Extensible Markup Language
For Electronic Transactions
in Higher Education

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1 Introduction

1.1 Purpose & Scope

Over the past year, Extensible Markup Language (XML) has become one of the hottest topics in electronic commerce and the Internet. Some have predicted that XML will rapidly make traditional EDI (electronic data interchange) obsolete, while others downplay XML as just EDI in different clothing. This report has been developed to assist the members of the Postsecondary Electronic Standards Council (PESC), and the broader postsecondary education community, in making sense of XML developments and how they relate to the needs of the PESC community. It presents a future vision for the relationship between traditional EDI and XML, both at the standards development level and the technical implementation level. This vision should assist both standards developers and implementers with developing strategies for using XML.

To achieve this purpose, the report addresses the following topics:

- A brief profile of the postsecondary community outlines the community's needs in relation to electronic transactions
- A brief technical overview of XML and related specifications
- The attraction of using XML for electronic transactions with potential advantages and disadvantages in relation to traditional EDI.
- Representative XML efforts in other industries as well as current XML-based initiatives in education are also discussed
- Developing trends in XML usage and the potential impacts
- Recommendations for PESC action

The report deals with technology issues at a fairly high level, and is intended for both non-technical and technical audiences. Although it is written primarily for the education community, much of the information and analyses is applicable to other industries.

NOTE ON TERMINOLOGY: “EDI” has been traditionally defined as “the application to application exchange of structured business data between enterprises”. In this sense, XML may be considered as another technology for EDI, a companion to traditional EDI technologies and syntaxes such as ANSI X12 and EDIFACT. The term “XML/EDI” has frequently been used in this context (notably by the XML/EDI Group). However, many people inextricably associate the term “EDI” with the traditional X12 and EDIFACT approaches. Others think of XML/EDI as basically reformatting X12 or EDIFACT into XML syntax, using the same transaction set structures and data elements. This report intends to address using XML somewhat generically in ways that may have no direct relation to X12 or EDIFACT. So, to clarify terminology, in this paper “EDI” refers to the traditional X12 or EDIFACT approaches. The terms “electronic transactions” or “e-transactions” are used to refer to a larger context which encompasses several different approaches including XML, traditional X12 and EDIFACT, and object-oriented technologies. In general the term “e-business” is used in the same way “e-transactions” is used here. However, in order to avoid any confusion between for profit, not-for-profit, non-profit, and government entities, and any confusion with web-based applications, the terms “electronic transactions” or “e-transactions” are used.

1.2 Profile of the Postsecondary Education Community

PESC supports the postsecondary education community by promoting standards for sharing education-related data electronically. The community it serves is comprised of:

- Public and private postsecondary institutions
Large and small lenders, guarantors, and servicers of educational loans
Higher education professional associations
Software and service providers
State and Federal agencies

The student data exchanged among these diverse institutions and organizations focuses on student financial aid, enrollment reporting, transcripts and student records, testing results, applications for admission, course catalog information and student prospect information, among other applications. Some of these exchanges have used electronic delivery in closed systems and proprietary standards for a number of years. Others are slowly implementing national ANSI ASC X12 standards over the Internet. Still others, for various reasons, remain tied to their paper-based systems.

Some processes are mandated by a government agency or a single service provider, and those data formats tend to be proprietary. Others have been embraced by an industry group, such as CommonLine, for guaranteeing student loans. X12 standard transaction sets (TSs) have been set and implemented for many processes used by institutions, including:

- Sending and receiving transcripts (TSs 130, 131, 146, and 147)
- Educational Testing and Prospect Request and Report (TS 138)
- Course Catalog Information (TS 188)
- Application for Admission (TS 189)
- Student Enrollment Verification (TS 190)

In addition, supply chain X12 transactions such as invoices and purchase orders are used by a handful of postsecondary institutions.

Other standards of interest to the postsecondary education community include a standard for public key infrastructure, standard data definitions that support electronic exchange of education-related data, standard methods of identifying entities across the education community, and new standards-based data exchange methodologies.

Because of its diversity, generalizations about the whole community are hard to make. Several factors tend to have a great influence on how an organization implements technologies for electronic transactions and other software systems. Reflecting the diversity of the community, these factors tend to be played out differently in different segments of the community.

- Capital Cost Constraints - Higher educational institutions typically have smaller capital budgets for computer software and hardware than similarly sized enterprises in other industries such as manufacturing or retail. This situation is alleviated somewhat by education discounts offered by many vendors, but it is still a major consideration. There is significant use of free, public domain software where applicable. Smaller institutions and lenders may have similar cost constraints, but they may opt for low-cost, off-the-shelf software. At the other end of the spectrum, large lenders such as Citibank, and several government agencies, may have large capital budgets more in line with similarly sized enterprises in the private sector.
- Operational Cost Minimization - Many educational institutions frequently make use of low-cost alternatives to assist in minimizing operational costs. As an example, the higher education community pioneered EDI over the Internet (the SPEEDE/ExPRESS project) to avoid transaction fees charged by Value Added Networks.
- Labor Cost - Some higher education institutions have a fairly low-cost labor supply, often in the form of teaching or research assistants and student projects, to employ on information technology projects. On the other hand, many small lenders and institutions may have little or no programming staff, and little or no budget for outside consulting. Again at the other extreme, large lenders and government agencies may have large staffs with labor costs comparable to private industry.
• Limited Market – There are only approximately 3000 higher education institutions in the US in contrast to hundreds of thousands of manufacturing firms and retail enterprises, tens of thousands of which use EDI. This relatively small number tends to limit the market for certain types of application software. On the other hand, certain activities, such as procurement, may be handled by widely available general purpose software.

• Dominance of hubs - In other industries such as manufacturing and retail, trading relationships are typically characterized by “hub and spoke” configurations in which large customers trade with groups of smaller suppliers. The hubs dictate implementation conventions, and the suppliers may trade with several hubs. In higher education, the relationships among institutions exchanging transcripts tends to be more peer to peer. However, some student loan transactions, particularly when government agencies or large lenders are involved, tend to follow the hub and spoke model.

These factors have different influences on the different sectors of the community. For colleges and universities, the capital cost constraints combined with the limited market result in relatively few vendors offering specialized software packages for higher education administration. Due to limited vendor choices, capital constraints, and relatively low-cost labor, many institutions may build their own applications rather than buy them. At present, institutions typically use general-purpose EDI software, but staff rather than vendors often perform integration with administrative applications. However, again noting the diversity of the community, there is a trend toward student information systems vendors embedding EDI translators within their systems. For small colleges and lenders, the same factors may tend to dictate using PC-based commercial, off-the-shelf software, so their preference is to buy rather than build. Large lenders and government agencies may use large commercial packages where they meet their needs but may also perform considerable customization or in-house development when such packages don’t completely meet their needs.

The factors noted above will likely hold true and have continuing, similar effects as the technology for conducting transactions electronically evolves beyond traditional EDI.

1.3 The Time Line

One question revolving around the use of XML for electronic transactions is “When will it be ready?” It is difficult to say for sure, but there are several dependencies that must be met. The time line illustrated below shows the dependencies, and is used as a key to show the range of the time line being addressed and progress along that line in the relevant sections of this document.

1. Foundation - World Wide Web Consortium completion of base XML specifications such as XSL and XML schemas
2. Tools - Tools vendors support for these base XML specifications
3. Implement - Applications vendor implementation of the tools
4. Standards - Development of XML business standards, i.e., Document Type Definitions (DTDs) or schemas for particular business documents
5. Standards Support - Applications vendor support for XML business standards, and widespread availability of easy to use transformation tools

2 XML in a Nutshell

Time Line Progress: Due to publication of XML 1.0 and a great deal of work on related specifications, roughly two-thirds of the foundation work relevant to using XML for electronic transactions is completed.

First and foremost, XML is a markup language. Unlike programming languages, which describe data structures and embody algorithms for processing data, the primary purpose of markup languages has been to format and manipulate text. Markup languages were developed for publishing in the days before graphical user interfaces, such as those offered by Microsoft Windows and Macintosh, enabled documents to be formatted with WYSIWIG (what you see is what you get) editors. Markup languages are used to instruct text processing programs that certain "marked up" text is to receive special formatting when printed, such as bolding or underlining. Markup languages, as will be discussed later, have been adapted to other uses beyond publishing and displaying text, but this remains their history and primary motivation.

XML, like its cousin HTML (HyperText Markup Language), is derived from Standard Generalized Markup Language (SGML). SGML was standardized in the 1980’s by the International Standards Organization (ISO). SGML contains a very rich set of features that enable not only a wide variety of formatting but creation and maintenance of things such as tables of contents and indexes. SGML allows the user to create not only single documents but also templates that define the layout and organization of documents. These templates are called document type definitions, or DTDs. Documents can be created compliant with the templates, and when printed all have a consistent appearance and organization. SGML is still widely used in certain industries, particularly in Defense.

HTML was created for the World Wide Web as a single SGML document type. It is then a subset of SGML that is fully compatible with SGML. As web development exploded in the mid 1990’s, people began to run into the limitations of this single document type offered by HTML. They wanted to do things with web pages which were becoming awkward with HTML, and wanted additional features such as indexes, tables of contents, and the ability to format a single document both for printing and display using a web browser. However, SGML was too complex for this purpose, and something in between was needed. Thus, the World Wide Web Consortium
XML, like HTML, is a subset of SGML. The base XML 1.0 specification was approved by W3C in February of 1998. In computer science terms, XML is not strictly a language but a “meta-language,” or a language that is used to define other languages. XML is like a spoken or written language that has an alphabet, punctuation marks, a limited set of grammar rules, and about a half dozen nouns. If it were a language in this sense, you could create words, finish the grammar, and just as easily define the French language as you could English. It is this attribute of XML, its flexibility, that is both its greatest strength and, as will be discussed in using XML for electronic transactions, its most problematic weakness.

The base XML 1.0 specification defines the main features of the XML syntax. Like SGML, it defines both how documents should be created with XML and how to create the templates, or DTDs, that describe a document's organization and the specific elements or "markup tags" used in it. XML looks very similar to HTML, with the tags enclosed in angle brackets (“<” and “>”), and leading and trailing tags surrounding text. Like HTML, two types of information are contained within the tags. One is the XML "element name", and the other is one or more optional "attributes" with associated values. A typical string for a first level chapter heading in bold, blue type, might look something like this in XML:

```
<HEADING level="1", font="bold", color="Blue">Chapter One</HEADING>
```

HTML defines in its one document type all of the elements and attributes that are valid in an HTML web page. XML, on the other hand, defines only a small handful of special elements and attributes. The rest is entirely up to the user. The user may define a DTD for the document that specifies the set of elements, attributes, and their usage that is allowable for the document. However, use of a DTD is optional. If a document complies with a DTD, it is considered "validated" against the DTD. However, without being validated against a DTD, a document may be considered "well-formed" if it follows all of the XML grammar rules.

It is important to understand that XML is not just one specification but a family of related specifications. The XML 1.0 specification only defines well-formed documents and DTDs and does not deal with such things as display and data entry. These are defined in other specifications produced by W3C. Some of the other major specifications in the XML family, and their current status, include:

- **XSL**, or Extensible Stylesheet Language - This defines a language for creation of "stylesheets" that determine the formatting or display of printed XML documents. This work is still in progress.
- **XSLT 1.0**, or XSL Transformations - A language for using XSL to define rules for transforming one XML document into another with perhaps different tags, attributes, organization, etc. Intended primarily for use with XSL, rather than general purpose transformations. Approved in November 1999.
- **XHTML 1.0**, or the Extensible HyperText Markup Language - HTML 4.0 converted to be compliant with XML. Approved in January 2000.
- **XML Schemas** - More rigorous and detailed means to define XML document templates beyond what is offered in DTDs. This is important for using XML for electronic transactions where business applications may expect data to pass certain types of edits and validity checks before being processed. In progress, but expected to be approved in mid-2000.
Notably missing from the current work list is support for data entry forms, a common feature of many HTML web sites. Some forms support is built into XHTML, and there were early submissions dealing with "architectural" forms and "XML Forms Definition Language."

The divisions noted in the specifications illustrate another of the most important features and strengths of XML in addition to its flexibility. That is the ability, using XML, to separate document content from presentation to or usage by the end user. This enables the same XML document, for example, to be:

- Displayed in a web browser using formatting supplied by an XSL stylesheet
- Nicely printed using an XSL stylesheet
- Directly imported into a spreadsheet or database, perhaps by a future version of Microsoft Excel, for example
- Processed by or imported into a business application, according to the document definition in the DTD or schema.

It is apparent from all of this that XML has great potential for changing not only the web but also many other types of computing applications. However, it is also evident that at present this is just potential. Not only is software not yet available to support the features described above, but the specifications themselves to which the software must conform are still evolving. For example, Microsoft's Internet Explorer Version 5 offers the best XML and XSL support among popular web browsers. However, even it does not yet fully support the latest version of the XSL draft. The authoring tools to create web pages for XSL and XML are still rather limited in availability and primitive compared to HTML tools such as Microsoft Front Page and Netscape Composer. As will be discussed in Section 5, most of the XML software that is currently available is concerned with helping application software vendors build XML capabilities into their products. A reasonable guess is that it may take from one to three years for XML tools to catch up with and surpass HTML tools in both usability and availability. Most knowledgeable people in the industry believe that this will happen eventually, but it certainly has not happened yet. It is also believed that XML and HTML will co-exist for some time to come, even after XML matures.

So, despite all of the hype in the trade press, XML is not yet "ready for prime time." This is nowhere more apparent than in the area of electronic transactions, as a replacement for or next step in the evolution of EDI. Some of the most important base XML technical specifications are not ready yet, and the software that implements them is not mature either. Importantly, despite some claims to the contrary, business standards will be required for XML to reach its full potential for electronic transactions. As will be discussed in the next sections, that work is in its infancy.

3 Why XML for Electronic Transactions?

The previous section gave some hints as to why there is such great interest in using XML for electronic transactions. Indeed, if one keeps up with the trade press, it seems that greatest initial interest in using XML has been in just this area. XML potentially offers some great advantages for electronic transactions over traditional EDI technologies. However, there are a few caveats to be aware of and a few important dependencies to be met before the full potential can be realized. In addition, there are many benefits that have been hyped for XML that may not turn out to be real. Finally, there are some situations in which traditional EDI may still be the best technology for some time to come.

The following figures will be helpful in understanding how XML might be used for electronic transactions and how it differs from traditional EDI.
As noted in the previous section, one of the goals of designing XML was to separate document content from presentation or usage. This diagram illustrates this, showing that the same XML document may either be printed, displayed in a web browser, or imported into an application. This is one of the greatest potential advantages to using XML for electronic transactions. Like traditional EDI, XML documents may be used by business applications. However, XML differs in its support of small enterprises whose applications may not have an integrated means to process electronic transactions. With traditional EDI, these enterprises must acquire at least desktop EDI systems to print incoming transactions and perform data entry functions for outgoing transactions. With XML, these enterprises may need only a general purpose web browser. Even for those with integrated electronic transaction capabilities, the picture is significantly different, as shown in Figure 2.
General purpose EDI translation and management software is generally used to integrate traditional EDI with business applications. A processing flow involves the following steps for a typical X12 exchange:

- A business application generates an export file (labeled EXP) with documents to send to one or more partners.
- The export file is processed by the X12 translator to reformat it into one or more X12 interchanges for transmission to trading partners.
- The interchanges are sent through a network to partners. Value Added Networks are still usually employed, although there is increasing use of the public Internet.
- The receiver processes the interchange through an X12 translator to reformat it into an import file (labeled IMP) that may be directly imported by their business application.
- The import file is then processed by the receiver’s business application.

XML may make the process somewhat simpler, as shown below.

The processing flow in this picture is significantly simpler than in Figure 2.

- An XML-enabled business application directly exports a file of business documents in XML format.
- The file is transported over a network, probably the public Internet, to the receiver.
- The receiver's XML-enabled business application directly imports the file and processes it.
At least part of this scenario is likely to occur due to the availability of software development tools that enable XML to be integrated fairly easily into business applications. These tools will be discussed in a later section, but their impact, along with the great interest in XML, is clear. It is likely within a few years that XML will have broad support as a somewhat universal import and export format.

The picture in Figure 3 is a vision that is often hyped by XML evangelists. However, it may be somewhat “ideal” in that it expects each party to agree to the other’s format, and that the business applications may generate and process them with no further transformations. This is probably somewhat unrealistic for several reasons:

- Due to lack of standards and the rush to incorporate XML features into applications, the initial implementations of XML import and export features will probably use XML document structures and element names that closely match the vendor’s internal structures. For example, a QuickBooks purchase order might use internal QuickBooks field names and look quite different than a PeachTree purchase order. This trend is already becoming apparent.

- Even when file formats are basically the same, due to small differences in the same basic business processes, files exchanged with one trading partner may be different from files exchanged with another. This is quite common in traditional EDI.

It is therefore likely that there will be a transformation at one or even both ends of an exchange, as shown in the next figure.

![Figure 4 - Realistic XML Integration](image)

This flow is basically the same as in Figure 3, except that there is a transformation at the receiver’s end from the sender’s format into a format that the receiver’s application may process. Conceivably, there may also be a transformation at the sender’s end, so that what is exchanged between the two is an intermediate “interchange format” that is directly processed by neither application.

Even though there are transformations in this picture, what is different from traditional EDI is the probability that the transformations may be performed by low-cost, general purpose XML tools rather than specialized EDI translators. The most likely tools to perform these types of transformations are software utilities that use XSLT scripts. XSLT was developed primarily for use with XSL, but there is a good deal of interest in using it as a general purpose document transformation tool. Further, similar to today’s graphical EDI mappers, it is likely that there will be fairly easy-to-use tools to create XSLT scripts that perform the transformation from one XML document type to another. Two significant features stand out about these transformation tools:
They will be general purpose, mass market, and hence low cost. They will support for example, transformations of XML documents for publishing in addition to transformations for electronic transactions.

The XSLT scripts may be portable, i.e., they may be usable by completely different tools. This is quite in contrast with current EDI mappers and translators where one product's maps can not be used with another. This opens the possibility for users in trading communities to share XSLT scripts. It may also open a market for vendors to provide XSLT scripts with their applications.

An additional advantage of using XML over traditional EDI has to do with ease of use for software developers and implementers. To understand an X12 transaction set, one must refer to the published X12 standards. However, one of the primary strengths of XML is the ability to convey the description of the data along with the data, so that one does not have to refer to a manual to get at least a reasonable understanding of a document. For example, a programmer could read an XML document containing:

```xml
<StudentID type="SSN">123-45-6789</StudentID>
```

And know immediately that the field is a student ID number, using the student's Social Security Number. This is a significant advantage, and considering the cost of published standards manuals and the high learning curve in dealing with the standards and implementation guides, is not an advantage that should be discounted.

These are all significant advantages. However, not all of the purported advantages of using XML for electronic transactions are necessarily true. Here are a few that readers would be prudent to examine.

Business standards for using XML will not be necessary - Strictly speaking this may be true. And, if true, it would be a big advantage over traditional EDI because the processes to develop and approve standards tend to lag far behind the business needs. However, the price of having no standards is potentially a greater number and wider variety of document types depicting basically the same data. XML offers such a great degree of flexibility that the following are only three of the ways that the same data could be formatted:

1) `<StudentName>Fred Flintstone</StudentName>`
2) `<StudentName>
   <Last>Flintstone</Last>
   <First>Fred</First>
</StudentName>`
3) `<Name type="Student">`
   `<Surname UN_CODE="BXYZ-23">Flinstone</Surname>`
   `<Given UN_CODE="BXYZ-24">Fred</Given>`
`</Name>`

The complete freedom in choosing XML element names, as well as the additional flexibility of using attributes, leads to a near infinite number of ways to format any given item of data. Each different way requires a somewhat different programming approach and transformation. This wide variety of documents means that more transformations must be programmed and supported. This leads to higher labor costs and more error-prone processing. It reduces the likelihood that large groups of users will need similar transformations. This thereby reduces the possibility of shared XSLT scripts or vendors supplying XSLT scripts with applications. In addition, as those familiar with EDI integration will attest, wildly varying transformations may yield some which can not conveniently be done with standard XML tools, and may even yield some which are completely impossible without resorting to other programming tools such as C++ and Java. Standardized element names, attribute names
and values, usage of attributes, and document structures will help to minimize the variations and transformations that will be required.

- No translators are required - As noted above, it is highly likely that an XML document will be transformed from one format to another at one or both ends of an exchange. The EDI translator will not completely go away but will probably be replaced by a general purpose XSLT transformer.
- XML will be appropriate for all electronic transactions and will replace traditional EDI - Traditional EDI formats offer a much more compact syntax for transmitting data than XML. They may continue to be more appropriate for large, bulk data transfers. In addition, XML is not likely to quickly replace traditional EDI where there are large infrastructure investments in traditional EDI.
- XML will make everything easier - If XML achieves its potential it will make several aspects of exchanging transactions electronically significantly easier and cheaper. However, XML deals only with the technology part of the problem. The business aspects, such as negotiating the business process, the data that needs to be exchanged and the source or destination of the data in the business application are often the most difficult parts of doing business electronically. These aspects remain the same--though there are some initiatives, notably ebXML--which may provide some help in this area.

Using XML for electronic transactions may offer significant cost advantages over traditional EDI due to:

- Off-the-shelf integration with business applications, rather than custom interfaces
- The potential to use general purpose, and hence lower cost, XML tools rather than specialized EDI software

For XML to reach this full potential, business standards must be developed for using it. Several such standards initiatives are discussed in Section 4. In addition, some remaining basic XML specifications, such as XSL and XML schemas, must be completed and approved. Finally software which implements these specifications must become widely available, and application vendors must build XML capabilities into their offerings. Many vendors are already offering significant XML tools, and this is discussed in Section 5.

4 XML E-Transaction Standards Initiatives

*Time Line Progress:* With the exception of completed standards in a handful of specific industries, development of XML business standards, i.e., DTDs and schemas for common business documents, is in its infancy.
There is a great deal of activity to develop business standards for using XML for electronic transactions. Several standards are being developed for use in particular industries. There is almost so much activity that it might be easier to list the industries that are not investigating using XML than to list those that are. While this type of activity may have been going on prior to XML coming on the scene, the advent of XML certainly seems to have accelerated it. There are also several cross-industry initiatives that seek to be universally applicable. However, despite the activity, there are only a few efforts that as yet have completed and published specifications. This section profiles a sampling of some of the major cross-industry initiatives and an overview of some of the major initiatives in education. To give an idea of the breadth of interest in XML, a small sampling of efforts in other industries is also profiled.

For a comprehensive listing of several initiatives, please refer to the article, “Extensible and More” at the XML.ORG web site. This is a source of XML information sponsored by the Organization for the Advancement of Structured Information Systems (OASIS), an industry consortium focused on SGML, HTML, and XML. The URL for the article is: www.xml.com/pub/2000/02/23/ebiz/index.html

NOTE: The content of this section is for informational purposes only. Presence or absence of an initiative has no relationship with any PESC position on the initiative.

### 4.1 ANSI ASC X12

- **Who:** Accredited Standards Committee X12 of the American National Standards Institute
- **Sponsors:** American National Standards Institute
- **Main Players:** Major users of the X12 EDI standards, EDI translation software vendors, EDI Value Added Networks
- **URL:** [www.x12.org](http://www.x12.org)
- **What:**
  3) Ongoing development work aligned with the ebXML initiative

X12 began working on XML in February 1998, with the formation of an ad hoc task group with members of X12, primarily from the Communications and Controls Subcommittee (X12C), and the CommerceNet Consortium. CommerceNet is a global non-profit membership organization, founded in 1994, whose mission has been to promote and advance interoperable electronic commerce to support emerging communities of commerce. This effort was later joined by members of the XML/EDI Group, an affiliate of the Graphics Communication Association, whose mission is to promote the use of XML for electronic transactions. The task group was chartered to investigate the viability of using X12 data elements, segments, and transaction sets as a basis for using XML for electronic transactions. It was mainly concerned with determining the best way to represent X12 transaction sets in XML syntax. The final report was released in August 1998. This report proved that there was interest in using XML for electronic transactions, based on current X12 EDI standards, and provided a preliminary methodology for doing so. However, there were many deficiencies in that methodology, as noted in Rawlins' commentary.

In October of 1998, following completion of the ad hoc report, X12C took the X12-based XML work in house to develop an X12 technical report. The work was performed in the EDI Architecture task group of X12C (X12C/TG3). The goal of this report was to define a
methodology for using X12 semantics in XML syntax. The effort recognized that there is a wealth of business information contained in the X12 standards but that it was inextricably bound to the X12 syntax. The goal of the report was to devise a way to identify the business meanings, or semantics, in the X12 standards, and prescribe the best way to represent them as XML documents. The report was completed and approved in October 1999. It was published as an X12 Technical Report Type 1, which represents the work efforts of a single X12 subcommittee and does not have the consensus of a full X12 standard. It dealt only with representing an individual transaction set, and did not deal with full X12 interchanges, functional groups, and other related aspects of the X12 standards necessary for a complete XML-based solution. The work effort also developed a preliminary list of XML element names for X12 components, but at present this list has not been posted on the X12C/TG3 web site. There were plans to continue development of the methodology and involve other subcommittees of X12, but the work has been suspended with the development of the ebXML initiative. It may or may not be resumed, depending on whether or not the approach is consistent with the ebXML specifications.

X12 was invited to participate in the ebXML Work Group (see below) and a large turnout of X12 members attended the organizing meeting in November 1999. Several X12 members continue to participate, with much of the ebXML leadership coming from persons involved in X12. In light of the developments in ebXML and X12C, the Steering Committee of X12 at the October 1999 meeting formed an XML task group under its auspices to coordinate and recommend an overall strategy for XML development within X12. Based on the recommendations of that task group’s first meetings at the February 2000, X12 meeting, the Steering Committee resolved that X12’s XML development should continue within the framework being defined by the ebXML Work Group. There continues to be interest in most X12 subcommittees in pursuing XML development.

### 4.2 ebXML

- **Who:** The Electronic Business XML (ebXML) Work Group
- **Sponsors:** United Nations European Center for the Facilitation of Administration, Trade, and Commerce (UN/CEFACT, the parent body of the EDIFACT Working Group), and OASIS (the Organization for the Advancement of Structured Information Standards)
- **Main Players:** Wide and diverse participation, including members of CEFACT groups such as the EDIFACT Working Group, ANSI X12, major software vendors such as IBM and Sun, vendors working in XML such as CommerceOne, and trade groups from several industries.
- **URL:** www.ebxml.org
- **What:** A set of specifications for a framework to enable interoperability of XML-based business applications.

UN/CEFACT and OASIS announced formation of the ebXML Work Group in September 1999. All of the major players involved in developing XML for electronic business were invited to participate. The goal of the work group is to define an infrastructure, or framework, which will enable interoperability of XML-based e-business applications. Being a framework, it is not concerned (at least in this phase) with the development of DTDs or schemas for individual business documents. Rather, it seeks to specify consistent ways to develop, define, and transport such documents, along with specifications for supporting facilities and activities such as registries and repositories and business process modeling. The vision is that cross-industry groups such as the EDIFACT Working Group or ANSI X12, and vertical industry groups such as HL7 in Health Care, ACORD in Insurance, or the Open Applications Group in manufacturing industries, would use the specifications developed by ebXML to develop their own standards. Such standards may be developed "top down" with a consistent way to do business process modeling, with schemas or DTDs being derived from the models, or may proceed "bottom up" by directly creating schemas or DTDs. The goal is that if such standards are developed in compliance with the ebXML specifications, then systems that use them should be interoperable.
The work within ebXML falls into the following major areas, each assigned to a specific project team:

- **Requirements** - Determine the overall business requirements and specific requirements for the ebXML technical framework. An initial Requirements Specification has been submitted for ebXML comment, with approval expected at the May 2000 meeting.
- **Architecture** - Define an overall architecture for the ebXML framework. Also, deal with such related issues as XML message design.
- **Transport, Routing, and Packaging** - Specify the recommended means for transporting XML documents between enterprises and route them within enterprises. Also, handle security and related issues.
- **Business Process** - Define or adopt a business process "meta-model", i.e., a set of components or building blocks that can be used to define business processes using the Unified Modeling Language (UML), an object-oriented analysis approach.
- **Core Components** - Define or adopt a set of lower level components, such as name and address blocks, that can be used to define business processes and XML DTDs and schemas. The Business Process work defines components oriented towards processes, while the core components work deals more at the level of data items.
- **Registry and Repository** - Specify a registry for organizing and indexing XML (and other) related components, and a repository for storing them. It is envisioned that all sorts of ebXML components would be stored in these registries and repositories, along with business process models, DTDs, and schemas developed by other groups using the ebXML specifications. Trading partner profiles might also be stored here, enabling companies to consult the repository to determine the business processes and schemas supported by partner companies.

This is an ambitious work effort, with completion expected by summer of 2001. The organizing meeting was held in November 1999, and meetings follow every quarter. The project teams continue work in between meetings with weekly conference calls, work by e-mail listserv, and interim meetings. The first two meetings averaged around 150 participants, and most of these continue to be active on the project teams in between meetings.

OASIS and UN/CEFACT have plans to take the specifications produced by the work group and submit them to the appropriate bodies, such as the International Standards Organization (ISO), for adoption as full standards.

### 4.3 IFX

- **Who:** The Interactive Financial Exchange (IFX) Forum
- **Sponsors:** Initially organized as the "InteroperaBILL" initiative under the auspices of the National Automated Clearinghouse Association’s Council on Electronic Billing and Payment
- **Main Players:** banks, brokerage companies, billers and technology providers, such as Checkfree, Intuit, Microsoft, AT&T, Wells Fargo, FleetBoston Financial, Security First Technologies, Just in Time Solutions, Integrion Financial Network, EDS, IBM, PaineWebber, Citibank, BankAmerica, BITS
- **URL:** [www.ifxforum.org](http://www.ifxforum.org)
- **What:** IFX Business Message Specification - A specification for an open and interoperable online financial services marketplace.

IFX is designed to provide a robust and scalable framework for the exchange of financial data and instructions independent of a particular network technology or computing platform. It was developed as a cooperative industry effort among major financial institutions, service providers and information technology vendors serving these institutions and customers in the small business and consumer markets. It is the result of combining the Open Financial Exchange (OFX) specification (used by Intuit in Quicken, among others), and Integrion Gold.
These are some of the main features of the IFX Specification:

- **Services Provided:**
  - Bank statement download
  - Credit card statement download
  - Funds transfers including recurring transfers
  - Consumer payments, including recurring payments
  - Business payments, including recurring payments
  - Brokerage and mutual fund statement download, including transaction history, current holdings, and balances.
  - Bill presentment and payment
- **Provision of a Broad Range of Customer Service Providers**—IFX supports communication with a broad range of Customer Service Providers (FIs), including: Banks, Brokerage houses, Insurance Companies, Merchants, Payment and Bill Processors, Financial advisors, and Government agencies
- **Supports a wide variety of front end applications and clients**
- **Supports extensibility, reliability, security and international support**
- **Transport independent**
- **Supports batch and interactive exchanges**

### 4.4 **BizTalk**

- **Who:** BizTalk
- **Sponsor:** Microsoft
- **Main Players:** Microsoft; wide range of participants including major software vendors such as SAP and CommerceOne, and major users such as Boeing and BP/Amoco
- **URL:** [www.biztalk.org](http://www.biztalk.org)
- **What:**
  - BizTalk Framework - A set of guidelines for how to publish schemas in XML and how to use XML messages to integrate software programs
  - BizTalk Repository - A library of XML schemas conforming to the framework

Microsoft announced the formation of BizTalk in the summer of 1999. BizTalk describes itself not as a standards body, but “a community of standards users, with the goal of driving the rapid, consistent adoption of XML to enable electronic commerce and application integration.” Microsoft has largely developed the BizTalk framework, with review and input by the BizTalk steering committee. Membership in the steering committee is by Microsoft invitation. The BizTalk framework is similar in intention to the ebXML framework. It covers similar things such as message transport, routing, and packaging, security, and message design rules. However, consistent with Microsoft’s position that BizTalk is “not concerned with the content of documents,” it does not address a consistent vocabulary for XML messages, a set of core components, or business process modeling.

The BizTalk repository is similar in function to the registry and repository being developed by OASIS at XML.ORG, which may become one of the repositories for ebXML components. Any company or organization may post schemas in the BizTalk repository so long as they follow the basic design rules defined in the BizTalk Framework. There is no attempt to order or coordinate the schemas. For example, there are over fifty purchase order related schemas, all different, with most submitted by different organizations.

Being sponsored and guided by a single dominant software vendor gives the BizTalk initiative an advantage in technical consistency and rapid development. However, the close association with Microsoft is also a liability with some potential implementers. Microsoft has recently increased
participation in the ebXML initiative, and there may yet be a chance for the ebXML and BizTalk frameworks to unify, or at least not conflict.

Microsoft is developing products to implement the BizTalk framework.

4.5 Education

This section provides an overview of XML initiatives in education known to the PESC XML Work Group at the time that this report was prepared.

4.5.1 Department of Education - Office of Student Financial Aid

- Who/What: The Office of Student Financial Assistance, a performance based organization of the Department of Education
- Sponsor: U.S. Department of Education
- URL: www.ed.gov/offices/OSFAP/- Follow links to the Modernization Blueprint
- What: The SFA sponsored the Highway One pilot in 1999. It was a proof of concept to test various ways to collect and report data about students. FFEL loan, FDSL loan, and Pell grant data for a student were collected from multiple sources and displayed in a single, consistent view through a web browser. XML was used to format data extracted from ELMnet. As discussed in the Modernization Blueprint, XML is a key technology in SFA's future architecture for both internal application integration and all data exchanges with external entities.

4.5.2 Schools Interoperability Framework

- Sponsor: Microsoft. NOTE: The Software Information Industry Association (SIIA) has recently voted to take over management of the SIF project.
- Main Players: About 70 members as of February 2000. Major systems and software vendors such as Microsoft, Sun, IBM, Oracle, PeopleSoft, and SAP; vendors of school information systems; representatives of school districts.
- URL: www.schoolsinterop.org
- What: A specification to ensure that K-12 instructional and administrative software applications work together effectively. The specification defines standard formats for shared data (e.g., student demographics information), standard naming conventions for this shared data, and the rules of interaction among software applications.

4.5.3 IMS Global Learning Consortium

- Who: IMS Global Learning Consortium, A global consortium with members from educational, commercial, and government organizations.
- Main Players: Major systems and software vendors such as Apple, Microsoft, Sun, IBM, Oracle, PeopleSoft; vendors of school information systems such as SCT; several universities and school districts such as the University of California and Miami-Dade Community College.
- URL: www.imsproject.org
- What: Specifications for facilitating online distributed learning activities such as locating and using educational content, tracking learner progress, reporting learner performance, and exchanging student records between administrative systems.

4.5.4 ELM Resources

- Who: ELM (Education Loan Management) Resources, an alliance of student loan lenders.
- Main Players: Approximately 150 lenders, federal and state government agencies, and guarantors of student loans.
- URL: www.elmresources.com
- What: ELM Resources has created ELMnet, an ATM-scale data switch and interactive Internet client software to offer colleges uniform delivery of student loans. Currently this
service is providing remote access for schools and students, in a secure environment, to a loan service providers system in a “read only” mode. XML is used to format the data for both queries and responses. ELM Resources participated in the Department of Education’s Highway One prototype.

4.6  Efforts in Other Industries
This section offers a small sampling of efforts in other industries, indicating the wide interest in using XML for electronic transactions

4.6.1 ACORD
• Who: ACORD (Agency Company Organization for Research and Development) - The insurance industry's non-profit standards developer. Initially began in 1970 serving the industry with standard printed forms, has expanded role into data integration. Other non-XML standards maintained by ACORD include AL3, a traditional EDI like standard, and ObjX and OLife object oriented standards.
• Main Players/Participants: Over 1,000 major insurance carriers and 25,000 agencies, vendors
• URL: www.acord.org
• What: ACORD XML - Designed mainly for use between insurance agencies and carriers. ACORD is developing XML-based versions of current property and casualty and life insurance standards. These are based on the IFX specification.

4.6.2 DSML
• Who: Directory Services Markup Language
• Main Players: Cisco Systems, IBM, Microsoft, Netscape, Novell, Oracle
• URL: www.dsml.org
• What: An XML-based language for network directory access, intended for network administration.

4.6.3 HL7
• Who: HL7 - Health Level Seven, an ANSI-accredited standards development organization responsible for data interchange standards for clinical and administrative data.
• Main Players: Hospital systems vendors, major systems vendors. HL7 "Benefactors" include Ernst & Young, Johnson & Johnson, McKessonHBOC, Shared Medical Systems (SMS), and the U.S. Department of Veterans Affairs
• URL: www.hl7.org
• What: The current versions of the HL7 standards are based on a traditional EDI syntax that closely resembles X12. The new version 3.0 in development will also support XML and object-oriented approaches such as CORBA

4.6.4 OAG
• Who: The Open Applications Group
• Main Players: Major ERP (Enterprise Requirements Planning) systems vendors such as SAP, PeopleSoft, Oracle, and Baan
• URL: www.openapplications.org
• What: The Open Applications Group Interface Specification (OAGIS) - A set of XML-based specifications designed to enable in-house integration of ERP and supply chain functions.

4.6.5 RosettaNet
• Who: RosettaNet, a non-profit consortium focusing on the information technology supply chain.
Main Players: Major computer and electronics manufacturers such as COMPAQ, HP, Intel, Cisco Systems, IBM; retailers such as CompUSA, Ingram Micro, MicroAge

URL: www.rosettanet.org

What: XML-based standards designed primarily for use in the IT supply chain. Comprised of a data dictionary, an implementation framework that defines the infrastructure, and Partner Interface Processes (PIP) which define exchanges. The PIPs are developed using object-oriented modeling techniques.

5 Software Vendor Support for XML

This section is intended as a representative sample of vendor support for XML. Interest in XML is so widespread that it is hard to find a vendor that does not have an XML strategy, if not product, in development. So, this survey is only a sample.

Vendors are divided into three major categories:

- Tools - Those offering tools to assist developers of applications software in building XML capabilities into their applications
- E-Commerce Software Vendors - Firms that provide e-commerce systems with XML capabilities
- Applications Vendors - Vendors of a variety of business applications

NOTE: The content of this section is for informational purposes only. Mention of or failure to mention a particular vendor should not be construed as a PESC recommendation concerning that vendor’s products.

5.1 Tools Vendors

Time Line Progress: Roughly one-third complete. Support is provided for the basic approved XML specifications, but little yet for more advanced specifications and those still in development.

The vendors listed here have all made considerable investments in XML technology. They are listed here because they are major vendors, and their support and investment indicates that XML is a significant technology. A comprehensive list of tools, vendors and free XML-related software can be found on the XML Cover Pages, edited by Robin Cover and hosted by OASIS.
A common offering of many vendors is an XML "parser," which is a utility that reads XML documents and provides a means for developers to easily access and process the contents of the document.

5.1.1 IBM

URL: IBM developerWorks XML site: www.ibm.com/developer/xml

IBM dedicates a section of their web site to XML tools, articles, and news, and offers a monthly on-line XML newsletter. Some of the significant tools offered for download (currently for free) from their alphaWorks site include:

- XML parser written in Java
- XML libraries for C++
- LotusXSL, an XSL processor written in Java
- XML Generator test tool
- Visual XML Toolset

5.1.2 Microsoft

URLs:
- XML section of the Web Workshop - http://msdn.microsoft.com/workshop

Internet Explorer Version 5, as noted earlier, currently offers partial support for XML and XSL. Like IBM, Microsoft also dedicates a section of their web site to XML tools, articles, and news. Some of the significant tools offered for download (currently for free) include:

- MSXML XML parser. This is shipped standard with Internet Explorer but is frequently updated.
- XML Software Development Kit
- XML and XSL Developer's Guides
- Samples of XML processing using Visual C++
- XML Notepad
- Various XML and XSL demos

Microsoft has also recently completed initial development of its BizTalk server software, and a trial version is available free for download to developers.

5.1.3 Sun Microsystems

URL: "Java Technology and XML" section of the Sun's Java site - java.sun.com/xml

Most of Sun's XML work is related to the Java programming language, which they developed and continue to sponsor. Their XML section, like the others, has tools, white papers, and other downloads. Sun is currently developing extensions to Java that allow it to process XML. Sun states that "XML is fundamental to our plans for the next generation enterprise-computing platform, Java 2 Platform Enterprise Edition. We are using it to make Enterprise JavaBeans(TM) components even more portable. We also intend to make it a standard for the transmission of mission-critical enterprise data."

5.1.4 Oracle
Oracle, like the other vendors, has demonstrated strong support for XML for both application integration and business-to-business exchanges. Oracle has XML-enabled their entire Oracle Internet Platform, including the Oracle 8i database. They also provide the Oracle XML Developer's Kit (Oracle XDK), a set of components that facilitate the delivery and implementation of XML-based data exchanges. It is fully supported by the Oracle Worldwide Support team. The XDK, several other utilities, articles, and other items are available for download from their web site.

5.2 E-Commerce Vendors

Time Line Progress: Similar to that of tools vendors, with roughly one-third complete. Many vendors provide support for the basic approved XML specifications, although in many cases the support is fairly rudimentary. Most still do not support XML schemas, since the relevant specification has not yet been approved.

5.2.1 Sterling Commerce

URL: http://www.sterlingcommerce.com/

Sterling Commerce is a vendor of traditional EDI management and translation software, and operates a Value Added Network. Their main product families are GENTRAN, COMMERCE, CONNECTION, and VECTOR. Like most such vendors, they are building XML capabilities into existing products and seeking to position their offerings as "any-to-any" transformation utilities rather than just EDI translators. Currently XML support is offered as an option in GENTRAN:Server for Windows NT, and in the Web Suite add-on to that product.

5.2.2 Harbinger

URL: http://www.harbinger.com/

Harbinger, like Sterling Commerce, is a vendor of traditional EDI management and translation software, and operates a Value Added Network. Last year it also opened a portal site, harbinger.net, which has XML support. Harbinger has announced that it intends to build XML capabilities into its existing TrustedLink family of EDI software. It currently supports XML in the Windows desktop version. On March 13, 2000, XML support was announced in the latest version of their AS/400 offering.
5.2.3 CommerceOne
URL: http://www.commerceone.com/

CommerceOne was founded in 1994 as DistriVision, and reborn in 1997 as Commerce One. Commerce One has 600 employees, and is one of the current "high flyers" among Internet e-commerce companies. It acquired Veo Systems in 1999, which developed CBL (Common Business Language), an XML vocabulary for business documents. xCBL Version 2.0 is largely based on the UN/EDIFACT EDI standard, but deals primarily only with procurement activities and documents. XML is a key part of Commerce One's e-commerce strategy. Some of Commerce One's main products are their Buysite, MarketSite, Global Trading Web families of products and services for e-procurement and on-line auctions.

5.2.4 webMethods
URL: http://www.webmethods.com/

webMethods is one of a new group of firms that are offering XML-based e-commerce servers that in many ways resemble traditional EDI management and translation systems. So far, most of these are high-end solutions that only support XML, and not other formats such as X12 or EDIFACT. Their primary offering is webMethods B2B, with versions for both web portals and individual enterprises.

5.2.5 XML Solutions
URL: www.xmlsolutions.com

XML Solutions was established in 1998, and has specialized in XML-based electronic commerce. One of their primary work efforts has been to develop a methodology (dubbed XEDI) and supporting products for converting existing EDI Messages (such as X12 or EDIFACT) into XML format using information from existing EDI standards dictionaries. The approach is documented in a white paper at www.xmls.com/resources/whitepapers/X12.pdf. The approach has been presented to a few standards bodies such as ANSI ASC X12 and the ebXML Work Group but has as yet has not gained any official support from those bodies. XML Solutions' XEDI Translator is a server-based translator, implemented in Java, that takes EDI interchanges produced by an existing EDI system and re-formats them into XML for use by small to medium enterprises that do not have EDI systems.

5.3 Applications Vendors

![Diagram of Applications Vendors]

- Foundation
- Tools
- Implement
- Standards
- Standards Support
Time Line Progress: In the initial stages. Many vendors are planning to support generic XML import and export functions but few have actually provided it as yet. Even fewer support industry XML business standards.

This section offers a high level overview of XML support from a very small sampling of application vendors who have been active with XML. In most cases and unless noted otherwise, XML is supported primarily for in-house application integration. Most vendors are working with one or more standards organizations, and have demonstrated commitment to business standards for XML.

- **SAP** - XML support is included in SAP’s flagship R/3 product through Business Application Programming Interfaces (BAPIs). SAP is active in OAG and RosettaNet, and intends to support the specifications of those groups.
- **PeopleSoft** - PeopleSoft, a PESC member, in PeopleSoft 8 offers open integration with enhanced EDI/XML support. PeopleSoft also is active in OAG. It has recently joined RosettaNet and intends to support its specifications as well. XML support has been included in Student Administration 7.6 to facilitate the passing of person, class, and enrollment data to external Internet learning management systems using the IMS standards. The PeopleSoft Portal for Higher Education, in development, will also use XML.
- **Intuit** - Quicken currently supports importing of financial information, such as checkbook registers and credit card statements, in the OFX format (now being superseded by IFX which was discussed earlier). OFX was developed in SGML, but is compatible with XML.
- **SCT Corporation** - A PESC member and vendor of student information systems. SCT uses XML formatted messages to integrate student information in their back office student administrative system with the Campus Pipeline web portal.

6 Trends and Impacts

The preceding sections should provide an overview of the XML landscape. XML development in both software and business standards is rapidly moving forward. However, as has been noted, there is still quite a bit of work to be done in these areas before XML can be widely adopted for electronic transactions. Several clear trends are emerging for software vendor support. However, the area of business standards for XML is much more volatile and unclear. Several competing trends are evident, and there is not yet enough information to reliably predict how they will play out. This section addresses these major trends and their possible impacts.

6.1 Applications Support for XML

As has been noted, several major vendors of tools for application software developers are making large investments in XML and are making XML tools available. Tools from vendors such as Microsoft, IBM, and Sun are becoming increasingly sophisticated and powerful as the XML standards are approved. This trend will result in it becoming increasingly easier for application software developers to build XML import and export capabilities into their products. With a high degree of interest about XML in the trade press and increasing interest in the customer community, it will likely be common for applications vendors to provide XML support in their business applications. This is already evident with application vendors working in the postsecondary education space such as SCT and PeopleSoft, and with other major vendors such as SAP and Intuit. Other vendors of student information systems and related systems are likely to follow. With XML support built into applications, it is likely that XML will become one of the preferred means to integrate and exchange data between internal applications. For example, SCT is using XML to integrate with Campus Pipeline, and the SFA used XML in the Highway One pilot. XML will probably become much more commonplace than either the comma or tab delimited files familiar to spreadsheet and database users, or traditional "flat" files. As XML
support is built into future versions of common desktop applications such as Microsoft Office, it will likely become ubiquitous.

6.2 XML on the Web

For use on the World Wide Web, XML will probably gradually replace HTML as necessary standards are approved and as browsers and web publishing tools (or XSL authoring tools), such as Microsoft FrontPage, support it. As this happens, new applications will emerge that are either only speculated about now, or not even imagined. For example, new types of search engines will emerge that can scan XML documents with keywords contained in XML tags. Web-based course catalogs could have keywords embedded in XML tags to aid searches for specific course content. If the World Wide Web Consortium's vision for XML is realized, the web will become a much different place.

6.3 XML Complexity

There is one contrary trend, however, which may have a quite different impact. A history of computing (and other areas, too, for that matter) shows us that simple, easy solutions generally gain wider acceptance than complex and difficult ones. For example, the relatively simple TCP/IP protocol of the Internet has become the basis of the world wide computer network rather than the complicated OSI protocols (Open Systems Interconnect) developed in the 1980s to be the basis for the world wide computer network. Similarly, the Internet's SMTP mail protocol has made OSI's X.400 almost vanish. One of the great strengths of HTML has been its relative simplicity. Almost anyone can use it, even grade school students. Basic XML is fairly simple. However, as more complicated features such as XSL are built onto it in order to provide a complete solution, it is becoming much more complex. If the W3C designers do not attempt to hold this complexity somewhat in check, it may become increasingly difficult for software vendors to provide low cost, easy to use support for XML. This is a trend that bears watching. It may be measured by such things as the rate of introduction of and number of XSL authoring tools, and the rate at which application vendors support XML schemas. If vendor support lags approval of the XML specifications by months or even a couple of years, this trend will be confirmed. If confirmed, the trend toward XML ubiquity will be severely curtailed.

6.4 XML Business Standards

As noted, the picture for XML business standards is not quite so clear. After XML was first approved in 1998, there was a trend to promote individual, proprietary implementations on the basis that XML’s flexibility made standards unnecessary. However, this trend quickly died out for the most part. Perhaps learning from past experience with traditional EDI, most companies have been waiting for business standards to emerge before embracing XML for electronic transactions. 1999 saw trends toward vendor- promoted standards (such as CommerceOne’s CBL and Ariba’s cXML), and standards in specific industries. The vendor-promoted standards have largely focused on procurement and garnered wide interest when announced. However, after the initial interest died down and most of the early adopters had made their commitments, acceptance of these standards seems to have stalled. Users seem to want a stamp of legitimacy and support beyond what can be offered by a single vendor. Even Commerce One, whose CBL is perhaps the most prominent vendor-promoted standard, seems to recognize this and has committed considerable resources to participating in the ebXML initiative.

The trend in vertical industries continues unabated, however. As noted earlier, there have always been initiatives to develop electronic transaction standards in specific industries and for specific niches. However, most of them now seem to be using XML, and there seem to be more such initiatives than there were prior to XML coming on the scene. These initiatives are using XML for
both external transactions and internal application integration. The Schools Interoperability Framework in K-12 is a good example of the latter type of initiative. If the trend continues, we may expect to see a similar initiative develop for integrating applications in the college and university environment. These initiatives will continue to have an important role. Framework initiatives such as BizTalk and ebXML expect that most of the actual document DTD or schema development will be performed in vertical industry groups, only consistent with the guidelines defined by the frameworks.

However, for many essential business functions, such as purchasing, invoicing, and shipping, there are as yet no prominent cross-industry standards efforts. ANSI X12 and the EDIFACT Working Group certainly have a library of documents that could be easily converted to XML, but that work is suspended pending development of the ebXML framework. In addition to this lack of cross-industry documents, ebXML currently is the only initiative developing a standards-based cross-industry framework, and it is not expected to begin delivering any specifications until May 2000. Many ebXML participants believe that it is unlikely for another such cross-industry initiative to emerge. Microsoft's BizTalk framework is not as comprehensive and as yet has only tentatively been embraced. In this vacuum, many users are reluctant to implement XML. So, success of the ebXML initiative is important to developing cross-industry XML business standards and a cross-industry, non-proprietary framework. Without a successful cross-industry initiative, there will be competing XML standards for common cross-industry documents such as purchase orders and invoices, and competing standards for transporting and processing them.

If ebXML succeeds, it should enable widespread implementation of XML for electronic transactions by providing a single, consistent framework. However, if it fails, the trends toward development in vertical industries may fill the vacuum, but also lead to further problems. For example, the Schools Interoperability Framework could extend its scope beyond K-12 into postsecondary education. In other industries, the OAG initiative, which primarily focuses on application integration within an enterprise, is already extending its focus to exchanges between enterprises. In addition, RosettaNet is reported to have plans to extend its focus into other industries beyond just the IT supply chain. If this trend continues, there will be competing standards and users will be left with a different kind of problem, i.e., which standard to implement rather than having no standard to implement. The impact on the PESC community may not be as severe as in other industries, since at present there are few competing XML business initiatives in this area. However, those involved in procurement, and to a lesser extent, financial transactions, may be faced with having to support multiple standards.

This scenario could still come to pass in the event that ebXML is either behind schedule or software vendors do not adopt its specifications. Since X12 and EDIFACT have committed to ebXML, their success in providing cross-industry DTDs and schemas is dependent on ebXML's success. If ebXML fails and X12 and EDIFACT must proceed on their own, the time lost in waiting for ebXML may further aggravate the proliferation of competing standards. It may then take several more years for the XML business community to feel enough pain from implementing competing standards that it again undertakes another attempt at a single, all encompassing standard.

In the broad picture, it will probably take two or three years to determine which of these XML business standards trends will dominate. The progress of the ebXML initiative bears close monitoring as well as vendor support of its specifications as they are released. Progress of user communities in embracing vertical industry standards such as RosettaNet in industries outside of their origins should also be monitored as well as adoption of internal integration standards such as OAG for inter-enterprise exchanges.

### 6.5 Registries and Repositories
Another trend, related to XML business standards, has been the development of registries and repositories for XML DTDs and schemas. Repositories can be thought of as libraries of XML components, with registries serving the function of catalogs, allowing the DTDs and schemas to be publicized and shared among users. BizTalk already has a repository on-line, and OASIS is developing XML.ORG repository. The ebXML Work Group is developing a specification for a network of linked registries and repositories. At present, there are only these two major competing repositories, and if no others surface, then it may be fairly easy to locate desired DTDs or schemas. However, if several others develop and they are not linked with each other, finding and sharing DTDs and schemas could become more difficult than at present.

6.6 Summary and Impacts

For the PESC community, perhaps the most notable aspect of these trends at present is that there are relatively few XML business standards either in place or in development. However, nature (and the marketplace) abhors a vacuum. It would be unusual if one of these trends did not manifest itself with the development of XML standards in the postsecondary education space. Although the development of vendor-sponsored XML business standards seems to have slowed generally, there is certainly a chance that, lacking any available alternative, a vendor may propose a proprietary standard either for any of the common electronic transactions currently in use or for on-campus integration. There are also a few approaches such as XML Solutions, in addition to X12C’s preliminary work, for converting X12 transaction sets to XML messages. If one of these approaches gains acceptance in the market before X12 develops a full solution, it could start to appear in the PESC space. As noted, other standard initiatives such as the Schools Interoperability Framework or RosettaNet may expand their scope into the PESC space. Clearly, coordination is needed to prevent competing standards from emerging.

Finally, even if XML becomes widely adopted for electronic transactions, it is likely that traditional EDI will persist. There is a significant installed base and heavy investment in traditional EDI technology. For many types of applications, the benefits of moving to XML (mainly easier use by small to medium enterprises), may not justify the conversion costs for some time to come. In addition, relatively small, simple, near real-time, commonly used transactions, such as those related to procurement, will probably be the first to become widely accepted. More complex, batch-oriented transactions, such as student transcripts or health care claims, may remain in X12 for years to come.

7 Recommendations

Based on the analysis presented here, the PESC XML Work Group offers recommendations for three constituencies: PESC regarding standards development activities, developers regarding XML support, and users regarding implementation strategies.

7.1 PESC XML Standards Development

As noted, the two greatest problems concerning business standards for XML are:

1. A lack of standards, leading to a multitude of differing proprietary implementations
2. Competing, overlapping standards

The XML Work Group recommends that PESC take action to alleviate these problems by promoting development of a single, unified approach to XML business standards for the PESC community. To do this, PESC must:
• Recognize and embrace the emergence of XML as an important technology for electronic exchange.
• Recognize the need to develop XML business standards, and work aggressively with the appropriate bodies to plan for development of such standards. Such standards should encompass not only transactions between higher education institutions/organizations, but transactions and integration within them. Several aspects of that work include:
  • Formulate a position on support for frameworks such as ebXML and BizTalk
  • Since business process models and information models are increasingly being used as a basis for standards development, work with appropriate bodies to insure that this work is being performed. Existing and planned PESC work on data dictionaries is an excellent basis for this work. This is consistent with the position of most frameworks that industry-specific XML element names and schemas should be constructed using industry data dictionaries. PESC may wish to offer its website as an XML repository to serve as a resource for the higher education community.
  • Identify the business processes and X12 EDI transactions that might be most appropriate for moving into XML. Those with a small installed base and relative transaction simplicity might be the most appropriate to convert first. Student transcripts might be the last for consideration due to an established user base and greater complexity.
  • Monitor and use PESC influence to coordinate work of the various mature organizations developing XML business standards for the PESC community, with the goal of preventing overlapping and competing efforts.
  • Provide guidance to emerging and immature XML initiatives.
  • Monitor and encourage XML advocates to incorporate the ANSI qualities of consensus development and public access to all standardization efforts.

In the past, PESC has served primarily to coordinate standards development and promote use of standards. However, in light of current developments in XML and the absence of any single organization responsible for developing XML business standards for the postsecondary community, the XML Work Group recommends that PESC take a more active role in and responsibility for development of such standards.

An approach for accomplishing this, the Work Group proposes, is to form a group of community stakeholders in XML development, with PESC providing any needed XML expertise. This group would focus on the bulleted items above. Coordination with the PESC data definition repository effort is recommended. With a number of XML implementations already taking place in higher education, the Work Group encourages PESC to move quickly to ensure the leadership and representation necessary to develop community standards.

7.2 Developers

By now, most applications software vendors are at least aware of XML, if not already forming strategies for supporting it. As previously noted, it is likely to become at least common import/export format, if not the basis for electronic transactions. Developers would be well served to begin researching the available development tools and make plans for providing at least basic import/export features. Basic import and export features should be built with a flexible approach so that XML element names may easily be changed to match industry standard names as these are developed. Developers are advised against creating their own XML vocabularies, DTDs, or schemas for electronic transactions. They are also advised to wait until standards for intra-campus integration are put in place before developing XML-based campus integration frameworks.

Large universities and others with internal development efforts would likewise be well served to begin researching and familiarizing technical staff with XML. Pioneers may wish to begin using XML for selected internal projects and generic import/export capabilities. However, the Work
Group recommends refraining from developing external interfaces for electronic transactions until standards are put in place.

### 7.3 Users

With the lack of XML business standards and the still relative immaturity of the base XML standards and technology, the Work Group recommends against general deployment of XML for electronic transactions at this time. Deployment in some niche areas, such as learning activities using the IMS standards, may be appropriate where no similar EDI standards exist. Users are advised to become familiar with XML technology and stay abreast of the offerings of software vendors. At present, a good guess is that XML may be ready for general deployment in two or three years, but this is only a guess. However, there are several clear dependencies. The timeline used throughout this document can be used as guidance. Users may monitor progress on the timeline to estimate when they should begin deployment.

For users considering further investments in traditional EDI technology, if the ROI can be attained within two to three years then the investment is certainly justified. Traditional EDI will likely endure and co-exist with XML electronic transactions for some time to come. If the ROI takes longer than three years the investment may still be justified. However, XML technology is rapidly evolving, and there is a slight chance that traditional EDI could become obsolete in as soon as five years. So, the risk of not achieving the desired return increases with more extended payback periods.

As noted, traditional EDI may still be more appropriate for several years for complex standard transactions such as student transcripts. The Work Group encourages institutions currently considering moving to electronic transcripts to adopt the current X12 transactions and not wait for XML messages to be developed.

### 8 For More Information

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