Workflow for Digital Book Production

Prepared by INTERQUEST, Ltd.
Although we customarily associate books with the trade publications found in bookstores and on book shelves, book printing encompasses the production of any and all bound volumes. This includes paperback and hardcover trade books; educational materials such as textbooks, workbooks, course packs, and standardized tests; professional and technical reference books and manuals; specialization books such as school yearbooks and fine art; and product catalogs and brochures.

Hardcopy book sales are doing quite well in the face of burgeoning electronic media. Despite the staggering volume of pages served over the Web, and overly ambitious expectations for electronic books, the traditional book industry continues to grow year over year. The association of American Publishers estimates that book sales in the U.S. reached $23.4B in 2003—an increase of 4.6% over the previous year.

According to the Book Market Overview, a study recently published by the Graphic Arts Marketing Information Service (GAMIS), the book publishing industry in the U.S. is expected to grow at about a 4% rate per year from 2001 to 2012.
**INTRODUCTION**

**Bound by Tradition**

In many ways conventional tradebook publishing is a case study in inefficiency—a complex and closed system where marketing, sales, and distribution channels are closely tied to the economics of the manufacturing process. The economics of offset printing favor long print runs and warehousing. Publishers assume an enormous risk in this consignment model since unsold books are returned to be destroyed or heavily discounted.

Digital printing technology has begun to loosen the stranglehold exerted on the book industry by the traditional manufacturing model. Cut-sheet and continuous-feed printing systems are now able to economically deliver high-quality digitally printed books in black and white, spot color, and process color on a wide range of stocks with a variety of in-line, near-line, and off-line binding methods.
Digital printing technology is effectively being used for a wide array of conventional book printing applications, including the production of proofs, advance copies, and samples. Moderate-demand first editions and shorter-run second and subsequent editions can be produced on demand, to match the quantities ordered. Reprints, backlists, and out-of-print editions in the public domain can now be brought back into circulation and generate new revenue streams for authors and publishers.

In addition to attacking gross inefficiencies in the conventional book market, digital printing technology has opened up entirely new applications. Books and manuals can be made to order or easily revised without fear of compromising existing inventories. Technical and training manuals can be electronically warehoused and customized by end users. Personalized brochures and catalogs can be produced on high-end full-color digital printers, yielding higher response and retention rates.

The Workflow Imperative

Professionals in all fields of publishing and printing are facing similar challenges brought on by the demands of ever shortening run lengths and turnaround requirements. Shorter run lengths mean that more jobs must be processed more efficiently. This places additional burdens on administrative and production resources. The confluence of traditional and digital printing along with additional challenges and opportunities brought by electronic media bring workflow into sharp focus.

Xerox approaches digital book production within the context of FreeFlow, a multi-tiered framework for assembling end-to-end workflows from highly modular hardware and software components. This White Paper examines the strategy and architecture of Xerox’s digital book printing solutions.

The benefits of digital book production include:
- Fast, economical short-run printing
- Less set-up and running waste
- Just-in-time inventory
- Enables versioning and customization
- Compatible with existing production processes

PIA (Printing Industries of America) estimates that in 2000 15% of all printing was delivered within a day, 18% delivered in five days, and 13% in five-to-eight days. PIA expects that in the future, higher percentages of printing will be delivered in shorter time frames. By 2010, as much 30% of all printed material could be turned around in one day or less.
FreeFlow for Book Manufacturing

Xerox’s approach to book manufacturing is to provide a toolkit of hardware, software, and services that enable print providers to construct book production workflows that best meet their needs. FreeFlow is the scaffolding upon which configured solutions can be built using Xerox and partner components that share common platforms and standard interfaces.

By focusing on the end-to-end workflow of book production, FreeFlow enables printers already involved in digital book production to reduce costs, improve efficiencies, and maximize their existing equipment and personnel resources. It also lowers the bar of entry for providers who are contemplating adding digital book production capabilities to their existing services by removing complexity from the book manufacturing process.
Xerox has traditionally focused on printing, and although printing and finishing are central components of book and manual production, they are only part of the picture. FreeFlow enables digital book manufacturers to extend production workflow beyond the walls of the printshop and bindery in order to address the process and business management aspects of their operation.

**Business & Process Management**

The business management layer of FreeFlow provides an interface between the print buyer, creative environment, and the book manufacturer. From the perspective of the producer, the goal is threefold: to better integrate upfront business and administrative processes with production; to improve and automate manufacturing processes; and to forge closer, more valuable, and more persistent relationships with customers.

FreeFlow enables a closer working relationship between creators and designers and the production facility. It utilizes JDF (Job Definition Format) to enable designers to embed finished product descriptions in files submitted to the manufacturer for production. “JDF intent,” or product description, can be automatically translated into production processes in the prepress and makeready stage using FreeFlow Process Manager.

**FreeFlow Web Services** also improves and streamlines job submission for both the client and the production facility. A wide range of file formats can be automatically and accurately transformed into Adobe PDF through the incorporation of Adobe Normalizer and Job Ready. Print ready files can be viewed by the client, complete with production attributes such as imposition.

Web Services also provides the book manufacturer a digital storefront where jobs can be uploaded by customers, estimates rendered, and orders submitted. The status of work in progress can be automatically conveyed to clients and invoiced upon completion.

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**FreeFlow Components**

- Web Services
- Document Library
- Process Manager
- FreeFlow Partners

Standards such as JDF and PDF are one of the cornerstones of FreeFlow. They are critical in providing public interfaces between components in the book manufacturing workflow. Third-party products and solutions are further integrated into FreeFlow through the use of SDKs (Software Developer Kits) and APIs (Application Program Interfaces) to ensure that Xerox-supplied hardware and software is fully maximized.
The **Document Library** straddles the business and process management layers of FreeFlow. It provides a file structure and security mechanism for FreeFlow Web Services to enable secure online ordering. Through this shopping cart approach, user profiles can be configured to automatically trigger appropriate levels of access for each customer. This enables personal libraries of books and manuals to be set up with full search capability by content or attribute.

Within the manufacturing environment, the Document Library provides a range of services for files put into production. This could include automatic file conversion, OCR, and moving, copying, and printing files in a background mode.

**FreeFlow Web Services**

With catalog ordering through Web Services, anytime a process associated with a job is changed, an e-mail is automatically sent back to the customer updating the job status.
**FreeFlow Process Manager** provides a drag-and-drop GUI for automating repetitive tasks that may not require the intervention of prepress personnel. Files can be automatically routed from one operation to the next, dependent upon the results of each step. Scanned or imported PDF files, for instance, can be preflighted and ICC profiles automatically applied and verified prior to impositioning and proofing.

**Operations Management**

The operations management layer of FreeFlow encompasses prepress, printing, and binding operations. One of Xerox’s major goals in offering digital book manufacturing solutions configured with FreeFlow is to achieve versatility in executing a wide variety of book formats and bindings across a full range of printing and binding equipment using one common approach. Equally important is flexibility in where operations are performed within the workflow.

**PrePress**

**FreeFlow Makeready** is comprised of Xerox and third-party solutions for preparing digital files for production. Because all of the components are fully integrated all prepress operations are performed within a common software environment.
Digital book manufacturing works with electronic files from a variety of sources. Files may be submitted by a customer or design agency in application file formats such as QuarkXPress or Microsoft Word, or they may be submitted in PostScript or PDF format. In many cases, however, there are no electronic originals, and books and manuals must be digitally scanned.

Scanning hardcopy books can be time consuming and problematic. Book covers and text blocks may contain a wide variety of black-and-white and full color illustrations previously rendered in halftone screens of various frequencies for offset printing or other reproduction processes.

The FreeFlow 665 Scanner performs operations such as deskewing and the automatic segmentation of image types on the fly to produce high-quality masters with little or no operator intervention. The scanner recognizes different image types in real time and automatically optimizes settings for the best image quality. Pages can be scanned directly to PDF and associated ICC profiles automatically applied. The SCSI interface between the scanner and Makeready is optimized so that scanned images are immediately available to the operator.
FreeFlow Makeready incorporates a variety of software tools designed to eliminate guesswork and rework once a job is released to the press and bindery. During imposition operations, for example, the operator can switch between Page View, Book View, and Print View to see individual pages, the actual page sequence after folding and finishing, and the way the pages will appear on the press sheet.

FreeFlow Makeready tools are equally applicable to cut-sheet or continuous-feed equipment. For continuous-feed printers a digital canvas is used to lay out multi-up impositions on the web. Custom sheet sizes can be specified and the operator is able to import book pages and check for page shift prior to printing. The same job can also easily be directed to cut-sheet equipment, and the operator can invoke a Light Table view to check front-to-back sheet alignment.

FreeFlow Makeready supports book impositions applicable not only to digital production equipment, but to bindery equipment normally used with offset equipment. FreeFlow Makeready supports multiple signature sets with automatic padding so that a book can be printed digitally and bound with off-line equipment.
DIGITAL BOOK & MANUAL PRODUCTION

RIP & Print

For some book or manual applications, page impositioning may best be done at the print controller rather than in prepress. FreeFlow DocuSP supports book impositions with specified margin settings, eliminating this step from Makeready. Virtual print queues with different impositions and job attributes can be set up to accommodate a variety of set-ups. The DocuSP controller is the common front-end across the full fleet of Xerox cut-sheet and web-fed monochrome and color equipment.

One important goal of FreeFlow is to expand a book producer’s options by facilitating the integration of digital book production with existing business, process, and manufacturing operations. FreeFlow Print Manager for Creo Prinergy™ is one example. Print Manager provides access to all Xerox production printers and is used to program job parameters that match the capabilities of each printer. Prinergy operators can program setup information and direct a job to either conventional or digital equipment. Print Manager supports JDF or Xerox job tickets.

Over time the production of books has progressed from scribes to letterpress, offset lithography, flexography, gravure, and most recently, electrophotography and other fully digital processes. Today it is increasingly likely that a book manufacturing operation will use a variety of reproduction processes and equipment types.

FreeFlow Print Manager
Binding & Finishing

Traditional printing is a highly customized manufacturing process which has always relied heavily on binding and finishing. This is in part because conventional printing processes produce uncollated press sheets that must be dried, folded, trimmed, gathered, and bound into finished products.

Digital printers initially did not support the sheet sizes and stocks required to produce many of the bindery formats used in book and manual production, and in-line binding options were relatively limited. In recent years this situation has changed dramatically and digital print production can now accommodate most book and manual bindings.

FreeFlow extends digital book manufacturing workflow to the bindery in order to help producers decrease labor costs, leverage existing equipment and skills, and operate faster, more efficiently, and more accurately. Xerox’s intention is to accommodate the full range of book and manual bindings required by book producers. In order to do this it is partnering with finishing equipment vendors to add binding and finishing components that can be used across all of its production equipment, including monochrome and color cut-sheet and continuous-feed models. Equally important, Xerox is utilizing prepress and press SDKs to build capabilities into FreeFlow that enable book manufacturers to integrate digital production into their existing operations.

The ultimate goal of Xerox’s approach is an end-to-end JDF-based workflow that uses FreeFlow components developed by Xerox and its partners to communicate product specifications to in-line and near-line binding and finishing equipment, and to accommodate the requirements of off-line bindery. Significant progress toward this goal has already been achieved and is now embedded in the FreeFlow framework.

The DocuTech was the first digital production publisher to raise the bar for binding and finishing, initially incorporating a variety of stapling and tape binding options, and eventually supporting sheet inserters, add-on input trays, roll-to-sheet solutions, saddle-stitching, and perfect binding. Today digital production equipment such as the iGen3 and Nuvera are building upon the DocuTech legacy in paper handling and finishing.
In-line binding and finishing hardware may be supplied by the printing systems supplier, or by a third party. The latter case clearly requires close cooperation between both vendors to ensure the units are compatible and well-integrated. This implies that misfeeds, jams, or shut-downs on either side of the line are communicated to the companion equipment, and recovery mechanisms are in place.

Off-line equipment implies that there is no “intelligence” in the binding and finishing equipment—it is strictly mechanical in nature. Even so, jobs prepared for off-line equipment must be prepared in a manner compatible with the process requirements.

Near-line equipment strikes a balance between in-line and off-line configurations. These solutions are often referred to as “soft connect” and are developed to work with multiple printers with a minimal amount of setup. Near-line devices have some degree of electronic intelligence, and equipment setup is accomplished through memory settings, stored jobs, and bar codes. Near-line equipment may also have communication interfaces with companion binding and finishing units.

The arguments in favor of in-line or off-line operation of binding and finishing equipment for digital book production are dependent on the volume, types and variety of applications handled by a producer, the existing equipment investment and configuration, and the level of integration the producer wants to achieve.

Off-line and near-line (versus in-line) finishing is attractive for a variety of reasons:

- The operating speeds of printing and binding and finishing equipment may be incompatible, especially if a producer has a variety of digital printing systems to support and does not want to invest in multiple dedicated in-line units

- Equipment stoppages are inevitable, shutting down both the printer and the binding hardware and ultimately impacting the throughput of both

- Short-run book operations often require a great deal of changeover and set-up between jobs, so an off-line or near-line approach may be more productive, especially if the off-line or near-line workflow operates faster than the printing system(s)

In-line operation of binding and finishing equipment is appealing if the book manufacturer handles a relatively large volume of similar application types. Other considerations include security requirements, application integrity, and the type of finishing required. In-line operations also typically require less manual paper handling, reducing the potential for error, and closed-loop systems offer a level of verification not achievable with off-line and near-line configurations.
Flexibility is one of the key goals for digital book manufacturing solutions. FreeFlow hardware and software components are modular, enabling book producers to construct different workflows to handle a variety of application types and formats using one common toolkit. Xerox facilitates this approach by choosing binding and finishing equipment that can be leveraged across multiple types of equipment.

Xerox has been actively developing and promoting standards for in-line binding and finishing solutions for digital production equipment for more than a decade. The company’s DFA (Document Finishing Architecture) has become a de facto industry standard for establishing two-way communication between a finishing device and a printer. DFA is a combination of hardware and software that functions on an individual sheet level to enable full job recovery. It handles equipment timing profiles to establish the transport rate between the printer and the in-line equipment, and establishes the finishing parameters or description of each job.

FreeFlow digital book manufacturing solutions can handle most book and manual bindings, including:

- Flats/Folded
- Stitched sets
- Booklets
- Perfect bound
- Case bound
- Lay flats (coil & wire)
- Tape bound
**UP3i** is an open source, vendor neutral communications standard for hardware components in a process line. The UP3i specification was developed by Xerox, Duplo, Hunkeler, IBM, Océ, and Straffors. It promotes integration with other workflow standards such as JDF by serving as the conduit for job ticket and control information for every device in a digital print line. Features enabled by UP3i include automatic job changeover, real-time process control, automatic waste reject and job recovery, automatic reprint, single-point operator control, dynamic finishing, and delivery control.

Standards for in-line binding and finishing components for continuous feed equipment are similar in concept to DFA, but use different communications protocols. Xerox’s goal, shared by other vendors in the industry, is to establish a universal binding and finishing architecture that will function with both cut-sheet and continuous-feed equipment. This XML-based protocol, known as UP3i (Universal Printer, Pre- and Postprocessing Interface), is already in development.

Xerox is actively laying the groundwork in FreeFlow to realize its longterm goal of establishing a JDF workflow that extends from project inception to binding, finishing, and fulfillment. DFA has gone a long way in establishing inter-connectivity and communications between printing systems and in-line binding and finishing components, but the ultimate goal is to enable a JDF job ticket to automatically configure post-processing equipment.

In order for this long-term vision to be realized, the JDF-encoded description of a finished book or manual must be translated into machine instructions. This is the role of DigiFinish, a backend digital server that will parse XML-coded product descriptions in order to set up and drive binding and finishing equipment in much the same manner a digital front end (DFE) uses a print stream to drive a production printer.

DigiFinish has already been successfully implemented in Xerox Book Factory installations to perform integrity checking of covers and book blocks which were produced on separate print engines. In these instances barcode readers at the in-line perfect binder and cover feeder are linked to the DigiFinish server containing the instruction set to ensure covers and text are matched.
Xerox has already implemented solutions that help integrate digital book manufacturing with existing binding and finishing equipment. The ability to produce signature sets for off-line Smythe-sewn books is one example. StackPort™ is another example, and is the first step in establishing a physical transfer mechanism between the printing system and near-line or off-line binding and finishing equipment.

StackPort™ was conceived by GBC Corporation, which established a consortium with Xerox, CP Bourg and Duplo to develop the product. It is a secure means for transporting paper from print engines to near-line and off-line binding and finishing equipment while maintaining stack integrity and reducing operator intervention. StackPort™ uses a cart that securely docks to printing systems output stackers and transport the output to finishing equipment. Future enhancement to StackPort™ will include job tracking and data transfer for integrating JDF workflows with off-line and near-line binding equipment.
Currently Strategic and Advanced FreeFlow partners for binding and finishing include:

- Bindomatic
- Challenge
- C.P. Bourg
- Duplo U.S.A. Corp.
- GBC Industrial & Print Finishing Group
- Gradco, Inc.
- Horizon International
- Plockmatic International AB
- Roll Systems, Inc.
- Standard Finishing Systems

**Partners, Services, & Business Tools**

Partner products and solutions are a key ingredient of FreeFlow. Xerox carefully selects partners to ensure their contributions are fully integrated into the FreeFlow framework. This means that book producers work within a consistent FreeFlow environment, and all components in the workflow make full use of upstream and downstream resources.

The integration of partner products is achieved through the use of open standards such as XML, JDF, and PDF, and through Xerox SDKs and APIs. The goal is to enable flexible digital book manufacturing workflows to be integrated into the provider’s own production environment, as well as with customer environments.

Services—along with standards, modular Xerox hardware and software, and optimized partner products—are the fourth cornerstone of FreeFlow-enabled digital book manufacturing solutions. Printing is part—and rarely more than a third—of the total cost of book manufacturing. Xerox publishing specialists work closely with book manufacturers to analyze the economics and logistics of their operations and help them configure workflows and solutions that help them lower costs, reduce errors, and leverage production resources.
Rarely has a manufacturing process shaped the marketing, sales, and distribution channels of a product to the degree that conventional printing has shaped the publishing industry. Because the economics and logistics of photomechanical print production favor long runs, the publishing industry has developed an operating model that places an enormous burden of risk on publishers, favors mass market best-sellers, and routinely lets titles slip out of circulation. The system is rife with waste and inefficiencies, but until recently there was no viable alternative.

Just as high-speed laser printing was quickly adopted for transactional printing applications in the late 1970s and 1980s due to clear and demonstrable cost savings, book manufacturers and publishers are embracing digital printing in order to drive down labor costs, reduce waste and overhead, and generate new revenue.
Leaving Nothing on the Table

The economics of traditional printing processes have let significant portions of the market lie fallow. Many publishers are now using digital print manufacturing to tap pent up demand for books that cater to smaller subsets of the book buying public. Examples include technical and scientific publications, self-published editions, textbooks and educational material, books in the public domain, and books that have gone out of print.

Publishers are leveraging digital book production to extend the life of titles that normally would fall out of print due to tapering demand. It enables these publishers to squeeze more revenue out of titles by economically printing limited quantities as they are ordered. One prominent publisher has brought more than 500 titles back into print in this manner and generated over $1 million in revenue that it would have otherwise been forced to leave on the table.

Just in Time Book Manufacturing

The traditional publishing model involves dual fulfillment since titles are initially printed to stock and later shipped from the warehouse to book distributors. Because of the economics of traditional book production and uncertainty over how well any given title will sell, overproduction is not uncommon. Unsold books are returned to the publisher for warehousing or destruction. Additional printings can become increasingly less profitable as demand tapers off until the book is finally officially placed out of circulation.

This "print then sell" model does not scale very well for many publishers not catering to a mass market. These publishers often struggle to match supply with demand, often resulting in back orders and overstock, and labor inefficiencies. For them, digital print manufacturing is a solution that best fits their business model and they are able to streamline production operations, eliminate costly warehousing operations, and eliminate back orders.
**Digital Book Production**

Unlike photomechanical processes, digital printing has very little process overhead so that manufacturing cost generally does not decrease significantly with quantity. But printing is only one factor in the overall cost equation. Because books can be economically printed in runs of $n$ to 1,000-5,000 depending on the page length and format, digital book manufacturing eliminates many downsides of warehousing which, when factored in, move the breakeven between digital and offset processes further up the scale.

**Consolidating Processes**

In many instances publishers do not print their own titles. Book printers are finding that digital printing can enhance their relationships with publishers by adding valuable supplementary services to their portfolio. Digital book production enables these book manufacturers to help publishers save money while at the same time adding revenue to their own bottomline.

Digital printing can be profitably integrated into traditional book manufacturing in a number of ways. It can be used to produce proofs, advanced copies, and trial runs to test the market before committing to long-run processes. As the life cycle of a book progresses and sales slacken, digital technology can be economically substituted, enhancing the publishers’ profit margins.
Digital printing equipment is being steadily improved to expand its applicability to a wider variety of book and manual output types and formats. Examples include: wider webs on digital production printers to accommodate 4-up 6x9 book production; the ability to handle larger sheet sizes and to support coated, light-weight, and SAPPI stock on cut-sheet printers; higher resolution scanning; in-line binding, folding, and trimming; higher throughput; and more rugged equipment.

As digital production hardware improves, the production infrastructure that supports it must also improve. Book manufacturing solutions based on FreeFlow are designed to leverage the unique capabilities and advantages of digital equipment, and to facilitate the integration of digital short-run production into existing workflows. It approaches this goal with modular components that can be mixed and matched to establish a variety of workflows within a single environment.

By utilizing open standards and common platforms FreeFlow enables printers to extend the manufacturing workflow to client and partner systems. It also provides a migration path for providers, enabling them to add short-run digital production to their operations without compromising existing investments in equipment and skills.

For book and manual providers already utilizing digital printing technology FreeFlow offers flexibility across a broad array of applications and equipment. Common digital front-ends and software tools facilitate upgrading from monochrome to spot and full-color equipment, and from cut-sheet to continuous-feed solutions. Software, printing, and finishing equipment can be configured into the most efficient workflow for a variety of book and manual applications within the framework of FreeFlow. This represents a significant step forward from the bundled, application-specific solutions of the past.
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