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ABSTRACT

eXtensible Markup Language (XML) has received much attention in the popular press lately as a new technology designed to facilitate information sharing among business entities. One of the biggest problems that companies are experiencing today with XML is that many executives do not understand what XML is and why it is important, nor do they understand what its potential impact on their information strategy might be. In this paper, we present an overview of XML and a framework for generating IS strategic alternatives, which was introduced in its original form in the 1980s. This framework is adapted to suit the properties of XML and its usage is illustrated with XML cases. Finally, considerations for developing XML applications that are identified by the framework are presented.

INTRODUCTION

Recently, much of discussion in professional circles has centered on the use of eXtensible Markup Language or XML (Bray et al. 2000). This language is seen as the next generation language of electronic commerce, going beyond the limitations of Hypertext Markup Language or HTML. As a markup language, it is similar in syntax to HTML, but is much more structured and can serve as a powerful enterprise application integration tool (Opara and Srivastava, 2003). A common misconception about XML is that it is a computer "language" like Visual Basic or C, which can be used for developing applications. This perception does not do it justice because XML is actually a meta-language that merely defines the rules necessary for defining specialized markup "vocabularies" for specific information exchange problems.

Currently, two to three new vocabularies are being defined each week using XML specifications. New XML-based industry-specific languages are continually introduced such as XBRL (eXtensible Business Reporting Language) for financial reports and data exchange, LegalXML for legal services, ebXML (for Electronic Business), OFX (Open Financial Exchange) used by financial institutions, cXML (Commerce XML), CDF (Channel Definition Format) and ECML (Electronic commerce Markup Language) to name a few. Being involved in defining an XML vocabulary for an industry group can give the participants an early mover advantage over their competition.

The main objective of this paper is to examine the key concepts behind XML and demonstrate how firms can apply traditional frameworks of information systems (IS) to XML functions in order to generate XML applications to gain competitive advantage. These opportunities are further illustrated by mapping a variety of XML application case studies to an IS framework.

As we know from IS research in general, one of the most common causes of the failures of information technology (IT) projects is that they are not properly aligned with the sponsoring organization's overall competitive strategy. It is clear that organizations that consider their IT projects to be strategic initiatives instead of simply part of the corporate infrastructure have a better track record of success, especially in the networked environment (Wheeler 2002). Firms that simply use information systems for running efficient transactions and generating managerial reports are in danger of losing their competitive edge. This is especially true with the question of how to evaluate and integrate new technologies such as XML. Many technical people have heard about it and understand it in general, but on the other hand, many high level administrators have not yet figured out what impact it will have on their competitive strategy.

CHARACTERISTICS OF XML

A recent survey of managers at 51 major companies also found that 71% expected XML would have a major impact on their businesses and over 50% were already planning XML implementations (Gillett et al. 2000). XML, a meta-language, is based on an earlier markup language called Standard Generalized Markup Language (SGML). "Meta" is derived from a Greek word that means "above, higher, or beyond" in the sense that it transcends normal language. Therefore, as a meta-language, XML is beyond normal computer languages, because it provides the rules that facilitate the development of industry and application specific markup languages. These specialized XML languages allow for the transmission of data between users regardless of the platform or operating system being used.

Since XML was recommended by the World Wide Web Consortium (W3C) in February of 1998, over 200 new XML languages have been established, with everything from Astronomical Instrument Markup Language (AIML) to Theological Markup Language (TML). As stated by the W3C itself, XML

> "… is primarily intended to meet the requirements of large-scale Web content providers for industry-specific markup, vendor-neutral data exchange, media-independent publishing, one-on-one marketing, workflow management in collaborative authoring environments, and the processing of Web documents by intelligent clients…. The language is designed for the quickest possible client-side processing consistent with its primary purpose as an electronic publishing and data interchange format." (W3C 2002)

Now as XML standards become more developed and authoring tools become more widespread, its relative value is becoming clearer. In the year 2001 alone, there were over 30 IT Conferences devoted to various XML applications and topics. It has even been suggested that its impact will be so important that companies that are not involved in setting the standards in their respective industry will be at a competitive disadvantage similar to the advent of the Web when some companies had a Web presence and others did not.

As mentioned previously, XML is a type of meta-language, a language that is "above" other languages in the sense that it contains rules that can be used to build other languages. The idea behind XML was that users needed a powerful but flexible markup language that would be easier to use than SGML but would also allow them to create their own languages for particular applications. Thus, XML defines the grammatical rules of the resulting markup languages and also the format of the components such as the Document Type Declaration (DTD), and eXtensible Style Language (XSL) and how they will be parsed. So if we wish to create a new language to help us develop electronic commerce applications, we simply follow the XML rules and generate a set of tags and element definitions that correspond with how we want the information in our application organized.

Usually, this type of standard setting is controlled by industry organizations, so it is very important, for businesses to participate in this process. Examples of early XML-based markup languages include Chemical Markup Language (CML), XEDI, ebXML and many others. As one example of an early XML-based language, financial markets have already been using an XML-based language called Open Financial Exchange (OFX) to exchange financial data over the Web for several years. Currently, the most important XML vocabularies to know with respect to business are probably XBRL (eXtensible Business Reporting Language) for Accounting and Financial reporting, finXML for exchanging financial data, ebXML for e-Business, and SOAP or Simple Object Access Protocol for sharing applications over networks. A comprehensive description of these and various other XML vocabularies can be found in Wagner and Hilken (2003).

For all the hype, XML is just another way of replacing binary computer files. XML is a technology, not an end-all application. Many refer to XML as the ASCII of the twenty-first century. ASCII was an important early attempt at solving some of the information exchange problems in the world of microcomputers and is still commonly used as a shared file format today. Even this analogy falls short in capturing XML's potential impact. For example, one might consider the relative place of XML and ASCII in the common ISO Model for Open Systems Interconnect (OSI) as shown in Table 1.

Table 1. OSI Seven Layer Reference Model

Layer	Layer Name	Function
7	Application	Program-to-program communication
6	Presentation	Manages data representation conversions
5	Session	Establishes communications channels
4	Transport	Responsible for integrity of data transmission
3	Network	Routes data from one node to another
2	Data Link	Physical passing of data from one node to another
1	Physical	Places data on and off the network media

While ASCII resides solely in the presentation layer (Layer 6), XML would be considered to reside in the presentation layer and/or the application layer (Layer 7), and quite possibly could reside in the session layer (Layer 5) and transport layer (Layer 4), should the designer of routing equipment desire such. XML is more versatile than ASCII, and such versatility has its advantages. Of course these advantages must be weighed against their costs, which will be discussed later.

This flexibility is certainly one of the general benefits of using XML. Besides its flexibility, other benefits include:

(1)It is a self-describing medium;
(2)It forces users to agree on how commonly used data will be structured;
(3)It lends itself to applications that are developed in heterogeneous environments such as electronic commerce;
(4)It is a low cost way of adding further functionality to Web sites;
(5)It can be easily integrated with existing Web technologies;
(6)It is human readable and therefore fairly easily understood and learned; and
(7)It enables tighter integration of the supply chain in electronic commerce.

In its simplest form, XML is just a replacement of binary data files. However, because it separates the content from the structure and formatting, XML has become a self-describing medium, unlike a binary computer file. In a binary file such as might be found in an EDI application, there must be an exact agreement, with the strength of a binding contract, that data must be placed where it is expected, in a format agreed upon ahead of time. Breaking this "contract" will most likely result in a broken computer application.

XML alleviates some of this hard-and-fast contractual obligation by allowing data to be categorized and annotated. The actual sequence of the data is no longer a topic for negotiation. For example, under current methods, comparing one company's financial data with another's is not easy. Even if the financial statements are found on the Web, they still have to be cut and pasted manually into a common document such as a spreadsheet. Even then, there may be no general agreement on the placement and meaning of specific information within each financial statement. However, well-designed XML applications can even function using new and unknown categories of data. This flexibility is what makes XML a promising technology to deploy for many IT applications, offering new functionality in addition to savings from lower operating costs.

XML as a technology lends itself to working in heterogeneous environments. In this sense XML files behave similarly as binary computer files, in that data is stored in a retrievable fashion and can be reliably transported between applications and computing devices. Using its self-defining mechanism, XML files give the developer a reasonable chance of getting disparate and unknown systems exchange data; providing additional functionality and options for system design. It is this capability that electronic commerce systems are relying upon

in XML to readily offer much more utility than could be devised through traditional monolithic programming. In this sense, XML is sometimes referred to as one of the "Web-based alternatives" to DCOM, EDI and CORBA. XML can also be readily leveraged to provide a multitude of computing functions. This is evidenced through the many Internet standards written and in progress based upon XML. There are already XML related standards and proposals such as XSL, XHTML and XDATA. Then there are XML based higher-level technologies in the works such as DSML, SOAP, RDF, and LDAP.

When compared to monolithic programming technologies, XML provides exceptional value through its ability to work with disparate systems, using lower cost methodologies, expressing data in human readable terms, and providing additional functionality. It is this latter point that many Internet start-up firms are homing in on today. The Internet and XML have the ability to change the nature of day-to-day transactions, improving productivity.

Information security is an issue of increasing importance for managers and is becoming important with respect to XML also. The strength of XML is that it clearly defines the structure of documents and makes it easy to locate the data with clearly labeled tags. But when this is applied to credit card and transaction data, then application designers and managers should start feeling nervous. The simplicity and interoperability of XML could be a great opportunity of internal and external hackers to access the data. This is especially important with respect to SOAP which is designed to allow intermediary processing and modification of messages. Also, XML tags may point out servers and directories where other XML files could be located and accessed.

A number of XML security initiatives are now underway (Kay 2002, Hirsh 2002). Chen et al. (2003) provides an overview of security management in the era of XML and intranets based on the .NET platform. One encryption engine allows specific data and data tags to be encrypted so that someone looking for credit card tags will miss them. Another is the idea of XML Digital Signatures (XMLDigSig) that can either be stored as a separate document or embedded within it. This can be used to request and validate one or more signatures before proceeding with the document. This can be used in conjunction with XML Encryption (XML Enc) to make sure that all the signatures are encrypted. Incorporating security features into XML will be increasingly important as it becomes more widespread, but this must be done without detracting from the benefits of freely exchanging documents via XML.

XML FOR COMPETITIVE ADVANTAGE

Numerous studies and frameworks for studying the competitive advantage of IT have been put forth. See, for example, Bakos and Treacy (1986), Benjamin et al. (1984), Ives and Learmonth (1984), Henderson and Venkatraman (1999), Liang (1993), Raghunathan et al. (1999), Singh (1993), Spanos et al. (2002), and Wisemen and MacMillan (1984). With respect to corporate strategy, Porter and Millard (1985) describe three generic strategies that companies employ in order to gain and also to sustain a competitive advantage. These strategies are oriented towards (a) cost leadership, (b) product differentiation, and (c) product innovation. These three strategies or "thrusts" were later extended to include how companies can use (d) growth and (e) alliances to gain further competitive advantage. Rackoff et al. (1985) applied this framework specifically to the IT planning process and produced a matrix along with a methodology that was designed to help companies identify opportunities for using IT to gain a competitive advantage. Later iterations of the matrix added the "Partner" stakeholder as a special case of either a customer or supplier in the supply chain. The resulting matrix with the stakeholders and thrusts is reproduced here as Table 2.

When examining the matrix for different possible targets and strategies, it is important to keep in mind that these categories are not necessarily mutually exclusive. In other words, a new IT application may be innovative and also offer a way of cutting costs. The idea is to help users focus on the primary nature of the strategy and also its primary target. n order to show how the firms that try to exploit XML can identify opportunities to apply XML to gain a competitive advantage more systematically, we present a framework as shown below as a matrix. The various stakeholders in XML-oriented initiatives appear as column headers of the matrix, while the capabilities of XML for integration appear at the left-most column. Stakeholders include customers, suppliers, partners, and competitors. From our examination of XML integrative features, XML has been found to be useful to integrate data input, application linking, and also data output.

Table 2. The Matrix with the Strategic Targets and Thrusts

		Strategic Targets			
		Customers	Suppliers	Partners	Competitors
Strategic Thrust	(a) Cost Leadership				
	(b) Product Differentiation				
	(c) Product Innovation				
	(d) Growth				
	(e) Alliance				

We further examine various cases of XML applications identified as generating competitive advantage as a result of implementing the XML-oriented initiative. Such cases are positioned in the above matrix, and their strategic impact is discussed in depth. The main focus of our analysis is on the areas where very few XML applications have been built, and therefore no significant competitive advantage was observed. By providing explanations why certain area have been neglected by XML implementations, and by proposing what might overcome such deficiency in XML initiatives, we attempt to substantiate the efficacy of the framework, and ultimately to provide guidelines to build and implement strategies for the firms that seriously consider XML as their strategic weapon, which we suppose are virtually all organizations that rely on data.

Strategic Targets for XML Applications

This matrix is used to assist in generating strategic applications of XML that can be used to gain a competitive advantage in Electronic commerce. For instance, the cell marked as (1) in the matrix of Table 3 pertains to Sabre Group's new XML/Java application that feeds airline reservation data into PDAs and Internet enabled cell phones. This is a good example of an innovation using the output capabilities of XML to enhance the level of services for customers. Apparently, this new approach gives the company a competitive advantage over its competitors, and also presents a new obstacle to entry into this market.

Table 3. The Matrix with Examples of XML Applications from Strategic Targets

		Strategic Targets			
		Customers	Suppliers	Partners	Competitors
egic Thru	(a) Cost Leadership		(3) Assayer Workflow		

	(b) Product Differentiation				
	(c) Product Innovation	(1) Sabre Group Applications		(4) J. P. Morgan	
	(d) Growth				
	(e) Alliance	(2) Property Register			

Customer as Target A survey of reported XML case studies shows that the majority of them might have the customer as the initial target of the application. Customers may be people coming to search a Web-based catalogue or they may also be internal consumers of information off of a corporate intranet. The Sabre Group XML application mentioned above is a good example of a system with the customer as the target. Another example taken from the realm of governmental services would be the (2) Personal Property Register developed by the local government in the Canadian province of Manitoba. This system was developed by IBM using a combination of Enterprise Java Beans (EJB) and XML technologies. This application was designed to allow businesses to register liens on personal property such as cars or real estate. Because it was easily accessible through the Internet, it was expected that it would reduce the call volume and the amount of manual processing involved in filing a lien. This further strengthened the perception of businesses that they were able to work more closely with the provincial government to simplify standard processes.

Supplier as Target Many of the XML and Electronic commerce applications reported in the literature are developed to create corporate Web portals. Many of these portals are part of a larger strategy to link up suppliers with customers more efficiently. If one views employees as suppliers of labor then applications that improve their ability to provide labor can be viewed as a supplier as a target. Several XML case studies related to using XML to share information on the corporate intranet have been reported. One interesting and well-defined application that used XML was the (3) UK Assayer's Office Workflow system. In this application, worknotes with assay information about gemstones are passed along to the appropriate Assay Office employees on the office intranet. The HTML notes are presented via Web browsers and are generated from a set of XML files. Worknotes are associated with a customer and an invoice is printed and then sent to an accounting package. This system improves the efficiency of the Assayers and enables work to be tracked more easily through the various stages in the system.

Partner as Target One of the less obvious targets for an XML application is the business partner. Partners have recently become increasingly important as businesses work to increase the efficiency of their supply chains using Internet technologies. In one sense, a business partner is just a customer or a supplier, but identifying them as "partners" means they have a special relationship that businesses want to be careful to focus on (Raouf 2000). A growing number of reported XML applications have been targeted at these partners. In the highly competitive field of trading financial derivatives, JP Morgan has been working with a select group of partners to develop an application that would automatically generate trade confirmations. Existing systems for this are labor intensive because they usually involve the fax and phone and are susceptible to errors. It can also sometimes take days to confirm a transaction. XML was good for this application because of its ability to structure the data in a way that enables automated processing. A number of XML standards such as FpML, OFX, and FIXML are being used to share different types of financial information no specific standards existed for trade confirmations. The leading derivatives firms are working with the FpML standards because it is more oriented to their industry. JP Morgan is using this standard to produce an XML application for automating the trade confirmation process. This application is being piloted internally and with some key partners.

Competitor as Target While most strategic IT applications can be thought of as ultimately having one or more competitors as its target, not all of these would have the competitor as the primary target. One highly publicized firm, E-Chemicals used Internet technologies such as XML to redefine the chemical supply industry (Schwartz 1999). Founded in 1998, E-Chemicals was able to reduce distribution costs 7-10% by tying all the players together in a single network. They used an XML-enabled Advanced Messaging technology to integrate information related to the sale, purchase, delivery and billing of industrial chemicals. The set-up for new products and suppliers can be done in just a matter of hours and because it takes advantages of the company's existing ERP systems, the costs range from $15,000 to $50,000 depending on the number of products and the complexity of the IT infrastructure. This new company has shaken up the chemical supply industry and has forced most of the major players to develop an Electronic commerce strategy in response to their success.

Strategic Thrusts of XML Applications

Once a target for the application has been determined there are a variety of different themes or strategic "thrusts" that the XML application may have. As before, an application can have multiple thrusts but for our purposes we are interested in exploring the primary thrust for which it was developed. The notion of thrust has been broken down into five different areas as described in Table 4 below. Case studies of XML applications have been placed in the matrix to further illustrate this.

Cost as Strategic Thrust Because one of the primary benefits of XML is to increase the efficiency of operations, almost all XML applications can be thought of as having a cost dimension or thrust. One example of this would be (5) General Motor's use of XML to share CAD/CAM designs via their corporate portal (Karpinski 1999). Their enterprise information portal was designed to give employees access to legacy data over the Internet. Specifically, they were trying to reduce the costs of the engineering design cycle by building XML interfaces to access data in legacy client/server and mainframe systems that were located mainly in Detroit and Germany. This information consisted initially of cost, inventory, and technical data that designers needed to access when working with CAD/CAM drawings. For large corporations such as GM, internal information sharing applications for enterprise data and application integration may offer the biggest immediate opportunity for XML.

Table 4. The Matrix with Examples of XML Applications from Strategic Thrusts

		Strategic Targets			
		Customers	Suppliers	Partners	Competitors
Strategic Thrust	(a) Cost Leadership		(5) GM Portal		
	(b) Product Differentiation	(6) Dell.com			
	(c) Product Innovation		(7) Personnel DSS		
	(d) Growth			(8) Unit Trust Portal	
	(e) Alliance			(9) Irish Credit Inquiry	

Product Differentiation as Strategic Thrust While most people know of Dell Computer's story as one of the Internet's most successful companies, not many people are aware of the difficult technical hurdles that had to be overcome in order for the company to differentiate its strategy from the rest of the computer industry. Dell distinguishes itself from the others in several ways. Foremost of these is that their Web site allows users to configure and price their own computers, which are then assembled and delivered usually within three days. What most users are unaware of are all the technical difficulties in constructing and maintaining such a massive Web presence. Prices on most products change on average three times each week and the Dell.com site lists thousands of different components. Using HTML alone would mean that someone would have to perform the tedious task of updating all the HTML pages. In addition, Dell wanted to customize the page output according to stored user profile for things such as location, language, past purchase history, etc. In 1999 Dell took the first major steps towards accomplishing their goal of separating Web content from its presentation. They converted existing databases to XML (6) using an application development tool and used XSL linked to client cookie files to customize the Web page output. They are further experimenting with VoiceXML and also are working to integrate XQL for better query performance on their Web site. One of the side benefits of using XML based technologies for their Web site is that they are confident that XML will not disappear overnight or be subsumed by a new, incompatible technology. It is also expected that more than 50% of their total revenues will be generated from sales off of their Web site in 2001.

Innovation as Strategic Thrust Several innovation uses of XML such as the Sabre cell phone application and the JP Morgan trade confirmation application have already been mentioned. To be considered part of a product innovation strategy, we must imagine how XML was used to create a new product for one or more of the stakeholders involved. Because XML and its capabilities are so new to most developers and administrators, the product innovation strategy offers one of the most promising application areas for those who can think creatively. It should also be kept in mind that innovative new products also may provide the greatest immediate impact of any of the possible strategies. And because XML does not require a lot of new hardware and software, it may be that the cost of this strategy will not be prohibitive. Another early example of how XML has been used to develop an innovative new product would be the Personnel Evaluation DSS (7) developed for Shell Services International (Connolly 2000). The basic idea was that Shell wanted to be able to provide managers a tool that would help them rate the skills needed for certain jobs and also to evaluate the competencies of individual employees and then to perform a "gap analysis" assess their suitability and point out possible areas for training or improvement. This Decision Support System or DSS had to be able to be easily modified so managers in widely different divisions of the company could use it. In addition, it needed to be able to access job description data that currently resided on a company mainframe. It also had to be capable of running on almost any platform in the world, since Shell is a global company. Given these difficulties, it was decided that XML would be a good tool for developing the application because of its integrative capabilities. A successful tool was built using XML for the data integration and XSL to render the output along with another ActiveX development tool.

Growth as Strategic Thrust A number of traditional companies have been experimenting with XML to take existing products and distribute them more widely over the Internet. One obvious industry is publishing or content providers and several of these have also been reported as using XML for Web-based applications. In the financial industry, one leading unit trust company already had a very comprehensive Web site, but that they wanted to expand their presence into a full-blown Web portal (8). This would allow them to expand services, which they could provide to unit holders and also would brokers and third party consultants to offer their services more readily (Stackpole 2000). Under partnering agreements, the trust company even wanted to be able to repackage their services with the look of the third party if desired. The new portal would allow the company to grow in new markets with new services offered around the clock in a more efficient manner. However, there were a number of requirements that had to be met before they began. The company wanted an application that would be relatively independent of future changes in the system and also one that would not disrupt the current system. It also had to be able to extract data from the existing systems and databases. The system architects chose to use XML as the tool for transferring data from the current system into a "staging database". XML was chosen because it was designed to work with Web protocols and also because it was viewed as "future proof" in that more and more vendors would be supporting it. A side benefit was that it now became much simpler to interface their systems with other potential partners and thus to extend their services. Essentially, they succeeded in decoupling their Web site from its content.

Alliance as Strategic Thrust One of the least understood areas in IT planning is how to use IT to create and strengthen alliances. Alliances typically will be with key business partners, but could also be

between more generic stakeholders. One interesting case study shows how XML can be used to strengthen ties with existing partners. An Irish credit reference agency (9) decided that they wanted to create a "credit enquiry system" that would permit member institutions to more easily check a loan applicant's credit report. They also wanted to allow the ability for the member institutions to maintain and update account information for individuals. XML was determined to be the best appropriate tool for the application but there were obvious concerns about the security of the XML tagged information. This highlights one of the major concerns currently with XML, but the developers automated the process of encrypting the standard credit reference forms into a full-scale Public Key Infrastructure (PKI). This seems to have solved the initial concerns about the privacy of the information. Because of the open nature of the XML standards, the system deployment was quick. The same easy to use forms that member institutions had used before were recreated on the Web site interface and this ensured that members would have little trouble in adapting. The new system saved on communication costs and increased the efficiency of processing the credit approval forms. The alliance with members was further strengthened by the fact that the new site provided new query capabilities that did not exist previously and the ease of use ensured that the alliance would not suffer because of the change over.

CONCLUSIONS

The matrix presented above has been used successfully for a number of years as a way for companies to generate options for using IT to gain a competitive advantage. Because XML is such a new and comprehensive technology, this option generator represents a good way to organize thoughts and ideas about how it can be used for specific information sharing applications. The case studies that were presented were used to illustrate how XML has been used in various industries already to gain a competitive advantage and thus to help spur the imagination of IT planners. It should be kept in mind that it is possible that there may be multiple targets for applications and that the mode of the application should be recognized as being either offensive or defensive in nature. This section further specifies a methodology for using the matrix individually or in a group setting as a tool for systematically brainstorming about XML opportunities.

As specified in the original work of Wiseman and MacMillan (1984), there are a number of stages that one should go through when using the option generator as part of the IT planning process. At the start, all the participants should go through a Porter-type analysis of the competitive nature of the industry and an analysis of the position of their particular business unit and for their main competitors. At this point it may be advisable to have IS personnel present an overview of the existing skills, systems, and resources that are currently available to the business unit. These traditionally fall into the general categories of storage, processing, and transmission. As seen from the previous discussions, XML has implications for all of these IS skills. It is at this point that someone who is conversant in XML should give an overview of key XML features.

Next, the option generator matrix should be presented and examples should be given that illustrate what is meant by the different targets and strategic thrusts. Once participants are comfortable with the terms used in the matrix, they should begin by systematically reviewing all the different strategic targets for their business unit. Because XML is oriented towards information sharing, it is recommended that participants evaluate these strategic targets by performing an "Information Sharing Audit". This audit should encourage participants to think in detail about the nature of the specific information and data that is shared with each of the targets. Questions that should be addressed include:

(1) What kinds of information are shared?
(2) How important is this information to each of the stakeholders?
(3) What is the frequency and volume of this information?
(4) What is the format of this information and where does it currently reside?
(5) Do XML standards exist for this information?
(6) Is security an issue for this information?
(7) How is this information collected and processed?
(8) What kind of access do the stakeholders have to this information?

Once these questions have been addressed then participants should go through the different strategic thrusts to see if any of them could be applied to the information sharing issue identified by the analysis of the strategic

targets. It may be helpful to consider also the strategic mode involved and also to reexamine some of the XML cases in more detail.

The XML option generator as presented above provides a simple yet powerful tool for systematically generating new ideas about how to use XML to gain a competitive advantage. This can be used in the context of an IT planning session or brainstorming session. It is especially important to approach XML applications carefully because they can be so confusing and there are so many indeterminate features currently, none of which are understood well. But XML initiatives are underway in most industries now and XML may have implications for data storage, transmission, and even processing. Because its potential impact may be huge it is important that forward thinking managers begin thinking proactively about its implications for their organization. This tool provides the basis for which management personnel can begin to systematically analyze and think creatively about how they may use it to gain a competitive advantage in their industry. From the case studies it is clear that effective use of XML can mean higher efficiency, new services, and new markets.

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