



Executive Synopsis

Megatrends in Printing Applications: A Refresh and Expansion of the 2010 Study Data and Future Outlook

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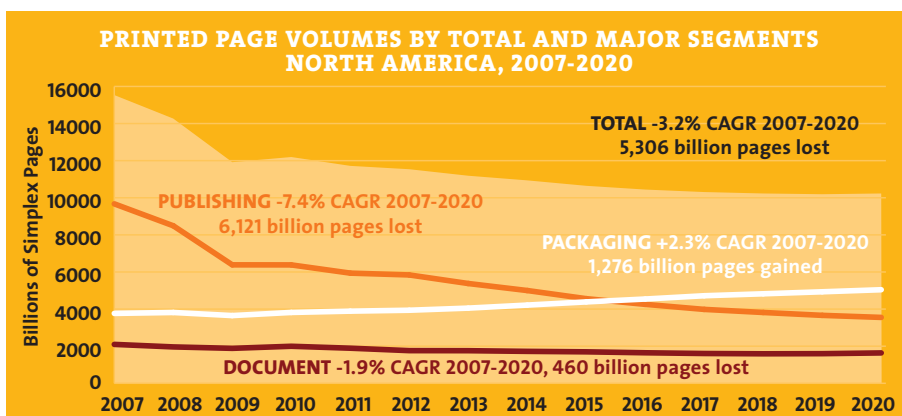
This study was delivered recently to your company as a NPES/PRIMIR member benefit. For your copy of "Megatrends in Printing Applications: A Refresh and Expansion of the 2010 Study Data and Future Outlook," contact NPES/PRIMIR at (703) 264-7200.

Megatrends define our future world and its increasing pace of change. This 2016 reexamination of the 2010 'Megatrends in Digital Printing Applications' study identifies key trends from today through 2020. When measured in page volumes, these megatrends include:

- An annual decline of 3% of total page volumes driven by economic and habit changes and fueled by incentives to reduce low-value pages.
- Annual decline of 3% of conventional printed pages independent from the 10%+ growth of digital printed pages.
- A projected 6% digitally printed share of pages by 2020. Digitally printed pages will have doubled their share from 2015 to 2020, but remain a specialty, keeping pricing and margins attractive to providers (in part because of limited digital print volume capacity).
- A stark contrast in total page volume trends when segmenting by application and technology. Publishing remains bleak. Document pages show a slow, gradual decline. Packaging grows slightly ahead of the economy.
- Due to productivity (and capacity) advantages compared to toner, inkjet is expected to lead digital page volume growth by a landslide. Monochrome toner pages will continue to atrophy, and color toner pages strive to mitigate monochrome toner volume decline.

The majority of pages lost from 2007-2016 mostly stemmed from newspapers, magazines and catalogs. Publishing is under severe continuing pressure as consumers shift to electronic communication alternatives for information.

Document printed pages, including marketing collateral and transaction statements, also are under threat. The decline of page volume is significantly tied to a reduction of "unused" pages — pages that were printed but never "consumed" because of out-of-date or irrelevant information. This trend is driving growth of more timely digitally printed pages.



ABOUT THIS STUDY

The original Megatrends study, conducted in 2010, was intended to establish a baseline identifying when and under what conditions analog printing could be replaced by digital printing and/or electronic formats. The study also developed a forecast by application for print from 2007 to 2014. The major areas under investigation were based around changes in technology, markets, economics and regulatory issues.

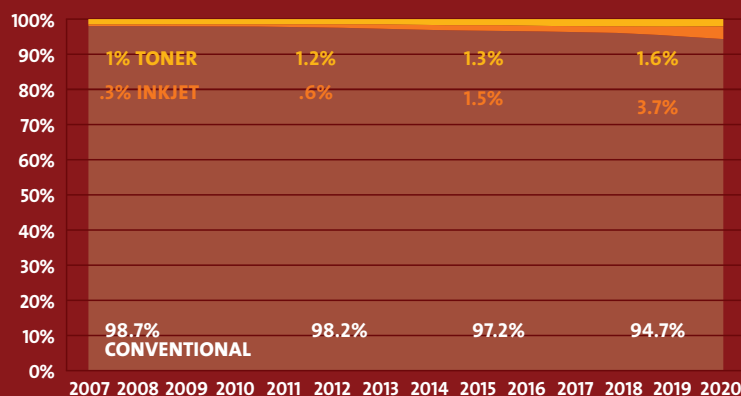
This 2016 study is an reexamination of the 2010 study, by expanding beyond digital to include all print. It looked at 12 applications and three print technologies from 2007-2020. There were some changes in the applications; manuals has been dropped as a separate category and absorbed into general commercial print, and corrugated package printing has been added.

The 2016 megatrends reexamination relied mainly on paper and plastics industry statistics, reinforced with selective end user and printer manufacturer interviews. Data was then triangulated against other major studies, including PRIMIR, key trade associations such as Bookstats and BISG, internal data from commercial printers, private data from key OEMs, the Alliance for Audit Media, independent consultants, and other sources.



Packaging is the only major print category in which consistent volume growth is expected. There are no competitive electronic alternatives, and the rising demographic shift to smaller households is causing growth in packaging to run slightly above the rate of economic growth. In fact, packaging's share of all pages printed is expected to double between 2007 and 2020.

**PERCENT PAGE SHARE BY PRINT TECHNOLOGY
EQUIVALENT LETTER-SIZE SIMPLEX, BILLIONS OF PAGES
NORTH AMERICA, 2007-2020**



Digital printing outlook

The impact of digital printing in package printing remains low. The technical hurdles for digital print relating to substrates, print size, and package converting are significant and will require a steep learning curve. The same holds true for publishing applications. Research and development to address those challenges is required today if digital print is to make a compelling impact in packaging and publishing beyond 2020.

With production toner printers averaging about 250,000 pages per month in document printing alone, about 500,000 toner printers would be needed to replace all the conventional printed pages in North America. Even with inkjet print system's greater productivity, the capital cost to

deploy tens of thousands of such systems would be cost prohibitive to printer providers. Even so, inkjet printed page volumes surpassed toner printed pages in 2014 and are expected to grow more than 16% annually through 2020. The share of digitally printed pages doubled between 2007 and 2015 and is expected to nearly double again between 2015 and 2020.

The growth of inkjet mainly is dependent upon capturing marketing collateral pages (sheetfed and rollfed) with new higher resolution printers that can handle coated offset stocks. The maturation of inkjet technology and its ability to print at image quality levels approaching offset are key to its growth. Inkjet's performance development path will be dependent upon these issues.

Document printing implications

About 60% of direct mail pages will feature some type of digital print by 2020, up from 45% in 2015. And direct mail is an important part of the marketing communication mix. As the true cost of electronic marketing communication is better understood, print volumes have gained some stability. With print volumes remaining over 350 billion pages annually in North America, inkjet technology is playing an increasingly larger role in printing direct mail. Inkjet productivity is unmatched by toner printer technology. For now, however, color toner print quality remains higher than inkjet. It remains the preferred print technology choice for very high-value offerings.

Marketing collateral consists of any print product used during the marketing and sales process. It is mainly printed on sheetfed offset print technology, with toner and inkjet recently gaining share as the desire for shorter-run, timelier collateral grows. The upside for capturing marketing collateral print volumes is in the hands of inkjet production technology. It must reach near parity in print quality to toner and offset. Much research needs to be done in the areas of pre-coatings, ink/substrate interaction, and post coatings. This is an area in which the traditional coating manufacturers may have stronger insight than inkjet technology developers. It would be beneficial for the industry to establish a link between the two entities in order to speed the research and development process.

Specialty print encompasses photobooks, greeting cards and yearbooks. Photobooks are defined as mainly amateur-created books in which photos are the main subjects. Yearbooks are a surprisingly large category of print volume. It is an industry entrenched in legacy business models and, to some degree, relatively protected from change. A captive market by virtue of the user software interface, specialty print overall page volumes are flat, with growth in photobooks balanced by decline in greeting card volumes. Photobook applications are expected to remain strong as they are a gift unattainable anywhere else for family and friends. Legacy and business models make it difficult to



convert yearbook printing to digital production printing. The opportunity lies in new sub-segments such as memory books, which can leverage lower-cost production inkjet printing.

Transaction printing includes financial statements, bills, and any other document requiring an action on the part of the recipient. All transaction documents are personalized and digitally printed. However, a significant percentage is imprinted on offset printed shells to take advantage of company-specific color logos on letterhead. Transaction statement printing is a declining market in which consolidation of print volumes with more cost-effective print systems (production inkjet) is the key to success. Transaction printing is a highly-regulated market, making print requirements predictable, but barriers to entry high. It will be difficult for first-time digital printing equipment and supplies manufacturers to enter this segment.

In 2015, growth of e-books slowed, and in 2016, North American book publishers saw a small percent of growth in printed book sales, the first growth in printed book sales in nearly a decade. The balance between printed and e-book sales may have reached equilibrium, which has led to a flat market growth projection for 2015-2020. The stability of printed book demand is allowing automation of the book publishing supply chain to push run lengths downward, which, in turn, expands pages for digital printing. To grow the digitally printed pages of books above the projected growth rate of 17%, a significant decrease in acquisition cost (or business finance model) is needed. Cut-sheet production inkjet printers could potentially make the difference in industry needs, once their availability becomes more widespread. Monochrome pages with low ink coverage, however, aren't the most financially attractive pages to inkjet printer manufacturers. Likely, this will result in a balanced hardware and supplies business model, precluding rapid hardware acquisition price declines.

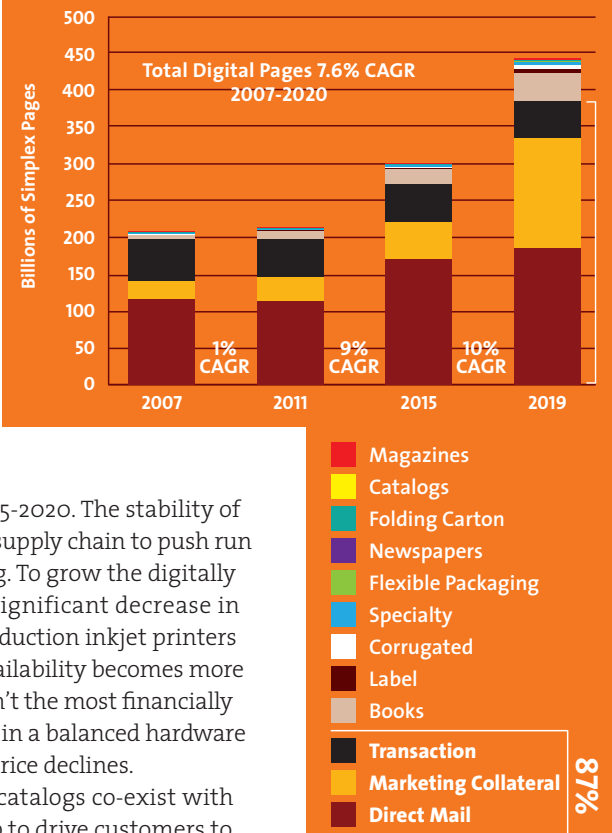
Nearly all **catalogs** are color printed using offset presses. Today, catalogs co-exist with electronic solicitation methods and often are considered an on-ramp to drive customers to a website. Catalog printing remains a high-volume business. Few digital presses have the capacity required by catalogs, nor the running costs desired. Only in 2016 have production inkjet systems that claim to print on coated catalog stocks begun to ship in limited quantities. The running cost of those systems is largely unknown due to the high variations in potential ink coverage, pre-treatment coating primers, drying, and finishing/coating costs. The secret to success in catalog printing is two-fold. The presses must print on existing catalog stocks at economically viable run lengths and costs. Secondly, they must print on consumer brands to deploy this resource beyond experimental stages. This means having the ability to consistently extract customer data to develop relevant, appealing offers based upon prior purchase patterns.

The **magazine** publishing industry is in a state of flux. The challenge is delivering unique and relevant content, while balancing revenues between advertising and circulation. One potential direction for magazines is to become curators of online stories, presenting them in a more cohesive fashion. They must provide more in-depth analysis and place content into a larger context.

From a digital print perspective, the cost to print magazines digitally is prohibitive except for the smallest circulations. Production inkjet presses want to change this, but until the ink and substrate technology gets resolved, it remains at an early development stage. There has, however, been success in the use of inkjet production printing for the creation of magazine wraps/covers. Inkjet is able to print at a satisfactory quality in sufficient volumes to meet the needs of major national publications. However, the solicitation and management of cover/insert advertising campaigns must be developed, with satisfactory print quality and volumes at the base of the effort. Few print providers have managed to develop such skills at present.

With declining demand for **newspapers** and limited capital for investment in printing operations, equipment and supplies manufacturers serving this segment need to adjust their resources. There is some equipment replacement and some very limited investment in inkjet presses, but paper and ink consumption will continue to decline. Plate sales, however, may be somewhat stable, as the number of newspaper issues printed remains steady.

DIGITALLY PRINTED PAGE VOLUME GROWTH BY APPLICATION, EQUIVALENT LETTER-SIZE SIMPLEX, BILLIONS OF PAGES, NORTH AMERICA, 2007-2020



At-a-glance

5,306 Billion pages lost
between 2007-2020

250,000 Average
number of digital toner pages
per month

29% Growth of digitally
printed document pages by
2020

20% Growth of digitally
printed collateral pages by
2020

3.7% CAGR from 2015-
2020 of flexible packaging

For more detailed
information on “Megatrends
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Package printing implications

Corrugated packaging is a large volume market, a segment in which over 80% is monochrome line art or information codes. The one-to-three colored boxes are mainly printed onto boards with flexography. About 10% of corrugated print is used for point-of-purchase (POP) retail display stands. The majority of these are printed with offset onto paper that is laminated onto corrugated board. It is this area of the corrugated market that is attracting attention from digital press manufacturers. Since the size and thickness of corrugated print goes beyond what toner-based presses can address, inkjet garners the most attention.

The volumes of corrugated print can only be accommodated by single-pass inkjet technology. In fact, single-pass UV-curable flatbed inkjet is establishing a position in printing retail POP display stands. New generation single-pass inkjet presses are being developed to print corrugated consumer packaging directly onto whiteboards. However, it is still early in the game. Inkjet's ink running costs (with full bleeds) will require redesign of packaging to eliminate color on the bottom of the box retail shelf-ready tray, etc. If laminate inkjet technology proves successful, adoption of digital print by large consumer retailers could scale faster than digital print capacity can be added. This is a good problem, but still a problem.

Flexible packaging includes both film and paper-based substrates. There are many segments of film-based flexible packaging, but the two most important are laminated and un-laminated. Un-laminated film accounts for about 80% of the film volume, of which an estimated 55% is printed. Nearly all of the remaining 20% of laminated film is printed.

Flexible packaging, especially film-based, is the largest and most sustainable long-term opportunity for digital printing among the applications included in this study. It also is technically among the most difficult challenges for digital printing. Input from coating providers and traditional ink manufacturers is required, in addition to all the digital press and supplies manufacturers, to further ongoing research and development. At present, no single manufacturer appears to have an advantage. The learning curve costs will be high, but rewards are going to be large and sustainable for decades into the future.

Folding cartons are a common packaging format in North America, but less so in the rest of the world. They are mostly printed with offset technology, since most folding cartons are customer-facing packages that require high print quality. Folding cartons are receiving attention from digital printing equipment manufacturers. Historically, folding cartons were mainly simplex printed. More recently, as much as 40% of folding cartons for high-value goods are duplex printed. In addition, many of those use foil packaging to give them a luxurious appearance—which means white inks are required.

Labels are a relative small part of the packaging industry in part due to their limited real estate size to display graphics and content information. They account for about 5% of all equivalent packaging pages. The performance and economic gap between modern flexo and digital label printer presses is shrinking. The installed base of legacy flexo printers, however, has much life left. In addition, the pressure to become more efficient in label printing is not as great as it is in commercial printing since the cost (and profit) is spread over both print and conversion. The acquisition cost of digital presses remains a hurdle for many converters, even though the expenditures are declining. The bigger challenge is the inability of digital label manufacturers to invest in expanding sales and marketing. Few digital label printer manufacturers can match the resources that vendors catering to other segments offer.

It is time to look at digital printing in a different context. Suppliers and print providers need to focus on applications in which digital print technology and expertise can make a difference in light of their development resources. The industry needs to identify what other parts of the workflow and business models accelerate or suppress print. We need to keep measuring and observing print volume, and recognize that digital page volumes, although small today, are the path to growth.

