benefits of auctioning and assuring they are doing the right thing for their long-term viability.

7 EDI considerations

In terms of direct B2B communications, EDI coupled with appropriate AIDC-related technologies can create an exclusive online channel among suppliers and/or manufacturers and buyers, and refers to the electronic exchange of standardised business documents (Smith and Offodile, 2002; Hart and Saunders, 1997; Bergeron and Balin, 1999; Rauner and Heidenberger, 2002). EDI and AIDC-related technologies provide up-to-date information and allow the supplier and buyer to conduct transactions, such as billing, ordering, and invoicing through secure telephone lines using standardised electronic documents. EDI provides companies with many distinct advantages in terms of

faster order processing speed with fewer errors, improved information sharing, and fewer mistakes as well as cost reduction in inventory, labour, and paperwork (Wang Eric. and Seidmann, 1995; Mukhopadhyay, Kekre and Kalathur, 1995). Thus, buyers have a strong motivation to persuade their suppliers and/or manufacturers to adopt EDI systems to maintain integration of their supply chains.

However, similar to the pressures brought to bear concerning ERP systems implementation, the actual implementation of EDI and/or AIDC-related technologies requires manufacturers and/or suppliers to incur relatively large asset-specific investments. The typical cost and associated value of EDI and/or AIDC-related implementations are frequently too high for small to medium-size suppliers. In addition, the investment may be specific to one supplier/manufacturer since most EDI applications lack standards. AIDC-related implementations are governed by membership organisations such as the UCC (Uniform Code Council) and discipline specific associations, such as AIMIGLOBAL and the Smart Card Alliance. EDI, as with other IT applications, may be customised only for one specific buyer and supplier/manufacturer relationship and its value is dramatically reduced if it is used for another relationship (Smith and Offodile, 2002; Williamson, 1975). Although many suppliers/manufacturers may hesitate to adopt EDI and/or AIDC-related technologies in the creation and performance of technical and innovative projects, their decisions should be based on the comparison between the risk of asset specific investment and incentives derived from it (Subramani and Walden, 2000). In addition, such technology adoptions may be governed by theoretical considerations (Cooper and Zmud, 1990; Gallivan, 2001; Orlikowski and Yates, 1994; Rosenburg, 2003; Hsieh, Tan and Lin, 2003). This situation is amplified with the advent of web-enabled suppliers and customers interacting through the seemingly transparent supply chain (Prescott and Conger, 1995; Swink, 1999; 2000).

8 Global supply base

In the article 'Beyond the Information Revolution', Drucker (1999) stated that the

> "Truly revolutionary impact of the Information Revolution is just beginning to be felt. It is something that practically no one foresaw or talked about ten or fifteen years ago: *e-commerce*, that is, the explosive emergence of the internet as a major, perhaps eventually the major, worldwide distribution channel for goods, for services, and, surprisingly, for managerial and professional jobs. This is profoundly changing economies, markets, and industry structures; products and services and their flow; consumer segmentation, consumer values, and consumer behaviour; jobs and labour markets. But the impact may be even greater on societies and politics and, above all; on the way we see the world and ourselves in it" (p. 47).

Throughout the article, Drucker compares e-commerce to the Industrial Revolution of the past. He is trying to equate e-commerce to inventions of yesterday, such as the railroad, which had a tremendous impact on our nation's economy at that time. 'In the mental geography of e-commerce, distance has been eliminated. There is only one economy and only one market. The competition is not local anymore. It knows no boundaries' (Drucker, 1999; p.50). Due to the advent of technology, more specifically the e-commerce/e-procurement, the ends at which a firm can acquire raw materials, goods, and services are boundless.

Taking the following scenario as an example, a firm during the e-procurement process identifies a potential seller of a good, or service that is instrumental in the manufacturing of their product, and the supplier is selling the item(s) cheaper and in bulk. If typical management interested in only standard cost variants were in the supply chain manager's position, then they would only be interested in purchasing the cheaper raw materials, goods, and services from the new supplier. In this struggle to find the biggest impact to increase the profit margin, where do firms turn to find raw materials, products, and services? Where can companies identify suppliers that can help the bottomline the most? The answer to these questions is rather a simple one. Establishing supply chain in a global environment with multiple criteria is the answer.

E-procurement has opened up a world of potential new suppliers and markets that can be identified through the internet. Purchases and order releases are communicated over the internet or to 'approved' online vendor catalogues. The internet is available 24 hours a day, anywhere in the world, enabling convenient transactions for those concerned. All of these factors help establish a more active, worldwide economy. There is no clear delineation of one national economy from another. One of the reasons behind this was the liberalisation of trade policies by governments all over the world. An example of this would be the North American Free Trade Agreement (NAFTA). This was a more localised phenomenon, but still allowed and stimulated more trade between the countries of North America. Agreements such as NAFTA will further strengthen the globalisation of the supply base. This is a great opportunity for an organisation to stay viable. Instead of only being a supplier to a particular region, a firm has limitless access to potential buyers throughout the world. 'E-commerce is a new distribution channel. New distribution channels change who the customers are, how and what they buy. In addition, they change consumer behaviour, savings patterns, and industry structure. In short, they have the potential to change the entire economy. This is occurring now in USA, the developed countries, and the developing countries of the world' (Drucker, 1999; p.52).

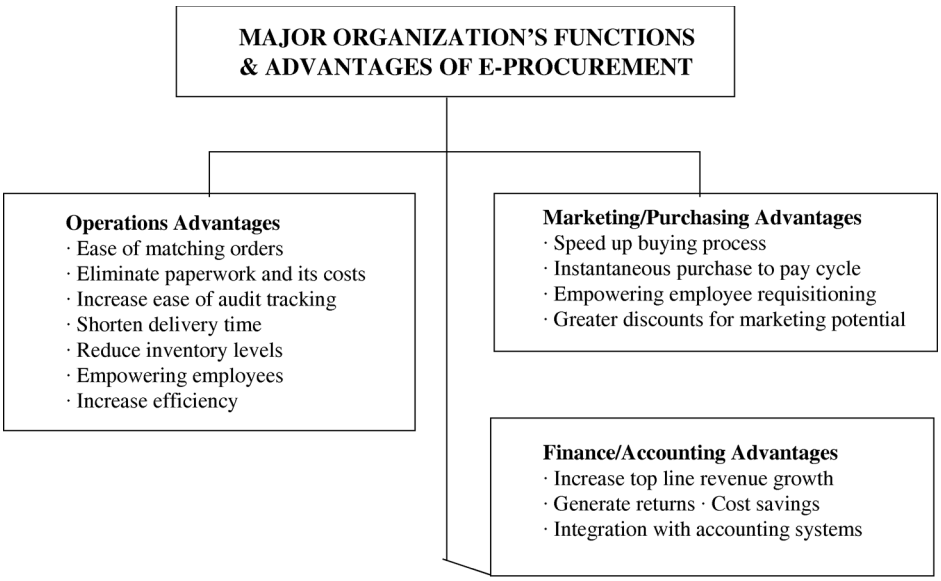
Development of a successful strategic plan for SCM/e-procurement requires innovative planning and careful research. Supply chains in the global environment must be characterised by the following: Flexible enough to react to sudden changes in parts availability, distribution or shipping channels, import duties, and currency rates; able to use the latest computer and transmission technologies to manage the shipment of parts in and finished products out; and staffed with local specialists to handle duties, trade, freight, customs, and political issues (Heizer and Render, 2001). All of these criteria are set to reach one sole purpose, which is to deal with global suppliers that provide the lowest cost and the highest quality. Allied Heath Care and its management are not immune to these processes, although fairly resistant. As stated earlier, the adoption of an e-procurement process has dramatically altered the global sourcing environment. Taking on a global endeavour requires a long-term investment, a sharing of ideas and processes, and a constant assessment of the activities, and occurring in and around regions of the world. In order to successfully assess the global environment, a supply manager must succeed in finding answers to the following questions: How do you source differently than your competitors; how do you identify the opportunities and the trends; how do you locate the appropriate source; how do you certify the appropriate suppliers and manufacturers; how do you execute your plan; and how do you ensure smooth flow of merchandise and quality (Yuva, 2002)? Healthcare management professions must actively seek answers to these questions on a continuous basis if they are to accurately assess the impact of the global environment on e-procurement activities.

After assessment of the global environment has occurred, a firm must realise what it is trying to accomplish on the global scale and what will be the priorities. The following are some basic guidelines that a firm can follow to achieve success: Buying power, price, consistency of product, and administrative simplicity (Duffy, 2000).

9 Advantages of e-procurement

E-procurement gives the promise to lower the costs of goods and/or services purchased, lower inventory levels, shortens lead times, and improves communications. The advantages of e-procurement can be broken down into the benefits that it creates for operations, finance, and purchasing. The organisational chart that follows will provide a summary of these advantages of e-procurementthat are illustrated in Figure 3.

Figure 3 Advantages of e-procurement as associated with an organisation's major functions



The operational advantages of e-procurement are based on the need of managers to overcome the challenges of cycle times and high costs frequently found in the healthcare field. Hence, 'E-procurement offers the greatest opportunity for companies to improve processes, reduce costs, and increase productivity across the supply chain' (Duffy, 2000; p.3). Two of the major advantages are efficiency and effectiveness. Lowering of procurement costs, reduced unauthorised buying, and faster cycle times are the most recognised benefits of efficiency. Hence, effectiveness may be realised through higher quality purchasing decisions and increased control over the supply chain. The advantages of e-procurement for the operations side of a business are vast and partly immeasurable.

The benefits of e-procurement for the purchasing and marketing functions of a company are also numerous. E-procurement solutions have focused on reducing costs with spending controls, automation of spending, and consolidation of purchases toward

preferred suppliers. It also expedites the buying process, with the goal being to make the entire purchase-to-pay cycle almost immediate. E-procurement allows a company to gain visibility into what the business buys and from whom. This benefit will enhance the marketing and sales promotion of any business. Once a company gets a handle on this system, sales professionals will use this to leverage spending power and negotiate better deals.

E-procurement not only reduces the burden on operations, marketing and purchasing, but can also benefit the finance side of a company. It can create opportunities for increasing top-line revenue growth by leveraging the expertise of the company's knowledge workers. In addition, procurement solutions can help companies generate returns by transforming the trading environment from an adversarial relationship to an environment in which buyer, sellers, and managers can actively communicate preferences, requirements, and costs with the finance department.

Shortened delivery times, reduced inventory levels, instantaneous purchase-to-pay cycles, and cost savings are just part of the growing list of advantages for e-procurement. With the implementation of new AIDC-related technology and by choosing the right e-procurement strategy, the headaches of healthcare management can be greatly reduced. As e-procurement expands to automate other business processes, they will inevitably lead to the procurement of direct goods and/or services. As a result, companies can drive greater efficiencies and savings in all their purchasing and ultimately provide greater value for its customers.

10 Challenges and solutions

10.1 Further research and difficulties in implementation of e-procurement

Although e-procurement has the potential to provide many benefits for companies, further efficiencies need to be employed by operations, marketing, and finance to make the company sustain a competitive advantage through their supply chain management (Figure 3). The basic research proposition that needs to be tested through empirically-based studies is how the growth of e-procurement hierarchies is triggered through a detailed cost-benefit analysis at the enterprise level. The cost of extending private networks to trading partners encourages linkages when a suitable volume of transactions is expected to occur. Therefore, the agents in the medical industry that control network applications will be prompted to add new types of transactions based on the dedicated capacity to each trading partner. Unfortunately, medical data networks are usually proprietary in nature and often fragmented in terms of its connectivity. This generates a situation of electronic hierarchies that actually creates barriers to communication that discourages B2C exchanges. Much research is needed if a scholarly attempt on medical supply chain management and e-procurement activities is to be successful, where trading relationships can economically be supported by network-based transactions.

The previously discussed factors of trust, degree of automation, EDI considerations, online reverse auctioning, and global-trading networks are all agents that promote change within the medical e-procurement field. For example, a poll of 50 global firms, US Express and Accenture found that the use of paper-based procurement is expected to fall

by 11% in 2003, but will remain the dominant purchasing method[3]. Why has e-procurement not been successfully adopted by more firms more quickly? Probably, the major obstacles of e-procurement include difficulties in implementation of e-procurement lack of security and trust and resistance to change from employees and/or management. The constructs need to be tested in an empirical fashion.

One of the major problems firms have faced is derived from the incorrect way of implementing e-procurement procedures into their operations functions. Many companies leaped into e-procurement too hastily without enough experience and research in the field. E-procurement is a fairly new concept in the medical field and knowing how to correctly implement the system is important key to success. Implementation problems arise from both the buyer and suppliers sides. Problems such as adoption of new procedures, integration of new and current software systems and perceived risks by employees and management have proven to be barriers to adoption.

E-procurement should be seen as an integral part of the business. It is not just an IT function or add-on, but a business function; it is a part of the whole SCM regime. All departments and disciplines of a company need to be involved in the adoption of an e-procurement system. Each department must identify its needs and describe its contributions to the programme. The specific needs and processes of multiple departments have to be mapped, understood, and integrated into the overall strategy for the operation of an effective procurement function (Atherson, 2002).

A company must decide what items to purchase through e-procurement. Currently, many companies are purchasing mainly indirect strategic goods. These are non-production items, such as MRO (maintenance, repair and office) items (Leaversuch, 2002). A direct strategic good is used for the direct production of finished goods. By deciding what is actually going to be purchased through e-procurementtransition becomes easier. A decision whether to stay with current suppliers or engage in new suppliers is something that must be determined. The buyer-supplier relationship is vital for the success of any procurement system. A supplier has to be able to meet all the needs of the buyer. It has to be open to suggestions and should have the capabilities to take the company into the future.

There has been much data generated from other firms that have implemented e-procurement systems. Companies can examine the firms that have been successful in cutting costs and at the same time remained effective and efficient in supply chain management through e-procurement.

11 Lack of security and trust

As with any e-commerce function, e-procurement poses the dilemma of security. Companies have concerns with: Who has access to their data, how the data is stored and what are the overall confidentiality issues? Companies are frequently worried that ‘trade secrets’ may be revealed because other users may be able to see the products they purchased, when they are purchased, and the quantity purchased. A well-defined contract from both buyer and supplier should describe the terms and conditions of all purchasing procedures. The buyer needs to have information on who accesses the information, how it is being used, and the steps taken when problems arise. There are also companies offering security solutions through software programmes. Ingrian Networks, a Redwood City,

CA-based network company, offers e-transaction privacy enabling businesses to protect their applications and data. It is a patent-pending software system integrated into a family of secure transaction platforms[4]. Whole Security Inc. just launched a network security system in April 7, 2003. Its focus is to prevent remote access trojans, or software-based eavesdropping, during e-commerce transactions (Messmer, 2003). Although these applications are costly, they may decrease the insecurities companies feel about the potential fraud of e-procurement.

12 Resistance to change from employees and management

Since the benefits of e-procurement may not fully materialise in typical budget cycles, it is difficult for some employees and managers to adopt the new system. The benefits of decreased costs and increased productivity may only be apparent to top management. Middle management and some employees view it as learning new software systems, altering work processes, and changing supplier relationships. Thus, getting an organisation to change is no easy task. However, good communication and education is an important starting point. Change management can be accomplished by stressing the benefits of e-procurement to employees and management; forming project teams to help with collaboration; enabling people to work the way they used to; teaching the correct use of new software; and using consulting firms to facilitate the transition. Companies rushed to implement e-procurement and uncovered many weaknesses and hindrances. The coordinated efforts of everyone in the firm will help a company accomplish its goal of competitive advantage through its SCM system.

13 General conclusions and implications

SCM is one of the major strategic decisions made in operations management within the healthcare environment. It is one of the most important decisions because inventory accounts for as much as 40% of some companies' assets (Heizer and Render, 2001; Rauner and Heidenberger, 2002). The main goal is to operate effectively and efficiently while maintaining a low-cost strategy. E-procurement is proving to be a way to accomplish this goal. E-procurement is obtaining materials via the internet or through online catalogues. Not only does it eliminate a costly 'middleman,' it also improves communication and decreases lead times. Although there are obstacles such as existing procurement processes, employee resistance, and changing supplier relations, proper management can help overcome these problems. Through well-organised strategic plans, strong buyer-vendor relationships, proper implementation, online auctioning, and globalisation of supply base, e-procurement can promote the reduced costs and increased productivity a firm strives to achieve. As multinational companies are continually expanding and globalisation is affecting both the service and manufacturing sectors, firms have to find ways to stay competitive. Although suppliers should experience a myriad of benefits (such as expanded sales, reduced operating/inventory costs, and improved operational efficiency), many problems may initially plague firms due to systematic/application problems, cost concerns, security risks, and change/crisis management. However, from a strategic viewpoint, e-procurement can be the key that

makes a firm sustain a competitive advantage now and throughout the future in supply-chain management.

Healthcare e-procurement is grounded in the strategic leveraging of AIDC-related technologies. For example, the Health Industry Business Communications Council (HIBCC) is promoting bar-code provider applications and supplier labelling standards for the health industry. Standards produced by this organisation allow providers to employ bar-code technology to create a hospital-wide system that connects numerous departments and functions relating to patient care. This obviously reduces the likelihood of error. Hence, pen-based computers could disappear, leaving smaller and more powerful devices to take the place on clumpy and bulky machines, such as handhelds and portable machines. When third-generation wireless services are pervasive, it may be possible to have a big-screen tablet with a low-power processor. This may be possible in the near future, perhaps in three-to-five years. Thus, IT departments will need to take competitive advantage of the new 3-G technology to support portable thin-client computing. For example, Microsoft is currently supporting a pen tablet as the platform of choice (Turek, 2001). Costs on uniquely designed bar-code and RFID systems are constantly falling (Becker, 2001; Bedell, 2002; Cooper-Jones and Macklin, 2002). Regardless of the benefits of healthcare e-procurement activities, they still must demonstrate to its users that it is safe and secure.

In general, security in concern information systems, especially legacy systems may be more vulnerable to various computer crimes. This has become a vital issue since the September 11, 2001 tragedy. The leap in computing power may create a big gap between businesses equipped with the latest technologies and those who are not so equipped in executing automatic data collection and data capture technologies (Shin, Foust and Anders, 2003; Nylander *et al.*, 2002; Attaran and Attaran, 2002). Those businesses that lag behind will be extremely vulnerable to attacks such as data tempering and viruses – which in the healthcare industry would be crippling. Since computers systems and their associate e-procurement and ERP systems, such as SAP and Oracle, are especially sensitive to changes in the environment, it is entirely possible for hackers/crackers to disable or damage systems not just through software but also through magnetic disturbances and heating of the environment associated with the healthcare industry. Prevention will be ever more counted upon as a major role of any IT department, especially the applied health fields and any industry that utilises sensitive and personal databases. In addition, prevention against inadvertent damage to systems might be also required. Hence, multiple layers of security measures, such as tougher access control and new encryption schemes, may be needed to guard against computer criminals than ever before. In addition to criminal tampering, non-criminal damages in the AIDC loop may result in tremendous obstacles as well.

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