

# XPS DOCUMENTS AND THEIR APPLICATIONS IN THE CONSTRUCTION INDUSTRY

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## Abstract

This paper describes how using the XPS Document technologies of Windows Vista support and enhances interactions with the structural design and construction process. It illustrates the document workflows and the document life cycle in a typical construction base knowledge system. It provides engineers and decision makers and implementers with information about this new technology and how they can apply it to their design and construction models. The paper also highlights opportunities for the new format of data exchange in the recent efforts to develop National Management System Standards for Transportation Applications to benefit from these emerging technologies.

**Keywords:** XPS Documents, XML, open packaging, Zip, archive file specifications, construction documents

## 1. Introduction

XPS document is the XML Paper Specification[2], which describes a new, open standard for document management, processing, storage and publishing. It is considered as the heart of the new advances in the Microsoft Windows Vista operating system. Microsoft Windows® Vista also applies several new, related technologies to the document workflow that improve document simplicity, safety, and security. These improvements are also in Microsoft Office 2007 and other applications.

The specification describes the XPS Document format, which uses an XML-based language to store document text, graphical elements, and other metadata in a file (or document package).

The physical layer of the XPS Document format is defined by the Open Packaging Conventions specification [1]. The Open Packaging Conventions uses XML for flexibility and the .zip archive file format for efficient storage and compression. The physical layer of the document can contain digital signatures and supports Windows Rights Management Services (RMS) for additional information protection. Digital signatures can be used to authenticate the document contents and the identity of the authors and reviewers. Windows RMS can restrict access to a document's information and prevent unauthorized persons

from viewing document contents. Figure 1 illustrates the main components of the XPS document technology.

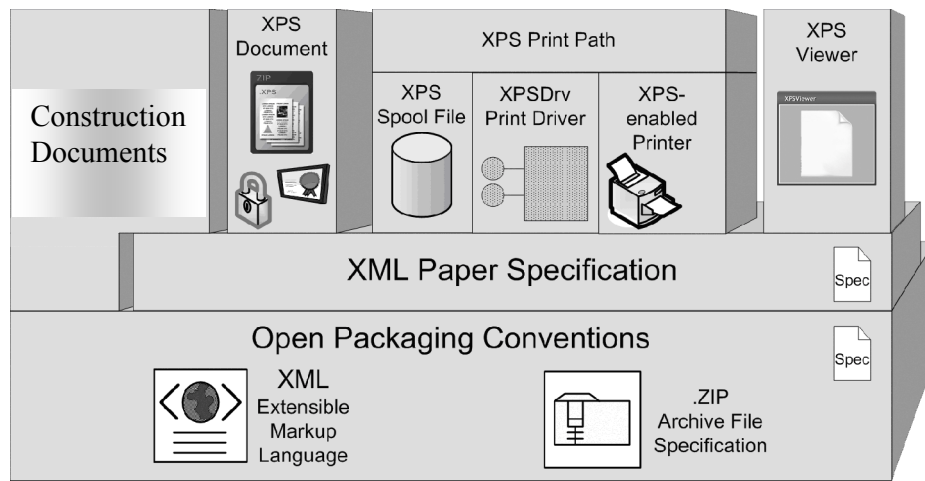


Figure 1. XPS Document technologies

XPS technologies offer benefits to users throughout the document workflow, starting with authoring and viewing the document and continuing through to storing and archiving. XPS Documents are fixed-format documents described by an XML-based language. This means the document layout is fixed, just as it would be if it were printed on a piece of paper. As a result, XPS Viewer and the XPS print path can present the document in the same way to the user whether it is viewed in a window or on a piece of paper.

In nutshell, the XPS Document technologies provide a common foundation for all aspects of document creation, storage, and publishing. Document processing workflows no longer need to be an amalgamation of different technologies.

## 2. XPS Document technologies and their interactions with the construction information processing

Figure 2 illustrates some of the more common methods of document origination, interaction and consumption and how XPS Document technologies can be applied to each of them.

### 2.1 Document Origination

XPS Document technologies provide new capabilities for document origination. Windows Vista supports the origination of XPS Documents from new applications and from those that were written before the availability of XPS Document technologies.

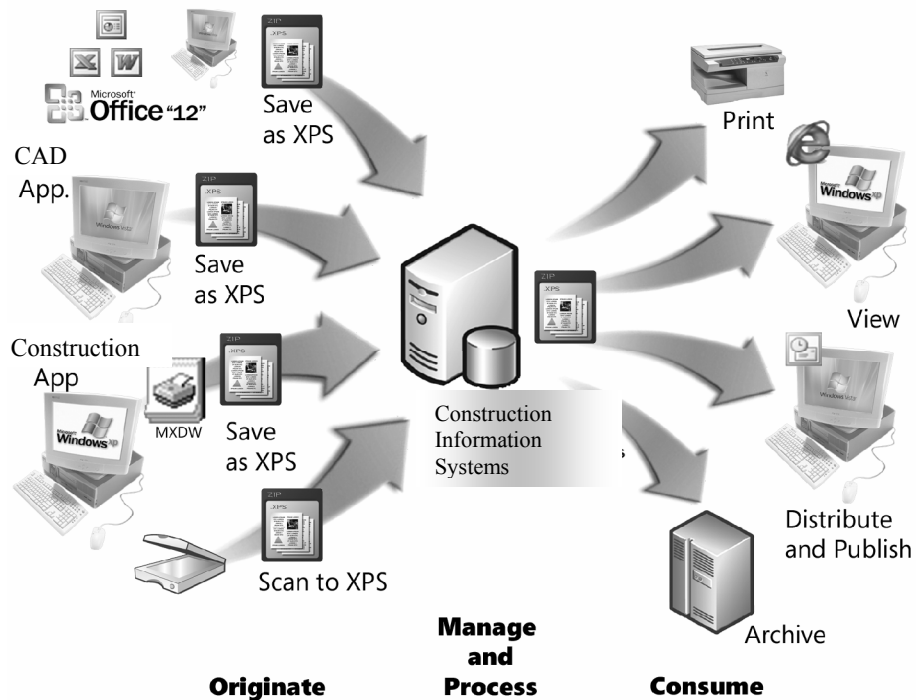


Figure 2: XPS Document and Construction Information Systems

## 2.2 Save as XPS Feature

Virtually all Windows applications that can print a document can create XPS Documents in Windows Vista. Office 2007 supports publishing XPS Documents directly. To integrate XPS Documents into their document workflow, Office 2007 users simply save their Office document as an XPS Document.

GIS applications, structural design and construction software can include the *save as XPS* function that uses the XPS Document application programming interfaces (APIs) when developed under Windows VISTA. These APIs serialize the application's extensible application markup language (XAML) code and write it to an XPS Document.

Users of unmodified Microsoft Win32®-based applications can also publish XPS Documents and take advantage of an XPS Document-based workflow. These applications employ the Microsoft XPS Document Writer (MXDW), a print driver that is included with WinFX Runtime. To create an XPS Document, users just select the MXDW from the list of installed printers in the **Print** dialog box. After saving the XPS Document, the user can apply access rights that are managed by Windows RMS and digital signatures to it by using the XPSViewer.

## **2.3 Scan to XPS Feature**

Scanner vendors have announced plans to produce scanners that support XPS Documents. These XPS-enabled scanners create XPS Documents that contain a full-page image of the scanned page. Optical character recognition (OCR) technology then makes the text available for searching and printing.

## **2.4 Security**

A design document often undergoes a series of revisions between the time it is originated and the time it is published or distributed. The security features of the Open Packaging Conventions make it possible to protect design and construction document information throughout this process.

Construction software packages and applications should store design documents according to the Open Packaging Conventions, which includes information protection features. Because of this, applications can support collaboration while providing information protection by using Windows RMS and digital signatures.

The modular nature of the XPS Document format, together with the .zip archive file format and XML-based content, makes the XPS Document more reliable and makes data recovery easier. Using the .zip file format provides error detection data to help protect the physical integrity of the data.

## **2.5 Document Interaction**

XPS Document technologies carry the document fidelity and information protection features that were provided during the authoring process into the document publishing and consumption phase of the document life cycle.

When documents are printed on XPS-enabled printers that use XPSDrv printer drivers, XPS Document technology supports document printing throughout the entire printing process. XPS Documents enter the printing process when they are queued for printing in the XPS Spool File format. XPS Documents do not require a file format conversion when spooled, as is the case with documents that are printed by an older, GDI-based print driver.

XPS Documents can be viewed in the XPSViewer with no dependency on the original authoring software. The XPSViewer is an Internet Explorer–hosted, WPF-based utility that is based on the DocumentViewer control that runs on Windows Vista. It also runs on Microsoft Windows XP and Microsoft Windows Server™ 2003 that have WinFX Runtime Components installed. Having support for Windows XP and Windows Server 2003 makes it easy to integrate XPS Documents into the document workflow immediately.

XPS Documents are not limited to only Windows-based computers. Any application can include an XPS Document viewer regardless of its native platform because the XML Paper Specification [2] is an open, royalty-free specification that specifies how to create and render XPS Documents.

## **2.6 Distribution, Publishing and Archiving**

The information protection features of XPS Documents make design and construction document distribution and publishing safer, more secure, and economical. Documents that have been protected by application of Windows RMS can be distributed to a wide audience while sensitive information is protected from unauthorized access.

XPS Documents can also be signed with digital signatures so that persons reading them can be sure that the document contents are authentic and valid. Digital signatures provide the electronic equivalent of a tamper-proof seal on the engineering document content by becoming invalid if the signed content is modified after the signature has been applied.

Although these security features add several layers of protection, they do not complicate the workflow and interaction with different structural and construction systems under windows because of the integration of XPS technologies into most of the future technologies.

The XPS Document format is especially suited for archiving design and construction documents because it is designed for longevity and uses a text-based language that is defined by an open specification that can be easily read and processed. The XPS Document format is also designed for space-efficient storage and transmission by using the .zip archive file format as described in the Open Packaging Conventions.

XPS Document content is stored with all the elements that are necessary to reproduce the document—images, fonts, and text are all contained in an XPS Document. The document content is described in XML by using a subset of the XAML that WPF applications use. All of this content is then stored as a compressed archive file in the .zip archive format. Using an open specification based on industry-standard technologies for content and storage ensures that the document content is available in the future.

## **3. Applications**

This section describes some possible application scenarios in which XPS Document technologies simplify and organize an existing workflow.

A civil engineering company uses Auto CAD and Office for much of its document origination and SharePoint server for document storage, management, collaboration services, and internal interactions. The company is considering the new XPS Document technologies that will be part of Windows Vista and how using these technologies could better organize the firm's current workflow and provide a foundation for future growth.

### **3.1 Business Flow**

In practice, new projects are assigned an internal project number. The project number relates to an entry in the firm's case database that also contains the list of project team working on the project, client information, and other information about the project. This database also includes links to billing and accounting. All the initial project documents, drawing, maps receive their project numbers. If some of these documents are hard copies,

they are scanned directly to an XPS Document by an XPS-enabled scanner. OCR software then processes the scanned documents to extract the text. The project number that is read from the document is then used to properly place the document in the digital workflow. This reduces the chance of misfiling or misplacing the documents.

The Project team relies on a document management system such as SharePoint to manage its drawings, reports, maps and photos as they collaborate throughout the planning, analysis, design, and construction phases. Eventually, the details are added and the plans are finalized. The team publishes its final design and construction documents to an XPS Document. To prevent any unauthorized changes to the plan, this document is digitally signed by the project team leader or licensed engineer. Any changes to the final plan might require the project team to revise the quote. If so, they publish a new XPS Document and apply a new digital signature. National Management System Standards for Transportation Applications [3] can gain effectively from these technologies.

Because document protection and confidentiality are critical in some projects, XPS Documents are perfect for such needs. After a document is scanned, the electronic copy of the document goes to the appropriate SharePoint document library based on the information that was retrieved from the project database. To guarantee that the contents of the electronic document are authentic, the scanner and OCR software can apply a digital signature to the document to indicate when the content was scanned and translated to text. Any subsequent interaction with the document's contents is easily identified by an invalid digital signature.

Image readability and document fidelity are absolute requirements in engineering projects. Transportation projects are really helping to fuel the firm's growth and often, these projects included geological and engineering-geological maps, architectural and structural drawings, field tests data, laboratory tests results, reports, and photographs. The firm desperately needed a way to integrate these different document types into its electronic workflow while retaining high image fidelity. XPS Documents are well suited for all kinds of data types, can support multiple image types, and can provide great document fidelity, readability and portability. XPS Documents support much higher quality graphics processing than was available in earlier versions of Windows, and documents can now be exchanged, viewed or printed in higher fidelity.

For archival purposes, it is vital that the XPS Documents in the near and far future would be readable and exchangeable. As a matter of fact XPS Documents were stored in a plain-text, XML-based format that uses elements that are defined in the XML Paper Specification. These plain-text document parts are stored in a file that is compressed by using the .zip archive file format. The .zip archive file format is described in a specification that was published over 10 years ago and is industry standard. Therefore, it is likely to be readable for a long time. If the firm must convert to other file formats some time in the future, the conversion could be as simple as an XSL transform.

As for the archiving and storage space requirements for all these documents, XPS Documents use the Open Packaging Conventions for document file storage. This means that the documents are stored in archive files and that their content can be compressed to make them more space efficient than many other document types.

Finally, Customers appreciate receiving the information as an XPS Document because they can easily view the information through any web browser and they do not need the authoring application to view the document. When customers are satisfied with the design plans, they apply their digital signature directly in the XPSViewer and the finished documents are forwarded to contractors who will handle the construction project.

#### 4. Conclusions

The XML Paper Specification and the Open Packaging Conventions (XPS) are the foundation for a new set of document management features in Windows operating system. XPS describes the set of conventions for the use of XML and other widely available technologies to describe the content and appearance of paginated documents. The primary goal is to ensure the interoperability of independently created software and hardware systems that produce or consume XPS content. This paper provided an overview of these new technologies and their interaction with engineering systems and how they can benefit end customers.

XPS Documents are not limited to only Windows-based computers. Any application can include an XPS Document viewer regardless of its native platform because the XML Paper Specification is an open, royalty-free specification that specifies how to create and render XPS Documents

Engineering drawings, data, blueprints, reports, and photographs desperately need a way to integrate these different document types into electronic management process while retaining high image reliability, security, and portability. XPS Document technologies provide such integration and benefits throughout the engineering document workflow to improve the simplicity, safety, and security of document processing and interactions. Construction document processing workflows no longer need to be an amalgamation of different software technologies. The adoption of such technologies by private, state and federal agencies will have an affirmative impact on the construction industry as a whole.

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