



DENISE NITTERHOUSE

*Digital Production
Strategies for
Scholarly Publishers*

DENISE NITTERHOUSE is an associate professor in the School of Accountancy and Management Information Systems at DePaul University, Chicago, Illinois. Her areas of expertise are information systems, accounting, and qualitative exploratory market research, with a focus on education, health care, not-for-profit, and knowledge industry organizations. She can be reached at dnitterhouse@mba1977.hbs.edu or 312-362-8752.

© 2005 by The University of Chicago.

No permission is needed for noncommercial redistribution of this white paper as long as a complete citation is provided.

This paper was made possible by a grant from the Andrew W. Mellon Foundation. It considers current and emerging book production and distribution alternatives and the related decision processes of scholarly publishers. Addressing issues of operations, finances, strategy, and risk inherent in the scholarly publishing process and marketplace, it discusses how digital printing can fit into a publisher's strategy throughout the life cycles of its scholarly books. It presents case studies for several university presses and titles, and proposes production strategies that can both serve the scholarly mission and optimize income flow throughout the title life cycle.

Author's note:

I wish to acknowledge the contributions of staff associated with the University of Chicago Press and its BiblioVault venture as well as Edwards Brothers. They, along with many other members of the university press community, provided the important input and feedback that made this work possible. Special thanks go to Sam Giannakis, Mary Summerfield, Joe Thomson, and John Walsh for their time and for their helpful comments and data. I am also grateful to DePaul University for allowing me to pursue this research, and to the University of Chicago Press and to the Andrew W. Mellon Foundation for supporting it.

Contents

SCHOLARLY BOOK PUBLISHING	1
Production	1
Offset versus Digital Printing	2
<i>Specifications, Processes, and Quality</i>	2
<i>Cost and Quantity Trade-offs</i>	3
<i>Schedule</i>	6
<i>Additional Considerations</i>	6
Production Decisions	6
<i>Scholarly Book Sales Patterns</i>	7
<i>Scholarly Press Overprinting and Storage Costs</i>	7
Production Decision Making and Management Processes	9
DIGITAL PRODUCTION STRATEGY EXAMPLES	11
Paperback Reprints	11
Hardcover Digital Reprints	13
Hardcover Digital Frontlist Printing	14
CHANGING PRODUCTION AND DISTRIBUTION MODELS	15

Integrating and Automating Production and Fulfillment	15
Short-Run Digital Printing (SRDP)	16
<i>An Oldie but Goodie</i>	17
<i>An Oversize Classic</i>	18
<i>Saved by SRDP</i>	18
<i>Impact of CDDC SRDP</i>	18
Harvard University Press: Ultra-Short Inventory-Replenishment Program (USIRP)	19
MIT Press Classics Series: Bringing Books Back into Print	19
Print-on-Demand (POD)	20
Electronic Distribution (E-books)	21
 CHOOSING PRODUCTION AND DISTRIBUTION ALTERNATIVES	 23
 CONCLUSIONS	 25
Effects of Digital Printing	25
Outstanding Issues	27

Scholarly Book Publishing

Scholarly book publishers are caught between their scholarly missions and business pressures and opportunities. The business pressures include library budgets increasingly devoted to expensive journals rather than books, margin pressure from a few increasingly dominant retail booksellers, and more efficient used-book markets thanks to the Internet. The business opportunities include the emergence of new electronic printing and delivery technologies. After a half century of offset printing dominance, digital printing is now a technologically and economically viable alternative for producing most scholarly books. Partnerships with vendors and integrated Web-based automated fulfillment systems enable efficient ordering and fulfillment of a few copies of a title. Understanding the operating, financial, strategic, and risk implications of emerging production and distribution options will enable publishers to choose wisely among them for both frontlist and backlist publishing decisions.

Both the initial stages of a scholarly book's life (research, writing, editing, and design) and the final stage (reading) involve primarily intellectual activities. The intervening stages of production and distribution, however, are largely physical processes, dominated by logistical and financial considerations. Although only distinguished intellectual endeavors can produce a great scholarly publisher, the economic consequences of poor production and distribution execution can destroy a scholarly publishing program.

PRODUCTION

Evolving printing and binding technologies give scholarly book publishers more production options than they had just a few years ago, and the parameters continue to shift as both technology and costs change rapidly.

The ability to economically produce a few copies of a book using digital printing is changing production strategies.

OFFSET VERSUS DIGITAL PRINTING

Cost, quality, and schedule weigh heavily in selecting a book printer and printing method. Book specifications and the quantity to be printed determine unit cost. If all else is equal, a publisher usually selects the lowest-cost printing bid. Quality, cost structure, and schedule characteristics differ in important ways between offset and digital printing, although quality differences are shrinking rapidly.

SPECIFICATIONS, PROCESSES, AND QUALITY Offset lithography, which applies ink to paper using plates, has dominated book printing since the mid-twentieth century. For most of this period, printers used film to create printing plates; the more recent computer-to-plate offset technology eliminates the film. Printers use Adobe Portable Document Format (PDF) files either to produce offset plates or to do “digital” printing, which uses heat to fuse toner to paper. Introduced in xerographic copiers in the 1950s, toner-based digital printing has become a technologically and economically more viable alternative for producing most scholarly books over the last decade.

For the last several years, typesetters have produced “native” (vector) PDF files routinely from their original files for a book, for example, Quark and PageMaker files, as books are published. Printers use these PDF files for both offset and digital printing. For titles that lack such files, print-ready PDF files can be created by scanning a book, creating a TIFF (tagged image file format) file for each page and converting the TIFF files to an image (raster) PDF file. Book conversion costs depend on book size and complexity, as well as contractual relationships between a publisher and the vendors involved, but \$75 to \$100 is a reasonable estimate for scanning the text and cover of a 256-page monograph. The quality of the PDF files is a major determinant of print quality. Native PDF files yield higher quality than do raster PDF files that were created by scanning a book, no matter how careful the scanning.

The graphic elements of book content determine its quality requirements. For books in which either black-and-white or color artwork is important, digital print quality may be inadequate. Or the cost to get the desired quality with digital printing may be prohibitively high for visually complex books. The more detailed and complex images a book contains, the less

likely it is that digital printing will suffice. Book design may also influence printing options. For example, coated or matte paper is poorly suited to digital printing, and digital printing is less readily available than offset for books of unusual sizes.

However, both scanning and digital printing technology and processes continue to improve. For example, scanning and digital printing can now produce interior color that is acceptable for some books, and color digital printing of vector PDF files can be quite good if expensive. Many scholarly monographs can now be digitally printed at an acceptable quality. Four-color covers printed digitally can be indistinguishable from their offset counterparts. For a typical scholarly monograph, most readers cannot distinguish digital from offset printing.

COST AND QUANTITY TRADE-OFFS Digital printing provides acceptable print quality for a growing range of book specifications. For such books, because of its impact on costs, quantity is the primary factor driving the choice between digital and offset printing.¹ Offset printing has substantial fixed costs, sometimes referred to as make-ready costs. The first offset print run incurs a cost either to create film or to prepare native PDF files for direct plate creation. Each offset print run also incurs “fixed” costs for creating the plates and for setting up printing and binding equipment. These costs vary with page count and trim but are usually in four figures. Digital printing from native PDF files has minimal printing and binding setup costs. If native PDF files are not available, the publisher incurs an additional one-time fixed cost for the first digital printing in scanning a copy of the book and preparing print-ready raster PDF files for the interior and the cover. However, offset printing has lower press costs for interiors and covers or jackets than digital printing.

These very different cost structures lead offset printing to have a lower unit cost for larger books and larger quantities, and digital printing to have a lower unit cost for shorter books and for small quantities. At this time, offset printing for standard scholarly monographs generally has a lower unit cost for print runs of more than 500 units, and digital printing has a lower unit cost for print runs of less than 200 units. For print runs between these two quantities, the attributes of the job—including trim size, page count, and finishing—determine the lowest cost option.

1. The costs of offset and digital printing used in this section of the paper were provided in September 2004 by Edwards Brothers, a printer that offers both offset and digital services.

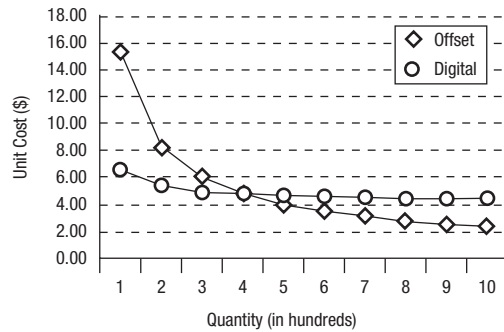
The following table provides offset and digital total and unit production prices for an initial print run of quantities from 100 to 1,000 copies of a paperback book (for which the publisher provides native print-ready PDF files) with specifications of 256 pages, 6”x9” trim, and laminated perfect-bound four-color cover.

Initial Printing Cost Comparison (September 2004)

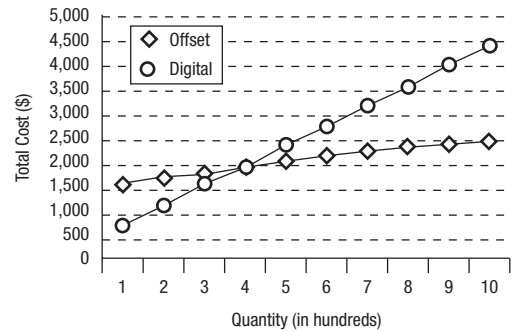
Quantity	TOTAL COST (\$)		UNIT COST (\$)	
	Offset	Digital	Offset	Digital
100	1,545	657	15.45	6.57
200	1,677	1,077	8.39	5.39
300	1,805	1,498	6.02	4.99
400	1,933	1,918	4.83	4.80
500	2,046	2,338	4.09	4.68
600	2,136	2,758	3.56	4.60
700	2,210	3,179	3.16	4.54
800	2,287	3,599	2.86	4.50
900	2,360	4,019	2.62	4.47
1,000	2,423	4,439	2.42	4.44

In this example, digital printing unit costs are lower than offset up to slightly above 400 units, and the reverse is true at higher levels. The unit cost graph below illustrates this relationship. The book specifications determine the absolute unit cost levels and the point of intersection for the two cost lines, but the general relationship is the same for all books that can be printed either digitally or offset. As the first graph below illustrates, the unit cost of offset printing declines significantly as the quantity printed increases because fixed costs for an offset print run are substantial and incremental costs per copy are low. Digital printing unit costs, on the other hand, decline much less and remain relatively high as the print run grows because digital fixed costs are smaller and incremental costs per copy are higher than for offset.

Many publishers consider total cash outlay—not just unit cost—in



Initial Unit Costs for Offset and Digital Printing



Initial Total Costs for Offset and Digital Printing

planning production. As the second graph shows, total expenditure increases as the number of books produced increases. Longer print runs require larger cash investments.

Publishers must consider two issues:

- Cash tied up in book inventory that does not sell for several years, if ever, is not available to support other projects. Copies that do not sell must be written off, and the cash invested to produce them will never be recovered.
- If production staffs are charged with getting the lowest unit production cost, higher-level managers must also carefully monitor the unit cost of books that actually are sold after taking into account inventory write-off.

Representative costs to manufacture a reprint of a paperback book with the same specifications are provided in the table below. These reprint costs are somewhat lower than initial print costs, especially for offset printing. Offset unit cost drops below digital unit cost at fewer than 300 units. However, offset printers may not routinely offer to fill such small orders in a timely fashion.

Reprint Cost Comparison (September 2004)

Quantity	TOTAL COST (\$)		UNIT COST (\$)	
	Offset	Digital	Offset	Digital
100	1,081	605	10.81	6.05
200	1,212	1,025	6.06	5.13
300	1,340	1,445	4.47	4.82
400	1,468	1,865	3.67	4.66
500	1,581	2,286	3.16	4.57
600	1,671	2,706	2.79	4.51
700	1,745	3,126	2.49	4.47
800	1,823	3,546	2.28	4.43
900	1,895	3,967	2.11	4.41
1,000	1,958	4,387	1.96	4.39

Page count has a significant effect on the relative costs of offset versus digital printing. If all else is equal, digital printing is most economical up to higher quantities for short books (fewer than 200 pages), and offset is more economical than digital at much lower quantities for longer books (more than 400 pages). However, both quality and cost differences between offset and digital printing continue to change. On the one hand, offset printing as few as 300 units of some titles is now financially and operationally viable for some printers, whereas 1,000 units was considered to be the minimum offset print run until recently. However, the feasibility and economic attractiveness

of offset printing fewer than 500 copies varies greatly among printers; some do it routinely and, well, others do not. Some printers may be reluctant to take small offset jobs. Digital print quality is improving, and its costs continue to decrease slightly. Publishers should review the changing cost and quality parameters regularly.

SCHEDULE Digital printing can usually be done more quickly than offset. In the busy season, it may take more than a month to complete an offset run of fewer than 1,000 units. Digital printing of comparable run sizes tends to be slightly faster, and very short-run digital printing has a much faster turnaround time of a few days because the system is highly automated. With some digital printing strategies, a book order triggers a printing.

Course adoptions are usually time-sensitive; many different academic calendars exist, and it is difficult to predict when inventory will be depleted. Sometimes a book adoption would be lost if it had to wait for an offset printing, or a premium would have to be paid to rush the offset job. Similarly, digital printing lets a publisher respond quickly to a demand spike for the works of an author who wins a prestigious award or appointment or who appears on a popular television show.

ADDITIONAL CONSIDERATIONS Digital printing enables a publisher to keep in print titles that would otherwise go out of print (OP) or out of stock indefinitely (OSI). Keeping works available benefits authors, instructors, students, and readers, fulfilling the scholarly mission of a university press.

At the other end of the publishing spectrum are general interest trade titles, which receive considerable promotion. The book review media require advance reader copies (ARCs) as much as two months prior to book publication. A publisher can obtain the PDF book files from the typesetter, print ARCs digitally, and send them to reviewers before the offset printing is complete.

Digital printing is an economical way to produce a first-time paperback edition or to satisfy a contract clause promising that a paperback edition will be published for a book that may not sell enough copies to economically justify paperback offset printing.

PRODUCTION DECISIONS

Every publisher has an implicit or explicit model for deciding which books to publish, under what contractual arrangements, with what prices, discounts,

and printing strategy. Pricing for a university press book typically reflects the cost of publishing the book, scholarly factors—such as the size and purchasing patterns of its discipline and likely classroom adoption—and prices for competing titles. Pricing and production strategies may change over a title's life cycle.

SCHOLARLY BOOK SALES PATTERNS In the golden age of library funding in the 1960s and 1970s, libraries purchased most of the first clothbound printing of scholarly books. In that period, university press titles commonly sold a thousand cloth copies to libraries. Due to the growth in publication of scholarly monographs, tight library budgets, and the growing use of cooperative collection development and interlibrary loan programs, library sales dropped to around 500 copies of most university press monographs in the 1980s and then to the current level of no more than 200 copies.

Traditionally, sales of scholarly monographs to individuals grew gradually as a book became known, or they stayed level for a few years before dropping off. An influential scholarly monograph can sell for a decade or more. Typically, a paperback edition was issued a year or more after the hardcover edition, in order to maximize sales of the clothbound version that was priced to yield a higher margin. However, as hardcover edition sales volumes declined, many publishers produced split runs (e.g., 200 cloth and 1,300 paperback units) to hold down costs or published the two editions simultaneously due to author pressure.

Classroom adoptions are a factor in many scholarly publishers' sales patterns. Their books are used in master's and doctoral-level graduate courses in many disciplines and in some undergraduate humanities and social science courses. An increasingly efficient used-book market enables students and other scholars to buy and sell used books easily. The result is lower demand for new copies and, hence, lower publisher income.

SCHOLARLY PRESS OVERPRINTING AND STORAGE COSTS The marginal cost (\$63 in the example above) of printing the last 100 units of a 1,000-unit print run is very low, and high fixed costs require a relatively high unit volume to justify reprinting. When offset was the only viable printing option, many publishers overprinted (printed more units than they expected to sell) because some overprinting produced better financial performance than did a similar amount of underprinting (printing fewer books than were needed to fulfill demand). The offset printing cost

structure also provides a strong incentive for publishers to produce split runs. Offset overprinting became common for both initial and reprint runs. However, digital printing now provides a superior alternative to offset overprinting for most scholarly books.

The following table² quantifies past overprinting by the thirty presses that used the services of the Chicago Distribution Center (CDC) in March 2004. The 13% of their ISBNs that sold more than 200 units in the year ending March 31, 2004, accounted for 82% of unit sales and had an average of 1.7 years of sales in inventory. In contrast, 87% of ISBNs had net sales of 200 or fewer units during the preceding year and had an average of 12 years of sales in inventory, most of which is unlikely to ever sell.

Chicago Distribution Center 12-Month Unit Sales Analysis (as of March 31, 2004)

Number of copies net sold	ISBNs		NET UNIT SALES		QUANTITY ON HAND (QOH)			AVG./ISBN	
	Number	%	Number	%	Number	%	Years Sales	Sales	QOH
<= 1	4,106	16%	-62,267	-2%	1,124,236	10%	NC	-15	274
1-25	11,556	44%	84,515	3%	2,180,160	20%	26	7	189
26-50	2,454	9%	89,374	3%	990,228	9%	11	36	404
51-100	2,440	9%	178,127	5%	1,186,065	11%	7	73	486
101-200	2,242	9%	318,660	10%	1,314,031	12%	4	142	586
201-500	2,084	8%	653,246	20%	1,631,695	15%	2	313	783
501-1,000	737	3%	507,597	16%	892,193	8%	2	689	1,211
> 1,000	544	2%	1,498,637	46%	1,724,758	16%	1	2,755	3,171
Total	26,163	100%	3,267,889	100%	11,043,366	100%	3	125	422

*NC = not calculable

Other data indicate that 45% of the books in the CDC's inventory on March 31, 2004, were printed more than three years earlier. If these presses had intended to print to fill three-year demand for their titles, they overestimated demand by nearly half.

If a publisher writes off unsold units, the expense is reflected in financial statements. If not, and if the publisher is still carrying these units in inventory, financial statements reflect artificially high inventory values and low expenses. Either way, there is an economic cost to storing large quantities of books for which there is no demand. As more distribution centers assess fees for storing books, presses must either bear this cost or eliminate excess copies.

2. Data provided by Sam Giannakis, Chicago Distribution Center operations manager, April 30, 2004.

The usual methods of calculating unit production cost do not take into account inventory carrying costs or the actual cost per unit sold after write-offs. Digital printing now offers a way to meet demand without overprinting, but it requires a new approach to production decisions.

PRODUCTION DECISION MAKING AND MANAGEMENT PROCESSES

Publishers must decide how many of each new frontlist book to print, monitor backlist book inventories, and decide whether, when, and how to reprint books with low inventories. When a book is nearly out of stock, the publisher must estimate future demand using recent sales and other factors, such as the author's status and influence in the field, course adoption, prevalence of used copies, and the author's promotional activity. Many publishers still offset reprint 500 or more units (a three- to five-year supply) of books they expect to sell more than 100 copies per year. However, at the CDC, 79% of ISBNs sell 100 or fewer copies per year.

Publishers considering reprinting a book would like to know how many copies are still unsold in wholesale and retail outlets, as returns might provide enough units to meet sales demand for a considerable while, and offset printing another 500 copies is likely to lead to excess future returns and write-offs. Some major retailers and wholesalers now provide such data, but there is no way to know when or if returns will occur. Digitally reprinting only the number of copies ordered would reduce the risk of write-offs and preserve cash, while meeting customer demand.

In the past, most scholarly books went OP or OSI when no more copies were available and the small expected ongoing demand did not justify an offset reprint run. Digital printing enables presses to keep these books in print as long as there is some demand for them and to have them contribute at least modestly to press income. In addition, the scholarly community benefits by continuing to have access to these books for research, teaching, and learning.

Traditional reprinting processes require publishers to expend substantial effort on managing backlist titles. Marketing and production staff monitor inventory and sales, forecast future sales, get quotes from printers, negotiate and sign a contract, monitor printing, approve the invoice for each reprint decision, and pay that invoice. The University of Chicago Press estimates its overhead costs of reprinting a book using the traditional process as follows:

<i>Reprint Overhead Costs</i>	<i>Hours</i>
Review low stock report and put reprints on process	0.66
Production coordinator: estimate, schedule, quote, order	6.80
Management review and approval	0.10
Receiving, cost, and inventory accounting	1.25
Total time	8.81
Average rate/person hour (\$20 salary and \$5 benefits/hour)	\$25.00
Total overhead cost per title	\$220.25

This adds \$2.20 per unit to the cost of a 100-unit printing, or \$.22 per unit to a 1,000-unit printing. Using traditional production processes, keeping books in print longer requires tying up cash in book inventory and/or consuming substantial staff time for each reprint decision.

Even with somewhat more efficient processes and lower costs, small print quantities cannot justify such significant levels of production staff effort. To be financially viable, shorter, more frequent digital print runs require a different approach to making production decisions. Several publishers that do a significant amount of digital printing have either streamlined or automated their digital production decision making and management.

Digital Production Strategy Examples

Some publishers are now using digital printing at every stage of a scholarly monograph's life cycle. It helps them to manage cash flows and minimize write-offs and inventory-carrying costs, while keeping more books in print and available to the scholarly community. Books previously OP and OSI are being brought back into print if demand warrants. Judicious use of digital printing is extending the life of scholarly monographs, lowering financial risk, and improving financial performance.

Publishers are using different production and fulfillment methods for different books and at different points in a title's life cycle. The projected sales pattern and related uncertainty are key factors in the choice of production method, timing, and quantity. The production choices, in turn, determine financial performance.

Harvard University Press has been "aggressively using digital print as part of an overall production strategy" since 1999. Their current strategy, which covers and extends the life cycle of a title, has three currently operational components, a fourth being launched, and a fifth under consideration.³

PAPERBACK REPRINTS

Harvard University Press first used digital printing to reprint backlist paperbacks that were previously printed offset. In 1993 Integrated Book Technology (IBT), a leading digital book manufacturer, produced the first Harvard University Press digital reprint. With a change in reprint philosophy, the press began to do a significant volume of digital reprinting in 1998.

Although at the end of FY 2004 Harvard University Press had more

3. This section is based on correspondence and discussions with John Walsh, assistant director for design and production, Harvard University Press, August–November 2004.

than 4,400 titles in print, only about 175 titles (fewer than 4%) sell more than 1,000 copies annually. Thus, for most of its backlist, offset reprinting previously required Harvard to commit to a multiyear inventory. Prior to 1998, Harvard would offset reprint 1,500 copies of a backlist paperback selling 750 copies a year (a two-year supply) or 1,000 copies of a title selling 350 copies per year (a three-year supply). Digital printing now allows Harvard to set print runs equal to one year's expected sales. Benefits of this strategy are as follows:

- Spend less money and preserve cash
- Reduce risk of overprinting and write-offs
- Reduce warehouse space costs
- Achieve shorter reprint schedules

This strategy initially presented problems that have since been solved:

- *Digital printing resulted in higher unit costs.* Harvard raises the retail price for most digitally reprinted books.
- *Digital cover (color) printing was expensive and had unacceptable color variation.* Harvard prints 1,500 offset covers (at the same cost as 500 digital covers), and the digital printer stores the extra covers in rack systems for subsequent reprints.
- *More frequent reprinting overloaded an already busy production department for order writing and invoices.* Harvard has streamlined the reprint production process; they no longer make corrections for digital reprinting, nor do they update the printing line on the copyright page.

Harvard does most digital paperback reprinting at IBT, although they use other printers as well. Buyers get multiple bids the first time a title is digitally reprinted and select a vendor based on price, service, and quality. Digital printing accounted for 50% of Harvard's backlist reprint orders in 2001 and nearly 70% of backlist reprint orders in 2004.

Digital reprinting helps publishers save money by "killing film" (destroying book page negatives) for books they are unlikely to reprint offset. Printers commonly charge \$60 or more per year to store film for books that they have not printed in the past three years. Film is not scanned, because it is easier to create a print-ready PDF file for digital printing from a book. The decision to kill film is based on inventory, sales, and how the book was last printed.

The unit cost of multiple digital printings will be greater than the unit cost for a single offset run of 500 units. However, for Harvard, the costs of tying up cash and storing inventory, along with the risk that many units will not sell, outweigh the lower offset production costs. Harvard's assistant director of design and production, John Walsh, estimates that digital printing

has cut the warehouse space used by slow-selling backlist titles by half or more. However, digitally printed books that would have gone OP consume some space that would not otherwise have been needed.

HARDCOVER DIGITAL REPRINTS

Digital printing has most commonly been used for paperback books. However, scholarly presses are printing a growing number and range of hardcover books digitally. The second Harvard University Press use of digital printing is to reprint backlist hardcover books as needed, in a print-on-demand (POD) model. Acme Bookbinding is both a rebinder of library books and an edition bindery that specializes in large-format, museum, and art books. Their cold-melt binding process exceeds the Library Binding Institute's guidelines for strength and durability. Because they received so many library books that could not be rebound, Acme began scanning books and printing facsimile editions—in essence, creating POD versions of books for which libraries could not purchase replacement copies.

Harvard University Press faced occasional requests from libraries and individuals for some classic OSI hardcover titles. In January 2003, Acme approached Harvard with a plan to produce such hardcover books at an affordable price. Acme proposed to scan the books and then print and bind them as they were ordered. Vintage series include *The Works of William James* (18 volumes), *The Complete Notebooks and Journals of Ralph Waldo Emerson* (14 volumes), and *The Letters of William Lloyd Garrison* (6 volumes). Harvard priced these books at five times production cost, from \$75 to \$125, about the same level to which inflation had brought the retail price of in-stock books published thirty to forty years ago.

When each such book is digitized, Harvard chooses the cloth color and the paper shade, weight, and finish. It reprints each book exactly as the last offset printing was done, preserving trim size and most of the other attributes of the original edition. To make this model work, Harvard invested in software improvements that allow the BookMaster inventory control system at its distribution center, TriLiteral,⁴ to redirect orders for these books via EDI (electronic data interchange) to Acme, which prints, binds, packs, and ships the book directly to the customer. Acme notifies TriLiteral that it shipped the book and bills the press for the printing and shipping cost. TriLiteral records the costs and sale, then bills the customer. EDI limits the demands on press staff to a weekly review and approval of an average of sixteen Acme invoices.

4. TriLiteral is a joint venture of Harvard, MIT, and Yale university presses.

By fall 2004, Harvard had 140 books in the program and expects to add about 70 more books per year. They carefully consider the demand for each book, as they need to sell about 10 copies to cover the costs of putting a book in the program. They are reviewing the economics of the POD model, as the cost of shipping a book to a customer can be as much as 40% of the Acme invoice.

HARDCOVER DIGITAL FRONTLIST PRINTING

Recently, new machines designed to bind relatively small numbers of hardcover books have expanded the reach of digital printing into the initial printing of hardcover scholarly monographs. The third component of the Harvard University Press strategy is to have IBT digitally print frontlist books from PDF files and bind them as jacketed hardcovers that have acceptable print quality and excellent bindings, nearly indistinguishable from offset. Frontlist digital printing represents another major strategic shift.

In 2003 IBT bought a newly available binder to economically produce hardcover books in runs from 100 to 1,000 copies. It proposed a new business model to scholarly publishers: print as many copies as needed to meet the backorder release, free copies (author, office, review), and the first few months' expected sales, then reprint as few as 100 copies as needed. All Harvard University Press frontlist titles, about 125 each year, have native print-ready PDF files. Harvard University Press digitally printed 12 frontlist titles that they felt were ideal candidates in fall 2003, 18 in spring 2004, and 22 in fall 2004.

Harvard applies break-even analysis to a proposed book to calculate how many copies it must sell at a realistic price to recover its editorial file preparation, composition, artwork, design, film and plate, manufacturing, and promotion costs. Books selected for the digital hardcover program are expected to sell between 450 and 550 copies. Because TriLiteral allocates space charges to participating presses based on the number of units they store, Harvard University Press saves on warehouse costs as well by producing fewer copies.

This program yields the same significant benefits as digital reprinting—that is, it conserves cash, reduces write-offs and warehouse costs, and closely matches the timing of cash outlay with sales revenue. There is a small risk of underestimating demand and having to print more books at a higher unit cost than would have been incurred for an initial offset printing; this risk is much lower than the traditional risk of overprinting.

Changing Production and Distribution Models

Like book production, distribution—warehousing and fulfillment—involves extensive physical, financial, and logistical activities. The printer prints, binds, packs books in cartons, and ships them to the distribution center, which must receive, account for, and shelve the books in picking and bulk storage locations. Upon receipt of an order, the distribution center must process it; pick, pack, and ship the ordered books; bill the customer; and collect payment. It must also credit, process, inspect, and return to inventory or discard returned books. Warehousing and fulfillment is a significant cost (an average of 14% of net sales, per 2003 AAUP statistics) for university presses. Just as they have long outsourced book printing and binding, about half of university presses now outsource distribution.

INTEGRATING AND AUTOMATING PRODUCTION AND FULFILLMENT

Overprinting to minimize unit costs and avoid losing potential sales ties up cash and results in excessive inventory. Digital printing now lets publishers avoid both the risk of producing excess units and the risk of losing sales. Printers and distributors offer ways to automate ordering and link it with fulfillment for small print runs. Essentially, the publisher makes a one-time decision to outsource production of a title to a vendor that thereafter prints copies as they are needed. Automated ordering eliminates the need for marketing staff to monitor inventory levels and for production staff to get bids and monitor the production and shipping status. Automating the ordering and production process is critical to this strategy, which the University of Chicago Press calls short-run digital printing (SRDP) and Harvard University Press refers to as an ultra-short inventory-replenishment program (USIRP). These approaches rely on increasingly

sophisticated, integrated Internet-based information systems that provide a growing array of alternatives to traditional production and fulfillment practices.

SHORT-RUN DIGITAL PRINTING (SRDP)

As of January 2005, the Chicago Distribution Center (CDC), a division of the University of Chicago Press, provided warehousing, fulfillment, and business services for thirty-eight publishers, including the University of Chicago Press Book and Journal divisions. The CDC used 273,000 square feet of warehouse space, stored over 11 million units, and managed over 27,000 active ISBNs. They shipped an average of 13,000 units and processed 4,000 returned units daily in 2004, using highly automated ordering, fulfillment, billing, and payment processes.

In September 2001, the Andrew W. Mellon Foundation provided the University of Chicago Press with a grant of \$1.5 million to support development of the Chicago Digital Distribution Center (CDDC), including a digital book center adjacent to the CDC warehouse, the BiblioVault repository for digital book files, and the conversion and deposit into the BiblioVault of digital files for approximately 5,000 backlist and frontlist titles. In December 2003, the foundation provided another \$1.25 million of funding to develop these initiatives further through June 2005, including involvement of additional presses, the conversion and deposit of files for another 7,000 backlist and frontlist titles, an enhanced information technology infrastructure for the BiblioVault, and involvement of a BiblioVault Advisory Board in planning for the future of this repository.

The purpose of the BiblioVault is to enable scholarly publishers to keep books in print, to preserve book content indefinitely, and to make this content known to anyone who might want to access it.⁵ As of early January 2005, thirty-seven scholarly presses were participating in the BiblioVault or planning to do so. Over 45% of these presses were not clients of the CDC. By July 2005, the BiblioVault is expected to contain files for about 12,000 titles. A participating publisher can easily transfer copies of any of its files in the BiblioVault to any electronic destination at any time.⁶

5. The BiblioVault charges a fee of \$15 for depositing files for a book (a fee that grant funds cover now) as well as an annual file storage fee, now \$8 per title. As the BiblioVault works with participating university presses to make this repository optimally serve the scholarly community, its board and management team will review the fee structure to make it reflect costs and value. Other vendors have varying fee structures and levels.

6. Information about the BiblioVault is available at <http://www.BiblioVault.org/>.

Edwards Brothers operates the digital printing center in a space adjacent to the CDC warehouse. When a title in the CDDC program runs out of stock, the CDDC uses BiblioVault print-ready PDF files to print the needed books. The typical preset print run has been 24 units. Some presses print more than 50 units of their better-selling titles as the unit price declines modestly at 50 units. As few as 10 units have been printed, and that print run may become the norm for titles with particularly low sales or high costs, as technology and business processes have evolved to make printing such small quantities economically viable.

When the inventory for an ISBN in the CDC gets low, the publisher evaluates that ISBN and selects a strategy for keeping it in print or lets it go out of print. The CDDC Web site⁷ provides an online calculator where CDC clients can enter specifications for the book and a quantity to obtain a quote for CDDC digital production. Once the PDF files for an ISBN are in the BiblioVault, the publisher “activates” the title for SRDP in the CDC fulfillment system. The CDC encourages publishers to review a book’s discount and price before activating it, to at least cover the higher unit production costs of SRDP.

When an activated book is ordered, the CDC fills the order from inventory if possible. If inventory falls short of the order quantity, the CDDC prints the multiple of the preset run size needed to fill that order. Edwards Brothers prints the book (either in the CDDC or another facility, depending on book size, binding, and capacity) and bills the CDC for the printing cost. The CDC stores the units not needed to fill the current order in the warehouse to fill future orders. For CDC client presses, using the CDDC to print books eliminates both freight charges from the printer to the warehouse and the delay in filling orders that shipping requires. The CDC pays Edwards Brothers, bills the publisher, and ships or puts the copies in inventory when they are complete. This system minimizes cash invested in book inventory and removes the substantial burden of handling reprints from publishers’ marketing and production staffs.

As of year-end 2004, nearly 1,400 CDC client press titles were activated at the CDDC, taking advantage of this efficient SRDP system. Other BiblioVault participants can send copies of book files to any printer as they determine the best way to reprint a title to fill immediate needs. The number of BiblioVault titles being produced digitally at the CDDC or elsewhere will grow as the current inventories are depleted. Following are examples

7. Information about the CDDC is available at <http://www.CDDC.uchicago.edu/>.

of University of Chicago Press titles that would now be out of print if the SRDP option had not been available.

AN OLDIE BUT GOODIE One title (300 pages, 6"x9" trim) had sold 1,800 copies since publication in May 1988. With recent annual sales of fewer than 50 copies, it was put in the CDDC SRDP program in February 2002. It is now digitally printed, bound, and delivered to the warehouse for a unit cost of \$8.28. It sold 79 copies in FY 2003 and 24 copies in FY 2004 at a list price of \$25.25, an average discount of 21%, and an average gross margin of 58%. In FY 2003, it generated \$1,576 in net sales.

AN OVERSIZE CLASSIC Another title (882 pages, 6"x9" trim) had sold 1,100 copies since being published in December 1989. With recent annual sales of fewer than 20 copies, it was put into the SRDP program in November 2003. Because it is physically too large for the CDDC to print, another digital printer printed and bound it at a unit cost of \$17.25. The FedEx shipping cost of \$185.44 raised the unit cost, including freight of \$8.39, to \$25.64. Note that the shipping cost was nearly half as much as the manufacturing cost and nearly a third of the total paper, printing, binding, and freight costs. This title sold 19 copies in FY 2004 at a list price of \$46.25, an average discount of 4%, and an average gross margin of 42%. In early FY 2005, Chicago increased the list price of this book from \$46.25 to \$64.00.

SAVED BY SRDP A title published in May 1996 (242 pages, 6"x9" trim) had initially printed 3,000 copies offset at a unit cost of \$2.42. With recent annual sales of fewer than 100 copies, it would have gone OP rather than being reprinted offset. It was put into the CDDC SRDP program in November 2003. With an SRDP unit cost of \$7.00, it sold 80 copies in FY 2004 at a list price of \$16.50, an average discount of 35%, and an average gross margin of 35%. In early FY 2005, Chicago increased the list price from \$16.50 to \$21.00 to improve its return.

IMPACT OF CDDC SRDP As of year-end 2004, the University of Chicago Press had more than 450 books activated in the CDDC; it expects to activate 400 books annually for the foreseeable future. In FY 2004, Chicago sold net 25,428 units that were printed at the CDDC's digital book center, providing a valuable service to authors and readers.

Books the CDDC produces for CDC client presses do not need to be

packed or shipped to a warehouse and are available to fill orders as soon as they are produced. Publishers can continue to generate positive contributions from books that would otherwise go OP and offset print frontlist books more conservatively, without the risk of ever losing a sale. Having native PDF files minimizes the cost of depositing files in the BiblioVault and of shifting among print strategies over the life of the title. The CDDC and BiblioVault demonstrate that short-run digital printing, combined with streamlined production and fulfillment processes, can enhance the financial performance and support the mission of scholarly publishers.

HARVARD UNIVERSITY PRESS: ULTRA-SHORT INVENTORY-
REPLENISHMENT PROGRAM (USIRP)

To cover the “reprint gap” for their backlist paperback books that sell fewer than 200 copies annually, the low end of their current digital paperback reprint range, Harvard University Press has created an ultra-short inventory-replenishment program (USIRP). Many titles at this level of sales are now designated OSI. Although their vendors can print fewer than 200 copies, until recently Harvard considered the indirect production, accounting, and inventory costs of their business processes to be prohibitive for shorter runs. The USIRP reprint ordering system is similar to the CDDC SRDP program except that Harvard will not have a digital printing center in its warehouse and plans to reprint once or twice a year.

As most of the books targeted for this program have no digital files, they must be scanned. In FY 2004, Harvard began to participate in the BiblioVault, which currently offers subsidized scanning for some titles if a press also deposits frontlist titles systematically. Harvard sends books to the BiblioVault, which manages scanning them and puts the files in the BiblioVault repository.

An inventory control clerk sets print quantities based on annual or semi-annual sales rounded up or down in multiples of a title’s carton quantity. Harvard enters orders online at the printer’s Web site. The printer will send via EDI an acknowledgment, a scheduled ship date, and a cost summary. Production will approve the acknowledgment and send it to the accounting department, which will process monthly invoices from the printers, rather than title-by-title invoicing. The books ship on prespecified days every week via a specified carrier.

Harvard launched USIRP in autumn 2004 and plans to shift higher-quantity digital reprints that the production department currently manages into USIRP if it works as planned. Because of high freight costs, Harvard

is also considering changing the Acme hardcover program from pure POD to USIRP, with six-copy print runs to provide better control of packing, shipping, and fulfillment schedules.

MIT PRESS CLASSICS SERIES: BRINGING BOOKS BACK INTO PRINT

In April 2003, the MIT Press announced the launch of its Classics Series, in partnership with Edwards Brothers, to “make available on demand in sleek paperback editions 1750 previously out-of-print titles from The Press’s backlist.”⁸ Individuals, retailers, and wholesalers place orders via telephone, fax, e-mail, or the Internet. Orders are routed to Edwards Brothers in Ann Arbor, Michigan, which produces the books and ships them directly to customers within forty-eight hours. The series uses a standardized black cover design that minimizes cover design and printing cost, and it ships with MIT Press packaging and labels. The MIT Press investigated the possibilities for such a program for nearly a decade before it became technically and economically feasible. Their goal is to make all MIT Press books available to customers who want them, replacing OP with POD.

PRINT-ON-DEMAND (POD)

Books are printed on demand and shipped directly to customers in both the Acme hardcover program with Harvard University Press and the MIT Press Classics Series program with Edwards Brothers. However, in both programs a customer may return a book to TriLiteral, where it will be put into inventory to fill a subsequent order. The decreasing cost of quickly printing a few copies and the growing cost of warehousing and managing inventory have driven some publishers to adopt “pure POD,” in which the publisher maintains no stock of a title. The publisher grants credit for returned books but destroys (pulp) them instead of adding them to inventory.

A POD paperback program was intended to be the last component of the Harvard University Press digital printing strategy, but it is uncertain whether they will implement it. Some customers, especially large ones, object to receiving their orders piecemeal, because of the efforts they have to make to match shipments with their orders. High shipping costs are also a challenge for POD programs.

Lightning Source, Inc. (LSI), provides a “range of digital fulfillment services, including content management and storage, digital rights management (DRM), secure ebook delivery, and distribution of printed ‘on

8. Additional information is available at <http://mitpress.mit.edu/Classics>.

demand' books."⁹ LSI was launched in 1997 as a subsidiary of Ingram Industries, Inc., the parent company of the large book distributor Ingram Book Group. In October 2003, LSI printed its 10 millionth "on demand" book; its digital library includes more than 100,000 titles, and it adds about 1,000 titles each week. LSI will ship books to a distributor or directly to customers. Several university press customer testimonials on the LSI Web site tell how digital printing lets them keep books in print and generate revenue on sales they would not have realized without it. Although LSI prints on demand, the publisher decides whether to use a pure POD strategy of printing for a single order or whether to print in small preset quantities and warehouse the books.

ELECTRONIC DISTRIBUTION (E-BOOKS)

Although e-books, which can be read online or offline on various electronic devices, have modest sales, they continue to make inroads into the book market. Commercial publishers provide a growing amount of electronic access to everything from reference books to fiction. Several vendors offer e-book delivery services, either direct to consumers or through Web bookstores that handle e-books. The number of ventures offering online books, either individually or in collections, to libraries continues to grow.

Many university presses are exploring how electronic distribution might fit into the scholarly book life cycle. The challenge of obtaining and tracking rights to distribute book content online has slowed adoption of this method of making books available to the scholarly community.

One option for a publisher is to let a book go out of print, retain the copyright, and make PDF files of the book available on the Internet for free, as the Ohio State University Press does through its Open Access Initiative.¹⁰ The Ohio State University Press, a client of the Chicago Distribution Center, uses SRDP for its Hawthorne series because the prestige and high list price per volume of nearly \$100 justify keeping these books in print. However, most of its titles would cost about \$6 to print and provide about \$12 contribution. It believes that few of its titles would have enough sales to justify the cost and effort of putting them into the CDDC SRDP program.

9. See <http://www.lightningsource.com>, Lightning Services—Overview, last accessed on January 11, 2005.

10. See <http://www.ohiostatepress.org/Books/Complete%20PDFs/Contosta%20Suburb/Contosta%20Suburb.htm>, last accessed January 11, 2005. Malcolm Litchfield, director of the Ohio State University Press, provided additional information in e-mail correspondence, August 31, 2004.

Instead, it plans to scan such books in-house and make them available freely as Web-delivered PDF files.

Publishers launching such a program need the permission of the author and any others who hold rights to parts of the content, but some scholarly monographs involve only the authors. The publisher foregoes the contribution that selling printed copies of the book would have brought and authors lose their royalties, both of which would be modest. Libraries and readers that want to purchase professionally manufactured books must buy used copies.

Few people now read at length online, at least not if given an option, but preferences and behavior are changing. If adequate reading devices, access controls, and business models are developed, electronic books could replace print for some types of books and purposes, eliminating returns and used-book sales, as well as the costs of producing, shipping, and managing physical book inventories. These are likely to have significant impacts on publishing and distribution operations, costs, and pricing structures.

Electronic book technologies, laws, and practices continue to evolve and will play a significant role in scholarly publishing in the future. However, printed books will continue to dominate the market for the foreseeable future. In general, scholarly publishers view e-books as a complementary means of distributing their works to libraries and readers, not as a substitute for printed books. Once the rights issues are solved, electronic access to scholarly works may bring more readers to these titles and enhance sales of paper editions.

Choosing Production and Distribution Alternatives

The trade-offs between offset and digital printing continue to change. Offset printing is now cost-competitive for many print runs of 500 units. Digital printing offers more options for binding, color interiors, and quantities, and the cost of these features is declining. Book manufacturers that serve scholarly publishers are creating programs to let a publisher use print-ready PDF files to print initial cloth or paper runs, reprint a few hundred units, and digitally reprint runs of as few units as are needed. Being able to economically print books in small quantities has changed the decision parameters for publishers.

Scholarly publishers continue to do most initial printing in runs of hundreds or thousands. The choice between offset and digital printing will depend on the quality and economics of each option for the book and publisher when it is being printed. Presses that pay a fee to store each unit from the outset will find it more economical to print fewer books than will presses that face such charges a few years into a book's life cycle. Eventually, all presses are likely to print fewer books as they realize that the first printing need not be the last printing, as it was for scholarly monographs for so many years.

Until recently, most books that sold fewer than 200 units per year went OP or OSI when inventory ran out. When existing inventory of slow-selling titles sold out, it was not cost-effective to offset print another 1,000 units, the smallest run available at a reasonable cost. Ironically, books for which there was modest demand sold out and went OP, while those for which there was little or no demand continued to be available.

Selecting the best approach for these titles is challenging for scholarly publishers. As these titles rarely have native PDF files, a book must be scanned to be put into a digital printing program. Halftone and color

images continue to present quality challenges. Between scanning and publisher activities, the cost of putting a book into a digital printing program is a few hundred dollars. Each press needs to develop its own process for deciding whether to put a book into a digital printing program that would extend its life. The University of Chicago Press examples and data illustrate how older backlist books, some more than a decade old, successfully live on in the CDDC SRDP program and continue to contribute to revenue. The MIT Press Classics Series has successfully brought many books back into print. Lightning Source, Harvard University Press's USIRP, and open-access initiatives provide other perspectives and models.

Thus far, only a few scholarly publishers have developed reliable business and decision processes for managing the later days of a title's life cycle. SRDP, USIRP, pure POD, and e-books present a variety of alternatives, each with advantages and disadvantages. To be financially viable, very short digital print runs require a standardized program of tightly integrated automated systems among the publishing, printing, ordering, and fulfillment operations. Quantitative differences among printers in price levels, price structures, and freight costs play a role, along with less tangible but important factors like print quality, flexibility, speed to warehouse, and reliability. Both printers and publishers need sufficient volumes of sales to justify the cost and effort of setting up programs and integrating systems. The process should improve as all parties involved gain experience and expertise. There is unlikely to be a single best answer. Each press must develop an approach that fits its mission, sponsoring institution, available resources, and list.

Conclusions

University presses and their scholarly book publishing programs must evolve in response to the many pressures they face, or the costs of supporting them will be viewed as prohibitive in an age when the academy is questioning many of their traditional practices. Digital publishing expands scholarly publishers' production options in ways that support their scholarly missions and can help them maximize a title's life-cycle contributions. It can help publishers make more scholarship available and keep it available longer. At this point in the evolution of digital printing, each scholarly publisher should become aware of what it can offer.

EFFECTS OF DIGITAL PRINTING

Digital printing affects many aspects of a publisher's business processes and performance.

Financial. Before digital printing was a viable option, generally publishers chose the risk of having too many units over that of losing sales of books that ran out of stock. Declining demand for scholarly titles then exacerbated the "overprinting problem" for scholarly publishers. Changing its production strategy to match print runs more closely to demand enables a publisher to conserve cash, to decrease the amount of inventory on its balance sheet, and to minimize its cost of inventory write-offs. Digital printing and shorter offset runs let publishers print only books that are virtually certain to sell, helping to minimize book storage costs and write-offs. Cash that would have been tied up for years in inventory is available to support additional books that should generate income and support scholarly missions.

The vast majority of university press titles are backlist titles that sell fewer than 200 units per year. In the past, these titles would have been allowed to go out of print. Now they can be printed digitally to continue to serve

the scholarly community and to help cover press operating costs. While the earnings from any one title are modest, they add up quickly when applied to a press's list. Keeping 100 books in print that sell an average of 50 units per year at a \$15 gross margin yields \$75,000 of "found money."

Careful analysis of current operations and the related financial performance can be a useful starting place for publishers considering digital production. Prices and projected revenue from books that will otherwise go OP or OSI, savings from killing film and storing less inventory, costs of putting books into a digital printing program, savings from automating reprint production decisions, and cash-flow effects are all important quantitative factors. Qualitative factors, such as the value to the scholarly community and general reading public of keeping books in print, should also be considered in the decision-making process.

Risk and Reward. The contribution of titles that sell more than a thousand copies is greater with offset printing, but risks of high storage costs, of having to write off unsold books, and of ultimate losses are also much greater. As Charles Ault, assistant director at Temple University Press, noted: "One exercise I've found fascinating is trying to decide between digital or offset initial printings in the 500–1,000 range. In a life-of-title scenario, you win with digital if you never have to go back to press, but you win with offset if you're pleasantly surprised."¹¹ Shorter print runs have somewhat lower potential rewards per book and much lower risks. How often is a university press "pleasantly surprised" with a scholarly monograph in the current marketplace?

The Harvard University Press experience with digital printing of hard-cover frontlist titles shows that the press can break even with scholarly monographs that sell as few as 500 copies. Very short-run printing options effectively eliminate the risk of losing a sale due to OP or OSI status. The risk-reward trade-off is changing dramatically, as the previously high risk of losing revenue by underprinting disappears and the costs of overprinting continue to grow. Scholarly publishers' ability to predict sales for their titles diminishes as their operating environment changes, making decisions based on historical patterns increasingly risky.

Operational. Having print-ready PDF files in a vendor-neutral repository increases a publisher's printing flexibility and its ability to bargain on pricing and to realize speed in a print run. Creating and maintaining native PDF

11. E-mail correspondence, November 17, 2004.

files is becoming a standard publishing practice, but many presses are still establishing practices for obtaining and storing such files. The efficiency of using a single set of PDF files throughout a title's life cycle needs to be reflected in the design phase, as some designs work better than others for both offset and digital printing.

Shorter offset print runs and more digital printing options continue to emerge, changing the demands on publishers' production processes. To be viable, very short digital print runs require preset pricing and production order triggers (typically a customer order that cannot be filled from inventory), tightly integrated with the publisher's ordering and fulfillment system. The system integrating the publisher, printer, and fulfillment operation is set up once for a title, and from then on the system handles orders automatically. Successfully managing scholarly titles throughout their life cycles will require publishers to reconsider every aspect of their operations.

Keeping more books in print longer seems likely to present marketing challenges that have yet to be fully understood or addressed.

Strategic. Increasingly, scholarly publishers are outsourcing production and distribution activities, the physical aspects of book publishing, to specialized vendors. Doing so enables these publishers to focus on the editorial aspects of publishing, that is, acquiring, peer-reviewing, and copyediting titles. In addition, such vendors may provide economies of scale and technological advantages that will reduce costs to publishers and allow them to compete in the increasingly complex bookselling marketplace.

More and more, scholarly publishers compete for authors of the trade and crossover books that have relatively high sales. While advances and royalties are important, short-run digital printing programs may also become critical for acquisition. Faculty authors hoping for their works to become classics want their books to stay in print indefinitely, available to use in their classes and to continue to influence subsequent generations of scholars. A guarantee that their books will still be available in a decade, no matter how few copies sell each year, will appeal to them. In addition, scholarly books with lower sales potential that provide important contributions to their fields can now be published economically.

OUTSTANDING ISSUES

Digital printing and related business models are still being developed and tested. Financial, quality, and operational parameters continue to change. These issues will be better understood, and some current problems with

them will be resolved, as publishers, printers, and distributors gain experience and develop new alternatives. Many of the larger university publishers are successfully using digital printing, and their experiences bear watching. Whether it is best to print at the distribution center, have the printer ship books to the warehouse, or have the printer ship books directly to customers depends on the situation of the publisher and the title. Volume plays an important role. The CDDC is efficient because it serves the CDC, which has over 27,000 ISBNs, the vast majority of them eventually amenable to SRDP. A small publisher with its own distribution center will not be able to support an on-site digital book center.

The relatively high costs of cloth binding and design and printing of four-color jackets and covers present both challenges and opportunities for scholarly publishers. Scholarly publishers are reducing the costs of cloth covers by using less sewn binding, but foil stamping remains a significant cost. Some scholarly publishers are beginning to eliminate jackets for cloth books that are likely to be purchased almost exclusively by academic libraries, which typically discard the jackets and seldom even see them before acquiring books. A press might review the policy of digitally printing color covers for paper books that sell modest quantities mainly to academic markets. The cover of a book needed for a course seems unlikely to affect a student's purchasing decision. At the CDDC digital book center, a color paperback cover costs seventy cents more than a black toner cover. University presses could benefit from experimenting with the cover treatments for SRDP titles that are purchased almost exclusively for course use.

This research found only piecemeal information on the effects of digital publishing on scholarly publishers to date. Concise summaries and comprehensive analyses of the financial, operational, and strategic impact of the various digital printing efforts undertaken by publishers that have adopted this technology would be valuable. However, the changes in the scholarly book marketplace and printing technologies and costs make any such analysis accurate for only a short time.

Publishers will also need to assess the effects of keeping more books in print longer. Harvard University Press and MIT Press are reconsidering how they market books brought back into print through their digital printing programs. Now that scholarly publishers can keep low-demand books in print, they must determine how best to market (design, price, promote, and distribute) them.

Digital rights management issues remain a hurdle to electronic distribu-

tion of books that have complex rights structures. This topic seems likely to require a significant industry-wide effort.

Digital publishing has extended the potential life span of scholarly titles. The future life cycle of a scholarly book is likely to include cloth and paper phases, offset and digital printing, and availability as an electronic book. More scholarly books will be available to more readers for longer. Scholarly publishers and their vendors must develop and implement the business processes and practices and create the infrastructure to make this vision an effective reality.