3D PDF

3D PDF TECHNOLOGY

Multiple computer systems and authoring programs are part of the collaboration within companies and their extended supply chains. If development costs are to be reduced and time-to-market shortened, both internal and external communications flows must be improved.

3D PDF technology has the integration and features to make it the common denominator for communications in a wide range of collaborative business processes.

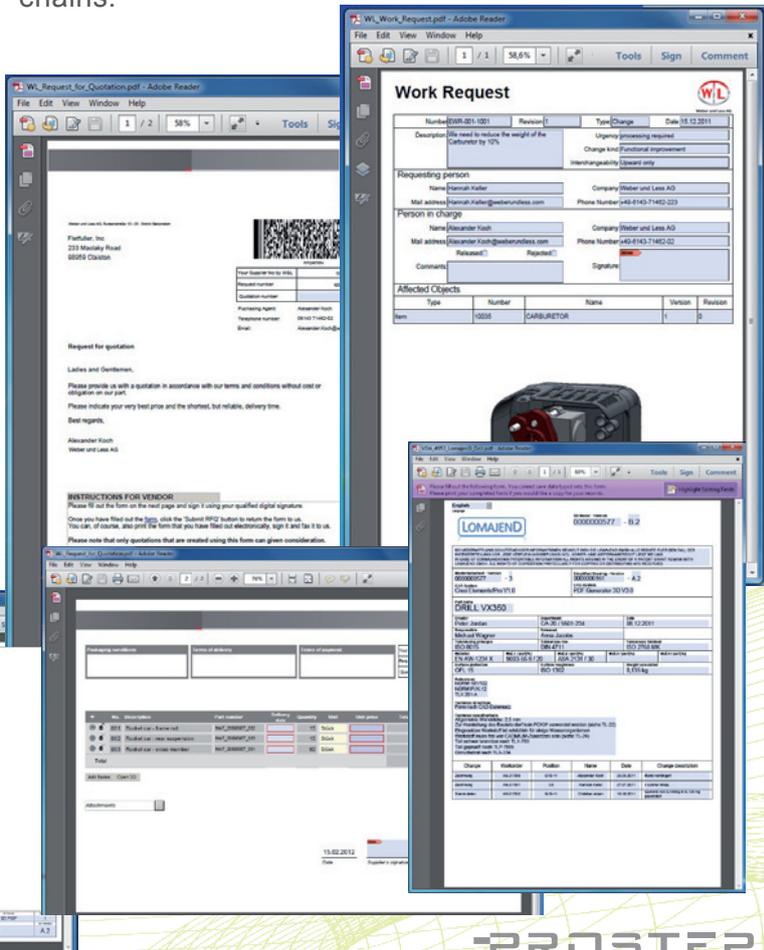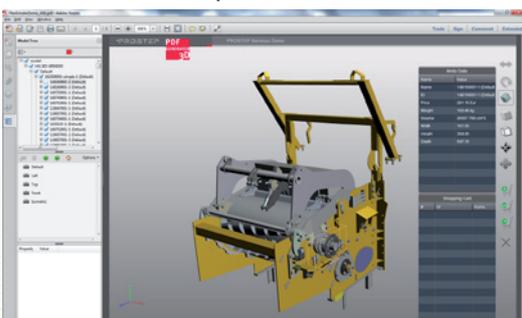PROSTEP

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>> Summary

If development costs are to be reduced and time-to-market shortened, both internal and external communications must be improved. Efficiently accessing and reusing information in all relevant business processes is the basis for enhancing the flow of information both within companies and between their supply chains. A communications tool that lets people easily send and receive data, easily view and, if necessary, edit the data—regardless of the number of computer systems and authoring programs involved—will not only make the collaboration between people and organizations possible—it will make that collaboration inviting.

3D PDF technology lets users share data from different authoring systems. The data is "published" in a uniform format: a 3D PDF container. Access to the intellectual property within the container is secure; the creator can set permissions to open, copy, print, and forward as required, thereby protecting the contents from unauthorized access. As a defacto standard, 3D PDF technology can be integrated in any software programs, rendering it a powerful tool for automating communications and data transfers across a broad range of both information technology and business processes.

3D PDF technology has the integration and features to make it the common denominator for communications in a wide range of collaborative business processes. These processes range from sending requests for quotation to exchanging "paperless" documentation for manufacturing, sales, and service. 3D PDF containers can combine 3D models and additional product information from diverse authoring applications into a structured, integrated, and interactive 3D PDF document. Companies can easily create and automatically publish these documents using predefined and configurable templates that capture the company's business logic and workflows and its industry's best practices. Recipients can read these documents using Adobe Reader, the ubiquitous, recognized de facto standard for viewing PDF documents and installed on virtually every desktop, laptop, and mobile device.

This white paper highlights the breadth of 3D PDF technology, its use in collaborative environments, and its potential benefits for enterprises and their supply chains.

> **3D PDF technology has the integration and features to make it the common denominator for communications in a wide range of collaborative business processes.**

>> 3D PDF – A technology with many strengths

Obstacles to collaboration

Manufacturing enterprises are constantly searching for ways to bring their products to market faster and less expensively. Three aspects of information flow beg for improvement: Efficiently moving information throughout all relevant business processes, reusing that information, and streamlining the collaboration between people and companies. Information use and collaboration occur both internally—within an enterprise's "four" walls— and externally—between it and its suppliers, partners, and customers. Collaboration occurs in virtually all business processes, from product development, to manufacturing engineering, to inventory and production management, to product sales delivery, to after-sales service, and more. In today's extended enterprises, external partners are contributing a far more significant proportion of value to almost every one of those phases in a product's lifecycle.

> A technology is needed to support and enhance collaboration —a technology that is open, versatile, and easily implemented.

Minimizing the "friction" in internal and cross-enterprise information flows is the key to improving collaboration throughout the product lifecycle. This friction largely comes from information technology (IT) implementations involving multiple and diverse systems. The friction creates discontinuities between information systems and applications, and the associated business processes they support. These discontinuities affect product development, and they affect upstream and downstream product lifecycle processes—from quotation to service. These discontinuities limit a company's ability to react to dynamic changes in IT, the partner landscape, and market requirements. These discontinuities limit a company's ability to communicate to its employees and its supply chain. Ultimately, these discontinuities limit a company's abilities to compete.

These discontinuities are most apparent in the collaborations between different companies in a supply chain. Information systems and processes across supply chains are generally not standardized to a high degree. Creating that standardization is time-consuming, complex, and expensive in terms of hardware, software, and data transfer.

Discontinuities in collaboration

System discontinuities and obstacles to communication exist in virtually all business processes in the supply chain:

>> When **requests for quotation** (RFQ) are solicited, purchasing agents collect intellectual property (IP) from various information systems and in a variety of formats. The collected IP—the RFQ—is then faxed, mailed, or emailed, or a combination of those transmission methods, to suppliers. Too often these transmissions are without proper safeguards against unauthorized access to the information in the RFQ. Or the RFQ is uploaded to supplier portals, where access security may be suspect. Once received, the contents of the incoming RFQ typically need to be manually entered into back-end systems at the supplier site before a response can be generated. The converse is also true: The initiator of the RFQ often needs to manually enter the RFQ response into an information system before prices and delivery terms can be compared.

>> **Design reviews** involve substantial amounts of data: computer-aided design (CAD), digital mockup, computer-aided engineering (CAE) analysis, collision analysis, and more. Preparing these data for colleagues in other departments, disciplines, and partner organizations is both time- and labor-intensive. This effort increases significantly when the source data exists in multiple data formats.

>> Distributed **product development and manufacturing** demands ongoing coordination between partners and suppliers. Too often this coordination involves transmitting unnecessarily large file attachments, even when the communication is merely a comment about the latest revision. Such "heavyweight" data transmissions slow down communications and design coordination. They also invite the possibility of large amounts of sensitive IP going to unauthorized recipients.

>> **Change/release processes** are still paper-based in many companies. This renders cross-site and, in particular, cross-enterprise collaboration slow and cumbersome. In complex projects, these two detriments tend to keep all participants into the change/release process "out of the loop" by not informing them of changes in a timely fashion. Without such dynamic communication, unapproved changes can accumulate and ultimately hampering further product development.

>> **Manufacturing, quality assurance, and assembly** generate innumerable drawings from 3D design models. These are often printed and distributed within the company or sent to suppliers. The time and effort for manual distribution is considerable. Also, the manual method hinders the timely distribution of revisions. Last, there's no guarantee the revisions will proliferate throughout the company. As a result, plant personnel can be working on different versions of the same drawings. Compounding this waste is that production line personnel do not always find 2D drawings easy to understand.

>> **Sales** produces a wealth of technical documentation and marketing collateral—often manually. Creating technical illustrations and descriptions is time consuming and costly. Translating this literature into multiple languages and updating these translations with every product revision also costs.

>> **After-sales service** often involves manually collating information from various information systems to create service documentation, and using yet other systems for customer relationship management and spare parts ordering. By the time the documentation is distributed, it no longer matches the configuration of the product to be serviced. The result is the appearance of poor customer service.

> **Enter 3D PDF technology—a common denominator in making information readable by a ubiquitous, recognized de facto viewer for PDF documents.**
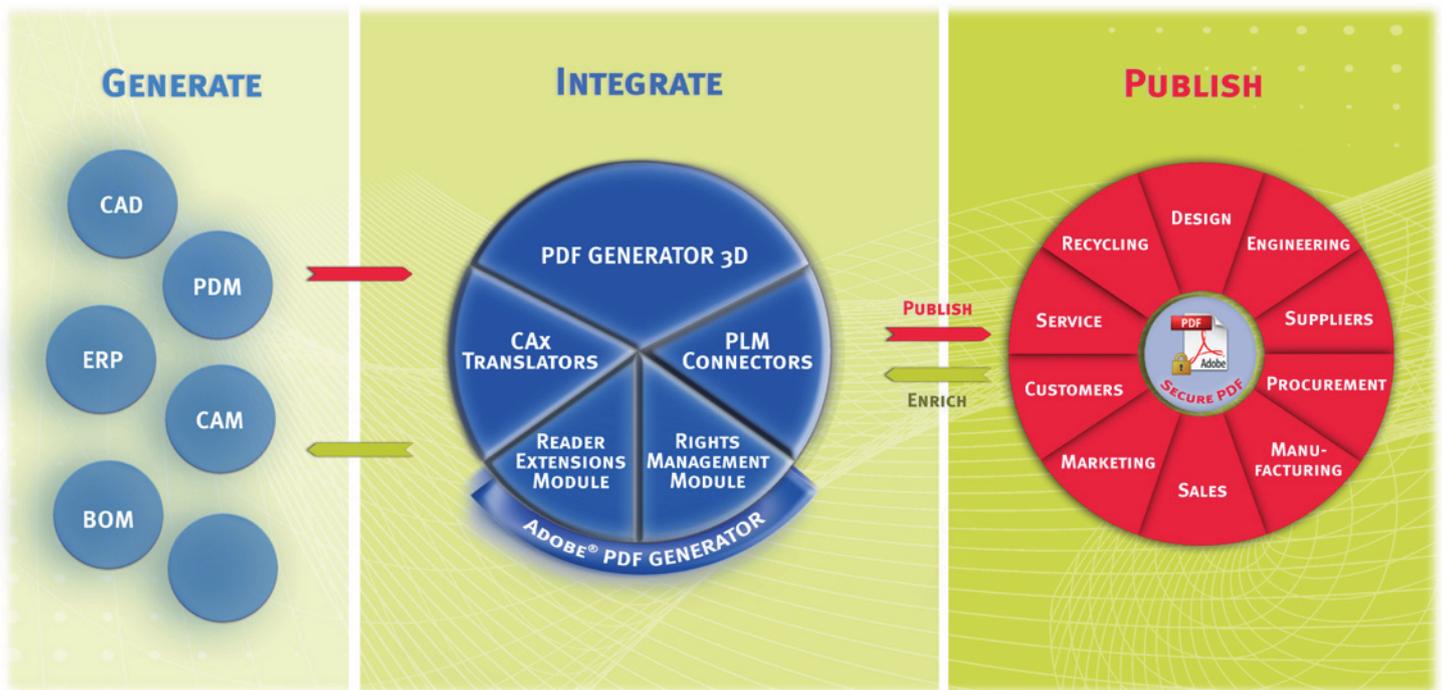
These business processes—within and between companies—call for a technological solution capable of bridging the discontinuities in existing IT, data communications, media, and file formats from multiple authoring systems. The technology should support and enhance collaboration by being open, versatile, and easily implemented. It should make the communicated information easily accessible and readable by all participants, regardless of the devices receiving the information. The technology should be bidirectional, capable of maintaining the link to the authoring systems that create, manage, and revise the information. The technology should optimize external communications by invoking a common denominator—a neutral, standard data and presentation format. It should enable a great deal of information to pass—in a form that even the technical novice can easily understand.

Enter 3D PDF technology—a common denominator in making information readable by a ubiquitous, recognized de facto viewer for PDF documents.

> **3D PDF technology supports a variety of communications, systems integration, and collaboration requirements in product development within and between companies in the supply chain.**

The 3D PDF advantage for product development

3D PDF technology supports a variety of communications, systems integration, and collaboration requirements in product development within and between companies in the supply chain.

>> 3D visualization:
3D PDF containers can contain 3D models from any CAD application. These embedded models are easily viewed using Adobe Reader, which offers common display manipulations to dynamically view models as desired, such as rotation, zoom, and pan. Document recipients can also navigate through the model's product structure, choosing to hide individual components or subassemblies, or to display them transparently.

>> Manufacturing information:
3D PDF creation tools give users the choice of converting native 3D data into tessellated U3D geometry or highly accurate BREP models in PRC format. While U3D is ideal for animations and displaying model and material properties, PRC is more streamlined. PRC includes the product manufacturing information (PMI) in 3D models, and it can be embedded in a PDF container as exact or tessellated representations, or both. Models embedded as PRC can be exported, for instance as STEP data, without any loss in quality.

>> Correct positioning:
CAD and PDM converters automatically extract and position assembly structures and manufacturing information correctly in 3D PDF documents. Even with models assembled in heterogeneous CAD environments, the converters will automatically and correctly position the 3D modeling information.

>> Structured portfolios:
Compressed 3D PDF containers with a multi-tiered structure are possible. PDF files stored in subfolders are retained as independent documents that can be encrypted separately with digital signatures. These containers can also contain native CAD files, each with its own security level.

>> Linked contents:
Technologies such as JavaScript and Flash can link the contents within the 3D PDF containers. This makes data in the individual PDF documents highly interactive. For example, by linking a parts list to the associated 3D model, clicking on a component in the parts list highlights that component in the model. Likewise, by linking metadata in different languages, users can select their preferred language using a dropdown menu.

>> Intelligent templates:
PDF technology enables forms-based 3D communication. PDF forms templates can contain placeholders for 3D models, fields for recipients to enter data,

and interactive functions based on JavaScript or Flash. Recipients can enter data in template-based PDF documents in two ways: online, as though the document were a web portal, or offline, before returning the document. When using the templates with CAD and PDM connectors, predefined fields in the 3D PDF documents can be filled automatically with metadata from the linked information systems. The converse—bidirectional communications—also holds true. PDF document data, which is stored as XML, can be fed back to the linked information systems.

>> Selective security:

Several security measures are available for protecting the contents of 3D PDF containers against misuse and unauthorized access. The degree of precision and detail of 3D models in the container can be defined when converting native CAD data to embedded PDF data. Document usage (e.g., view, annotate, print, and copy) can be specified for each recipient. The contents of the PDF container can be protected collectively or individually with passwords or digital signatures. Last, access to these contents can be restricted by specific user, user rights, and period of time. Access rights can be subsequently changed or withdrawn altogether.

3D PDF technology applies to a multitude of communications processes, business scenarios and collaboration environments.

The 3D PDF advantage for collaboration

3D PDF technology applies to a multitude of communications processes, business scenarios and collaboration environments.

>> Viewing:

Adobe Reader, the ubiquitous de facto standard for viewing PDF documents on virtually every desktop, laptop, and mobile compute device, displays 3D PDF documents. No additional software is required.

>> User interaction:

Embedded 3D models displayed in Adobe Reader are interactive. Additional functions in Adobe Reader let users measure, slice, and annotate these models.

>> Data collection:

3D PDF documents can include more than just the 3D data from a variety of CAD applications. Other data includes the associated assembly structures, PMI, service documentation, and even video and sound recordings.

>> Protection:

Data and documents embedded in a structured PDF container can be linked as required and assigned IP rights on an individual or group basis to protect the information against unauthorized access.

>> Intelligence:

Forms templates can capture the workflow for particular document layouts and types of business logic. For example, a template for automatically creating 3D PDF documents might include inserting specific content, defining IP rights, and distributing the finished documents.

>> Automation:

Templates with interactive fields let recipients enter information that can be automatically fed back to the respective back-end departmental and enterprise systems (e.g., PDM, PLM, and ERP) when the 3D PDF documents are returned. These templates are fully customizable, ensuring a high degree of flexibility in the recipient-specific structuring of data exchange and information content.

>> Offline/online:

Any web browser can display interactive 3D PDF documents online and offline. To users, this interaction is almost indistinguishable from a web portal.

>> Document control:

3D PDF technology provides graduated security mechanisms to protect the communicated information, enabling access rights per document recipient. This security extends to controlling the distribution and use of the contents even after 3D PDF container has been sent.

The 3D PDF advantage for intellectual property

3D PDF technology ensures the consistent end-to-end use and management of information in a company and its extended enterprise. This consistency saves time and costs in data preparation, transfer, use, and reuse, while enhancing the product development process. The following are just some of the benefits from using 3D PDF technology.

>> **Better use of 3D potential:**

The 3D data created in design development and engineering is used in other business processes. For example, modeling data is used in modeling and analysis programs, for generating 2D drawings, and as static views embedded in presentations and spreadsheets. Forwarding existing 3D data directly to these end-applications saves time and ensures that other people involved in these applications have access to the information faster and earlier in the product lifecycle. The alternative is to convert the modeling data for each end-application, requiring additional data processing at greater cost and effort.

>> **Better understanding of products and processes:**

With 2D drawings alone, people not intimately involved in a product's development may have difficulty visualizing how it is structured and functions. What may be even more difficult is visualizing how it is manufactured, assembled, even dismantled. These people can include purchasing, sales, and service, as well as customers and suppliers. On the other hand, 3D visualizations are easier to understand, speed up coordination with customers and manufacturing partners, and reduce the risk of expensive misunderstandings and errors.

>> **Greater data and process integration:**

Communicating product data is routine in distributed product development and manufacture. However, it is a time-intensive activity. Too many manual interventions are involved. Intelligent forms templates help integrate 3D PDF technology with back-end information systems. Such integration provides these systems with current data on a largely automated basis.

>> **Better protection of IP:**

Much of the data exchange during a product's lifecycle—namely development, manufacture, and warranty service—often involves external partners and their information systems. Companies can control access to the IP in these exchanges by configuring at both the broad and granular levels the read/write security rules of the data being exchanged—even after the 3D PDF container has been sent.

> **3D PDF technology ensures the consistent end-to-end use and management of information in a company and its extended enterprise network.**

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>> Application examples

3D PDF technology is a communications tool for the entire company—and its supply chain. It is suitable for a range of collaboration processes. The versatility and ease of 3D PDF technology make it just as suitable for processing RFQs in the purchasing department as it is for displaying work instructions in paperless manufacturing operations, or distributing documentation electronically for sales/service, or instituting information-rich workflows in cross-enterprise change/release processes. In these and so many other business processes, 3D PDF technology makes communications efficient, easy, quick, thorough, and cost-effective.

3D PDF technology is a communications tool for the entire company—and its supply chain.

In working with customers in the automotive and manufacturing industries, PROSTEP has been able to pinpoint a range of potential, practical uses for 3D PDF technology. Here are a few "best practices" using 3D PDF technology.

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curely distribute documents to external partners, and utilize 3D models to make the documentation easier to understand and to minimize errors in manufacturing and assembly.

>> Example: Paperless manufacturing

The challenges

Many manufacturing companies use 3D CAD systems to design their products. However, paper drawings are still considered the authoritative documents for manufacturing, quality assurance, assembly, and other downstream processes, including even sales and marketing. Paper documents are still commonly used in outsourced manufacturing. These paper documents often contain valuable technical manufacturing information, such as geometric dimensioning and tolerancing (GD&T), material properties, bills of material, and annotations. Such PMI is stored in the CAD or PLM systems, and linked directly to the associated 3D geometries.

Companies would rather go "paperless." This would free designers from producing paper-based drawings. It would also save companies the associated costs of printing, handling, and storing paper drawings. Paperless manufacturing would enable companies to—as required—rapidly update their manufacturing documents, se-

The PDF solution

Besides replacing 2D drawings and supporting paperless operations, 3D PDF containers bring together all the information in the product development process into a single file. A compact container may contain all the 3D models, PMI, and other related documentation necessary to integrate external manufacturing partners into the product design development/manufacturing process. These would provide invaluable product information to partners who would not normally have access to a customer's internal PDM/PLM systems.

>> The 3D PDF container can contain all the information associated with a CAD model as well as all the other information relevant to designing and manufacturing a product.

>> The 3D PDF container can contain native CAD data and STEP files, and multimedia files such as simulations, animations, and videos that illustrate manufacturing and assembly workflows.
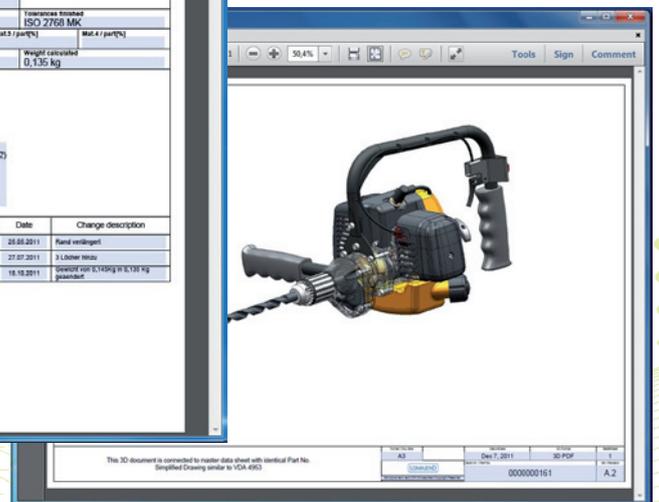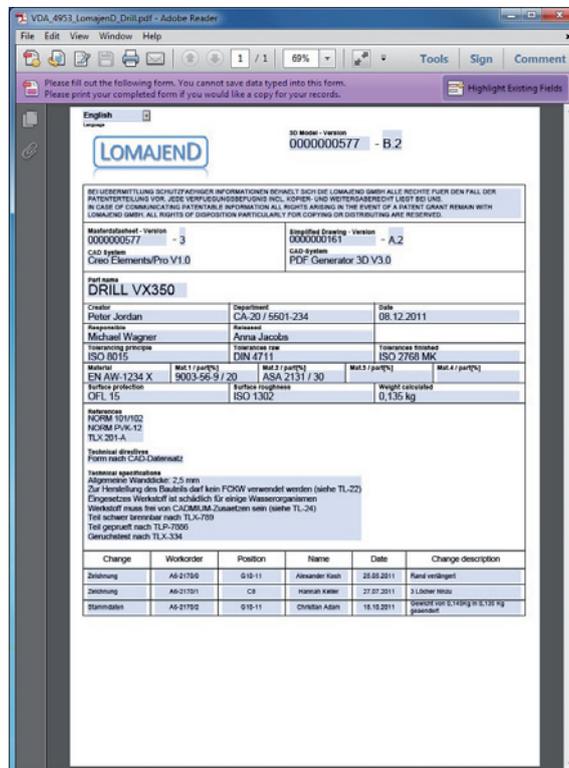
>> All documents and attachments can be password-protected for secure, authorized access per recipient. Optional security mechanisms can block access to invalid, time-sensitive documents within the PDF file.

>> Integrating 3D PDF technology into corporate processes supports automated and paperless operations in, for example, purchasing, PLM, and ERP.

>> Electronic workflows can support the distribution of 3D PDF documents, ensuring that all participants receive timely notification of changes.

Besides replacing 2D drawings and supporting paperless operations, 3D PDF containers bring together all the information in the product development process into a single file.

The benefits

>> Reduced documentation time and costs

>> Automated collection and distribution of manufacturing documentation

>> Less manual effort creating and revising drawings and other paper-based documentation

>> A single container for all information from the product development process

>> The elimination of distributing and storing paper drawings

>> Quick and secure access to PMI by all internal and external team members

>> Better understanding of complex manufacturing and assembly workflows

>> Greater security and transparency in revising documentation
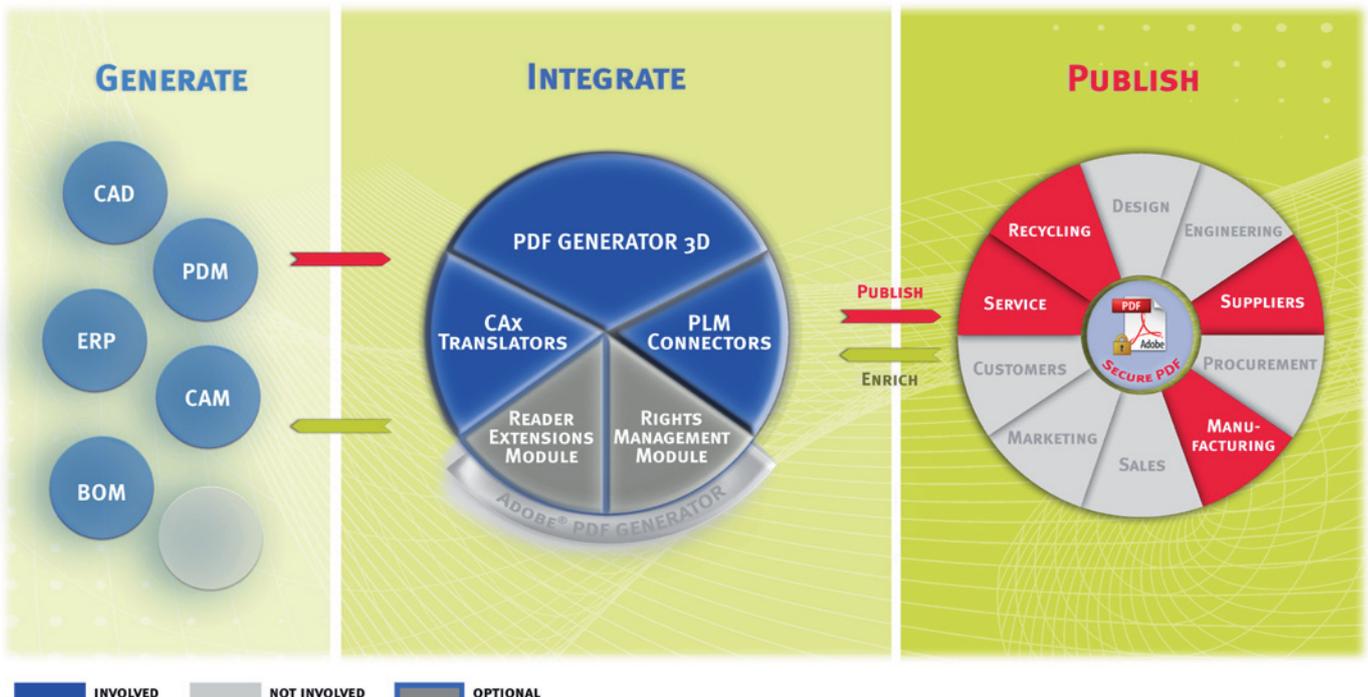
>> Example: Service documentation

The challenges

Companies spend much time and labor preparing, updating, and distributing technical documentation for maintenance, repair, and overhaul (MRO) operations. Despite this, maintenance and service engineers often have trouble locating the current documentation or having the requisite spare parts listed in that documentation.

A better approach would be to have design, manufacturing, and other business processes drive the service documentation and related service operations, such as generating technical illustrations of current designs and ordering spare parts consistent with the latest designs in the field. The result would be more than just 3D models, PMI, parts lists, and multimedia, but service documentation that is dynamic, current, easier to understand—and useful.

The PDF solution

3D PDF technology can combine all the MRO information into a single, compact 3D PDF document viewable on any desktop, laptop, or mobile device using Adobe Reader. Embedded interactive 3D models and other animations clarify a product's design, assembly, and MRO requirements, especially for complex assemblies. Through PDM/PLM/ERP integration, service documentation can be automatically prepared—even for specific configurations of a product—and updated in near real time.

>> A 3D PDF document can contain models, drawings, and other documents relevant to MRO.

>> Embedded assembly structures lets users navigate through the assembly and rapidly identify serviceable components. Navigation includes zoom, rotate, pan, cross-section, and fly through displayed models of parts and assemblies.

>> Displays of individual components can be linked directly with other documents, such as spare parts lists or catalogs.

>> Animations and other videos showing the activities to be performed can be embedded in the 3D PDF document.

>> Embedded intelligent forms templates can automate service work, including displaying MRO information, ordering spare parts, and updating customer records. The embedded intelligence can evaluate the entered data for consistency and accuracy, and can initiate the appropriate workflows (such as approvals in the parts ordering process).
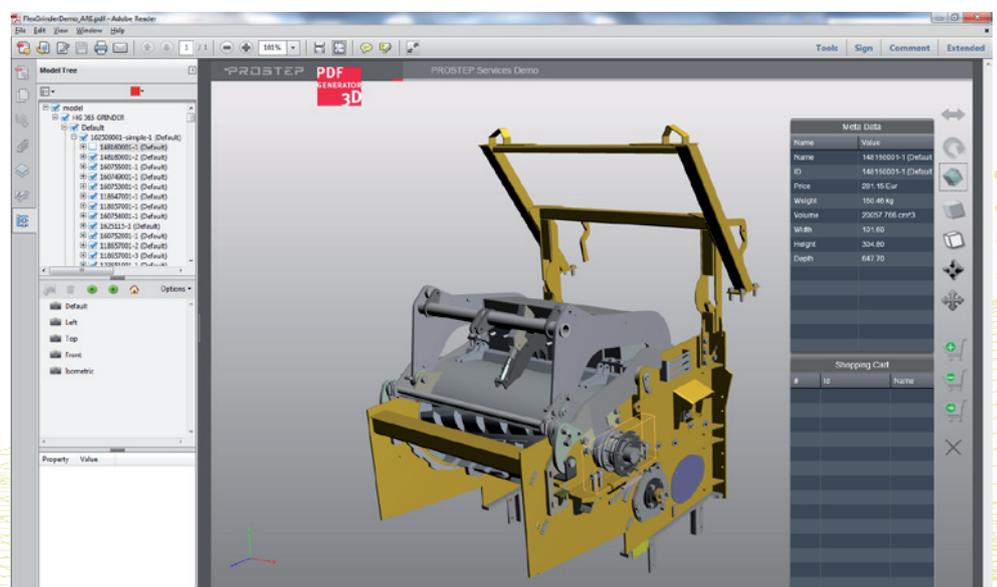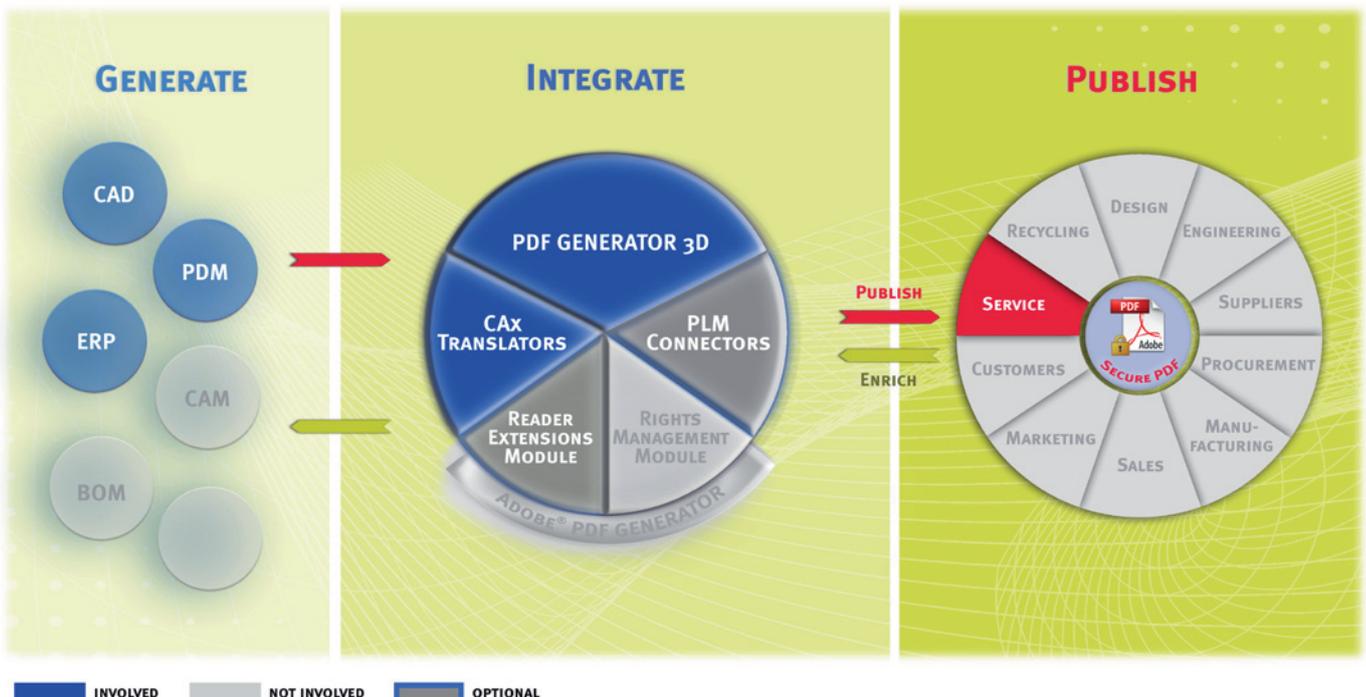
The benefits

>> Changes, queries, and other information in the field can be entered using the Adobe Reader comment function. Automated workflow processing can report this information back to the relevant business and engineering departments through their information systems.

>> Service documentation can be sent electronically to the local service organization and to on-site engineers.

>> Password protection and digital rights management (DRM) ensure that only authorized people have access to service information.

>> Faster preparation, collection, and distribution of MRO documentation.

>> Better quality documentation by including multimedia content.

>> Faster, easier, and more complete access to current MRO information—regardless of compute platform used.

>> More comprehensive and faster updates in the field.

3D PDF technology speeds up service documentation preparation, and it lets service engineers access MRO information fast—regardless of what compute platform used.

>> Better understanding of MRO activities.

>> Reduced downtimes from enhanced service quality.

>> Increased spare parts business through integrated ordering.

>> Faster MRO work performance, enhancing overall MRO service quality and customer satisfaction.

sites. Second, implement an integration technology that does not require reorganizing the existing business processes at both ends of the RFQ process.

>> Example: Request for quotation (RfQ)

The challenges

RFQ creation, distribution, and final disposition is the quintessential communications and collaboration environment. Throughout, the purchasing department is in intensive and extensive communications with departments within the company, such as design and engineering, sales, and finance. The purchasing department also acts as a clearinghouse for information to third-party partners.

The information for RFQ exists in many forms. There is the structured information found in software systems (e.g., CAD, CAE, PDM/PLM, and ERP) and the unstructured information delivered by fax, email, phone, and so on. Both forms need to be captured and exchanged for an external partner to get a true sense of the RFQ requirements. Moreover, some companies operate a "purchasing portal." While portals help standardize the RFQ process (e.g., the completeness and structure of the response), it forces suppliers to work with disparate online systems disconnected from their own corporate information systems, business processes, and workflows.

Two types of integration are key to gaining significant efficiencies, increased responsiveness, and reduced costs in the RFQ process. First, integrate the RFQ process with existing information systems—both within a company and at its supplier

The PDF solution

3D PDF technology can automatically combine all the information required for RFQs, including 2D and 3D drawings, material properties, parts lists, specification sheets, annotations, and other PMI. This automation works regardless of authoring and information systems. The result: All the relevant RFQ information in a uniform, accessible, structured, and secure format.

3D PDF technology automates some of the workflows related to RFQ preparation, response, and evaluation. This automation relies on intelligent forms templates that—at the touch of a button—can be filled automatically with information from the back-end information systems (e.g., CAD, CAE, PDM/PLM, and ERP). These templates can also contain interactive fields to be manually completed online or offline. The embedded template intelligence can ensure the quality of the entered data and automatically evaluate some of the supplier's credentials upon receipt of the RFQ.
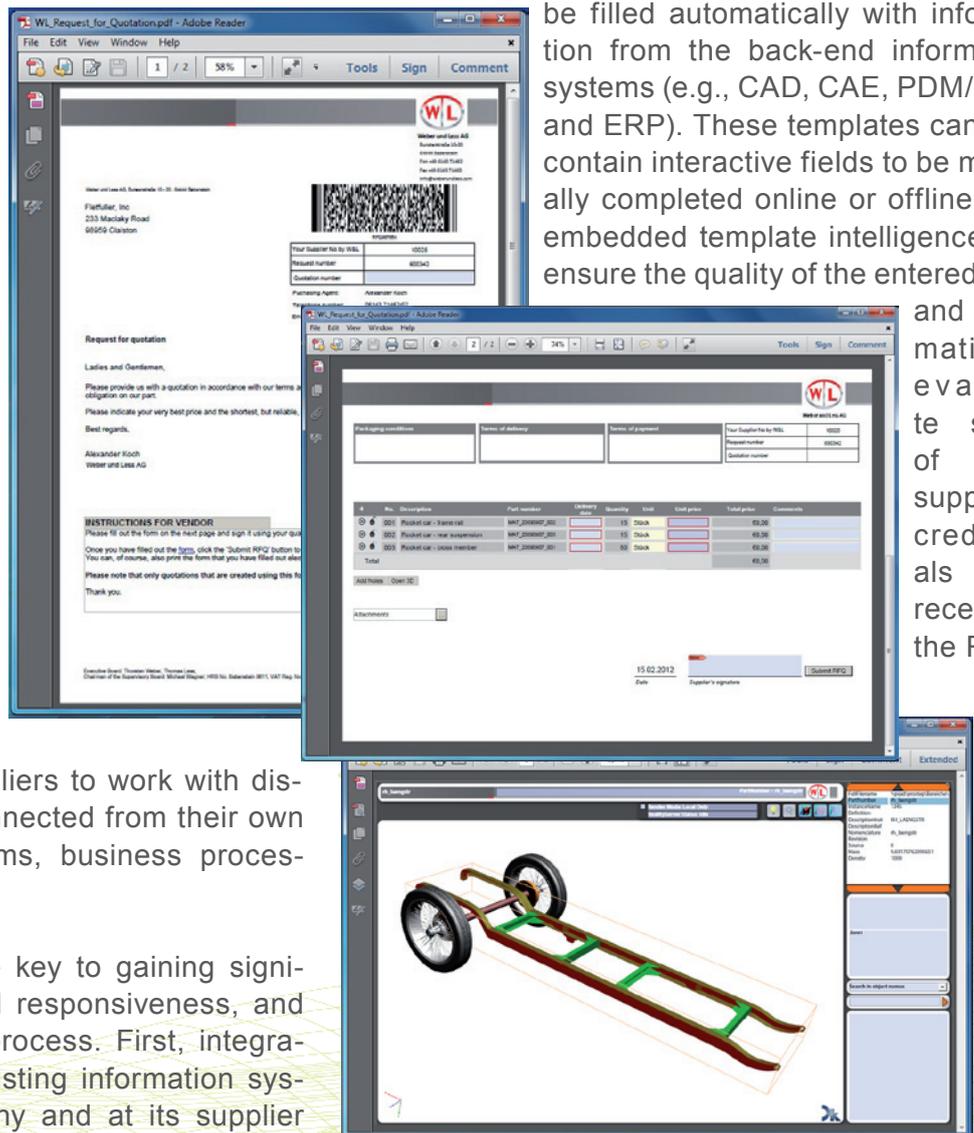
Purchase requisitions can be captured in the existing enterprise information system (e.g., purchasing-specific system, project management system, and ERP), and RFQs can be automatically generated once the requisition is released.

>> 3D models—in native or neutral CAD formats, or both—drawings, parts lists, specification sheets, and other PMI are provided in a uniform format.

>> RFQ can be available online in a web portal or sent through email for resolution offline.

>> An optional RFQ dashboard displays relevant and current information about RFQ status.

>> Suppliers only need Adobe Reader to view the PDF-based RFQs and to add their own information (e.g., trucking information, delivery dates, and prices).

>> Password protection and digital signatures ensure that only authorized persons have access to RFQ contents. Optional Adobe Reader functions permit user-specific security settings (e.g., what individual recipients may do with individual portions of the RFQ). Optional security mechanisms (namely, DRM) can control expiration dates associated with the RFQ.

>> Automatically including 2D barcodes to RFQs helps maintain the automated workflow for incoming RFQs when the PDF-based document have been printed (such as for signatures).

>> Information entered in the PDF forms templates can be automatically captured in structured form for the issuing company's back-end information systems.
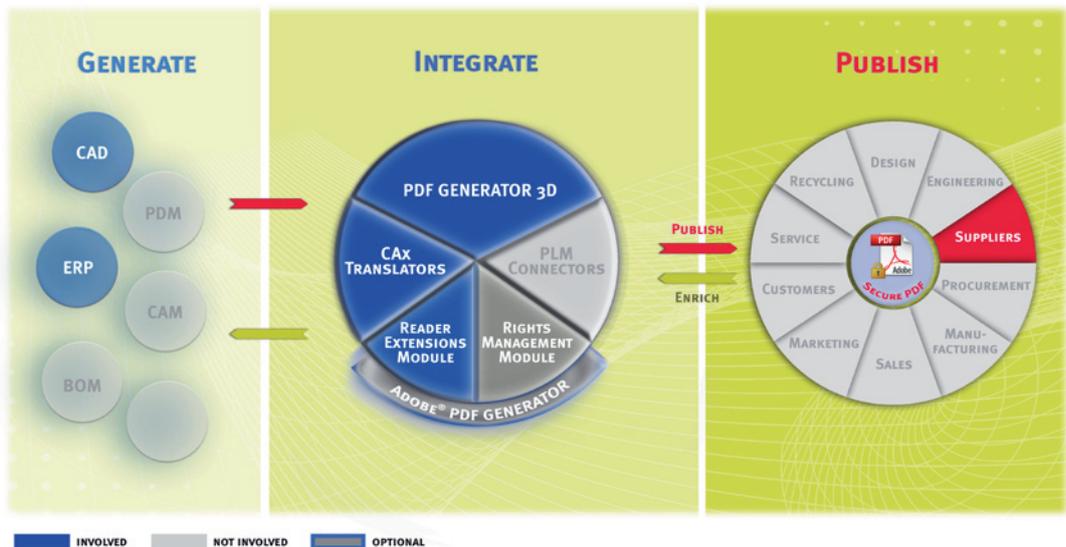
Structured 3D PDF document can contain all the relevant RFQ information in a uniform, accessible, and secure format, making RFQ processing significantly faster.

The benefits

>> RFQs available without manual intervention in a uniform format comprising of information from disparate authoring systems.

>> Significantly faster RFQ creation, distribution, response, processing, and evaluation—many of those tasks now automated.

>> More up-to-date and complete RFQs.

>> High level of protection for the information exchanged.

>> A uniform structure for respondent's information, leading to processing incoming RFQs faster (easier to compare and evaluate).

>> Simpler communications to colleagues in and outside the company through Adobe Reader, which typically exists already on compute devices and requires no additional software installation.

system supporting the customer's change/release processes.

The PDF solution

3D PDF technology supports cross-enterprise change/release processes. Intelligent PDF forms templates provide automation to support proposals for change, change orders, and change notifications. All the information relevant to evaluating and implementing change orders can be embedded in a single PDF container. All data—3D models, 2D drawings, parts lists, and much more—can be extracted from this container and automatically fed back into the respective back-end information systems. In this way, automation integrates the cross-enterprise change/release processes seamlessly into the internal engineering change management systems at each partner site.

>> Example: Change/ release process

The challenges

Product development is different in every company. Some companies have formal procedures; others work ad hoc. These differences make coordinating change/release processes between partner companies difficult. One problem involves proposing changes, understanding those changes, and communicating change orders. Another problem is in exchanging the associated data from different authoring systems, databases, and enterprise management system. A third problem is in disseminating approved changes to the 3D model geometry itself and associated parts lists, materials properties sheets, work instructions, annotations, and other PMI—source data in various native file formats in various information systems.

Suppliers have two choices. They can wholly support the change/release processes of their respective customers—while carrying on with their own processes. Alternatively, they can find some middle ground where they and their customers' change/release processes intersect. This intersection is the technology for the efficient exchange of information. The technology has to be able to convert information in a format readable and available to all involved, captures all kinds of product data (from native CAD files to BOMs to annotations), offer a range of individualized access security, and support bidirectional communication so that supplier-initiated changes automatically feed back to the corporate information

>> XML-based forms technology automates data import/export to/from 3D PDF documents and integrated back-end design, engineering, manufacturing, and enterprise management information systems.

>> 3D models, 2D drawings, parts lists annotations, and any other data relevant to changes in product development/design/manufacture can be included in a 3D PDF container, which acts as a standard format readable by all participants.

>> Recipients need only Adobe Reader to view data, add annotations, and use "red-lining" functions.

>> Comments can be collated in a document and extracted to document the change/release for back-end information systems.

>>   Using interactive 3D geometry in Adobe Reader facilitates understanding, evaluating, and coordinating proposed changes (e.g., highlighting the deviations between two model versions).

>>   Password protection ensures that only authorized persons have access to change/release orders, and digital signatures simplify authorizations across multiple companies. Optional security measures (DRM) can control the contents of the 3D PDF container throughout the change/release cycle.

The benefits

>>   Standardization of cross-enterprise, multi-company change/release processes, which ultimately facilitates and speeds the coordination, discussion, and decision-making related to change/release in cross-enterprise and multi-company collaborations

>>   Integration with internal change/release workflows, providing a high degree of automation in what would otherwise be manual change/release order processing

>>   Seamless documentation of change/release orders

>>   High level of access security to change/release information and authorizations

>>   Faster implementation and coordination of change/release order processing in cross-enterprise and multi-company collaborations

3D PDF technology facilitates and speeds up the implementation and coordination of change/release order processing in cross-enterprise and multi-company collaborations.
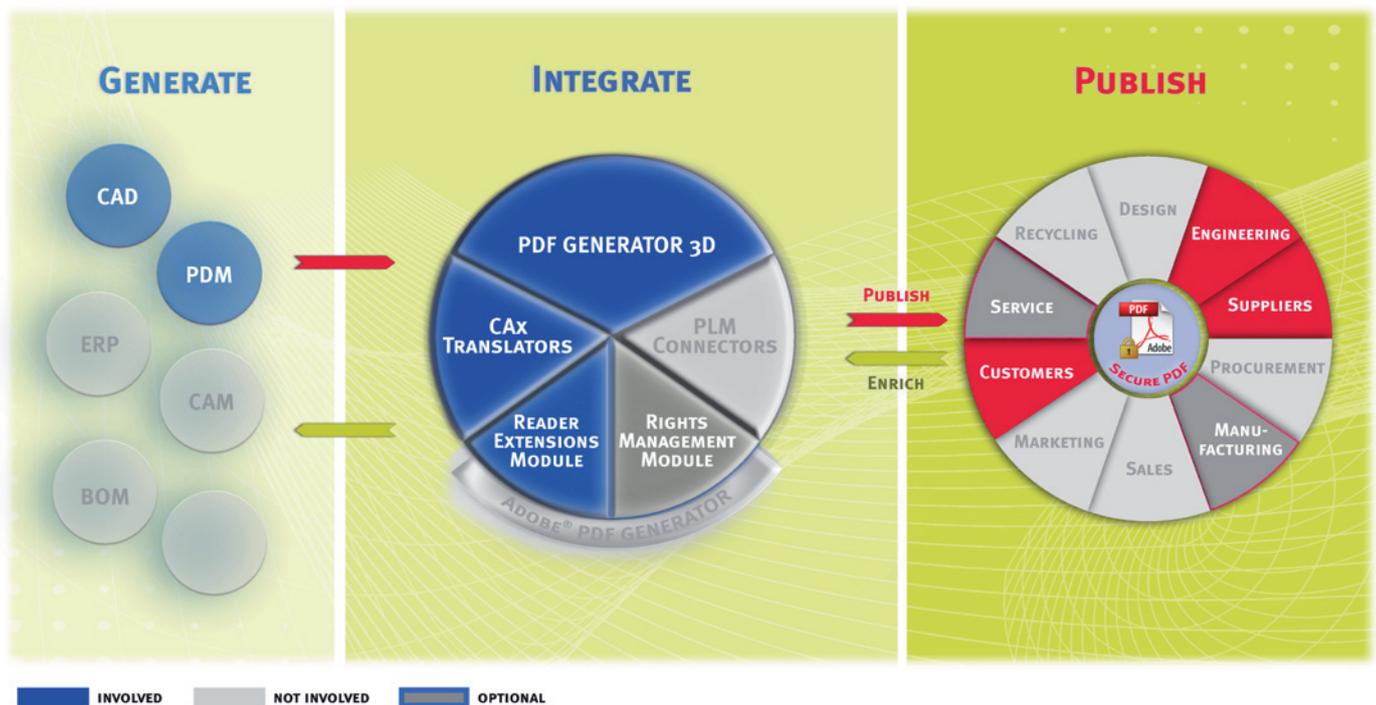
>> Introducing PROSTEP 3D PDF technology

The solution modules

The PROSTEP PDF Generator 3D is the foundation for 3D PDF technology. It has all the essential tools and functions for creating interactive 3D PDF documents, plus the CAD converters and PDM connectors to integrate 3D PDF technology with major, commercially available PDM and ERP systems. Add-on modules include the PDF Generator 3D Rights Management, which embeds security mechanisms in 3D PDF documents, and the PDF Generator 3D Reader Extensions for Adobe Reader, which adds functions to documents when viewed in Adobe Reader.

The 3D PDF architecture consists of the following:

>> **PROSTEP PDF Generator 3D** is a server application for converting data to PDF files. The Live-Cycle Workbench function creates workflows for automatically creating 3D PDF documents that contain native 2D CAD drawings, 3D CAD models, CAx data, STEP files, BOMs, material property sheets, work instructions, and other PMI, as well as XMP metadata and multimedia, such as simulations, animations, and videos that illustrate product design and manufacturing. The LiveCycle Designer function creates PDF templates for automating PDF-based business processes. All data and files in a 3D PDF document can be interlinked and protected by individual and document-specific passwords. Because it is based on the Adobe J2EE architecture, PROSTEP PDF Generator 3D can be combined with other Adobe server products.

>> **CAD converters** in PROSTEP PDF Generator 3D integrate 3D PDF documents with major CAD systems by extracting 3D data. PROSTEP currently offers converters for CAD systems including CATIA and SolidWorks from Dassault Systèmes, PTC Creo, Autodesk Inventor, and NX from Siemens PLM Soft-

ware. The CAD converters also support neutral formats, such as IGES, JT, and STEP. The converters can be used for translating native CAD data without a license for the respective CAD system.

>> **PDM connectors** in PROSTEP PDF Generator 3D integrate 3D PDF documents with major PDM, PLM, and ERP systems. Changes in designs, files, documents, and databases, predefined transactions, and other triggers can automatically activate the creation of 3D PDF documents containing data specified by the associated workflow. PROSTEP currently offers connectors to PDM, PLM, and ERP systems including Enovia from Dassault Systèmes, SAP, Teamcenter from Siemens PLM Software, and PTC Windchill, as well as customized connectors for legacy systems.

>> **PDF Generator 3D Rights Management** lets document creators set up protective mechanisms based on specific user rights and document-related functions. With these security measures in place, document recipients must explicitly log onto a secure server to view, copy, or print the 3D PDF document. User rights can be changed or withdrawn after the document has been sent, giving document owners full power and control over their documents throughout the product lifecycle. Document access can also be limited to a specific period (e.g., to prevent the circulation of obsolete document versions).

>> **PDF Generator 3D Reader Extensions** activate additional functions automatically once a 3D PDF document has been created and viewed in Adobe Reader. These functions include cross sectioning 3D models, taking measurements of model entities, and annotating and copying a 3D PDF document. The recipient of the PDF document can use these functions only after they have been "reader enabled" by the server creating the 3D PDF document.

>> **Adobe Reader** is the free, ubiquitous, recognized de facto standard for viewing, printing, and collaborating on PDF files, regardless of whether the source of the data for these files are 2D or 3D data, animations, video sequences, or audio recordings. This tool is typically available on most computers, including desktops, workstations, laptops, and mobile devices, regardless of operating system. The PDF Generator 3D Rights Management

and Reader Extensions modules can tailor the range of functions provided by Adobe Reader based on user-specific and document-related requirements.

3D PDF as standard

Manufacturing companies using a specific document, communication, or visualization format want it to be long lasting. They want those formats to meet their needs for long-term data storage, data traceability years after a product is introduced to the market (e.g., for warranty service and liability claims), IP reuse, and many other purposes related to long-term document and data preservation.

3D PDF technology satisfies these long-term needs. PDF itself is a formal, open standard maintained by the International Organization for Standardization (ISO). Major elements of the PDF format have been publicized and form the complete PDF specification (ISO 32000). PDF technology is subject to ongoing standardization activities. Two initiatives under the auspices of ISO are of particular interest to the engineering sector:

3D PDF technology satisfies the long-term needs of manufacturers. PDF itself is a formal, open standard maintained by the International Organization for Standardization.

>> **PDF/A**, an ISO standard since 2005 (ISO 19005), applies to long-term archiving of electronic documentation, namely creating, viewing, and printing digital documents for long-term preservation. The second part of the PDF/A standard, launched in June 2011, is based on PDF 1.7 (ISO 32000-1) and offers new features such as JPEG2000 image compression, support for transparency effects and layers, embedding of OpenType fonts, and provisions for digital signatures. Elements not acceptable in PDF/A include multimedia content, JavaScript and other executable file launches, encryption, and external content references. One advantage of archives based on PDF/A over traditional TIFF is that the full text of specific documents can be searched.

>> **PDF/E**, an ISO standard ratified in 2007 (ISO 24517), applies to creating, viewing and printing PDF documents in engineering workflows. The first version of this standard addresses only the representation of tessellated U3D content (3D, multimedia, and integrated source data will be addressed later). PDF documents based on PDF/E may use JavaScript associated with 3D, encryption, digital signatures, transparency, layers, and several other capabilities. Current work on the second version is addressing tessellated or exact PRC models, and long-term archiving.

At the beginning of 2012, the 3D PDF Consortium was founded to provide support for additional activities relating to the PDF/E standard. PROSTEP AG is one of the founding members of this international initiative. You will find further information about the 3D PDF Consortium at **www.3dpdfconsortium.org**.

>> Concluding remarks

A common denominator in technology is crucial for communicating all types of product design, engineering, and manufacturing data between the various departments of a company and between external partners in a company's supply chain. It is the key to the collaboration that drives product development. The technology must consist of several critical parts. It must have a data format understood by all entities—people, businesses, and associated information systems. Access to the data must use tools all participants in the collaborative environment can operate. The data access must be secure, safeguarded against unauthorized use. And the medium containing all the required information must be compact.

3D PDF technology meets all of these requirements. Used with the ubiquitous, defacto Adobe Reader viewer, a 3D PDF document is the medium that makes a wide range of data available to a heterogeneous group of users in a simple, secure, and controlled fashion. The technology simplifies bidirectional communications between multiple information systems—systems often beyond departmental and corporate boundaries. The associated documents, such as RFQs, change orders, work instructions, manufacturing documents, sales documentation, and service manuals, can originate from multiple sources and can pass through multiple people and information system. Recipients using Adobe Reader can add annotations and other information to the 3D PDF documents, thereby confirming the bidirectional nature of business collaboration. Moreover, the automated import/export and workflow capabilities in 3D PDF documents easily integrate information systems that previously required lengthy and costly interface development. No other technology offers this degree of flexibility combined with maximum security.

3D PDF technology is already used in a broad range of collaborative and product development applications. The technology is still advancing through the efforts of PROSTEP AG and organizations involved in international standards. The versatility of 3D PDF technology makes it a powerful tool for all communication processes in the company and its extended enterprise.

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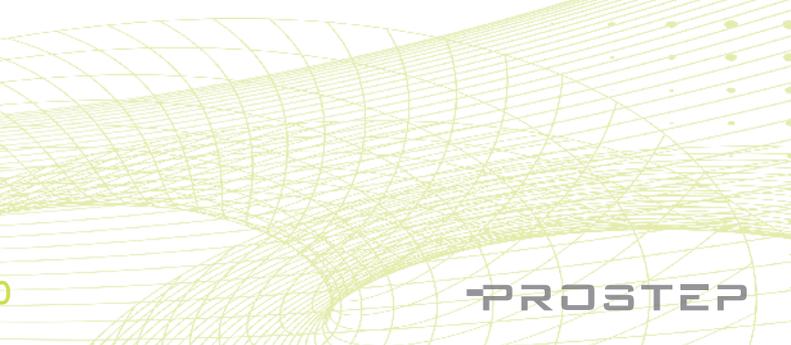
>> Abbreviations

2D	Two Dimensional
3D	Three Dimensional
BREP	Boundary REPresentation
CAD	Computer-Aided Design
CAE	Computer-Aided Engineering
CAx	Computer-Aided processes
DRM	Digital Rights Management
ERP	Enterprise Resource Planning
IGES	Initial Graphics Exchange Specification
IP	Intellectual Property
ISO	International Organization for Standardization
Java EE	Java Enterprise Edition
J2EE	Java 2 Platform, Enterprise Edition
JT	Jupiter Tessellation
MRO	Maintenance, Repair and Overhaul
PDF	Portable Document Format
PDM	Product Data Management
PLM	Product Lifecycle Management
PMI	Product Manufacturing Information
PRC	Product Representation Compact
STEP	Standard for the Exchange of Product model data
U3D	Universal 3D
XML	eXtensible Markup Language

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