White Paper

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Offset to Digital:
Production Inkjet as a Disruptive Force

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Table of Contents

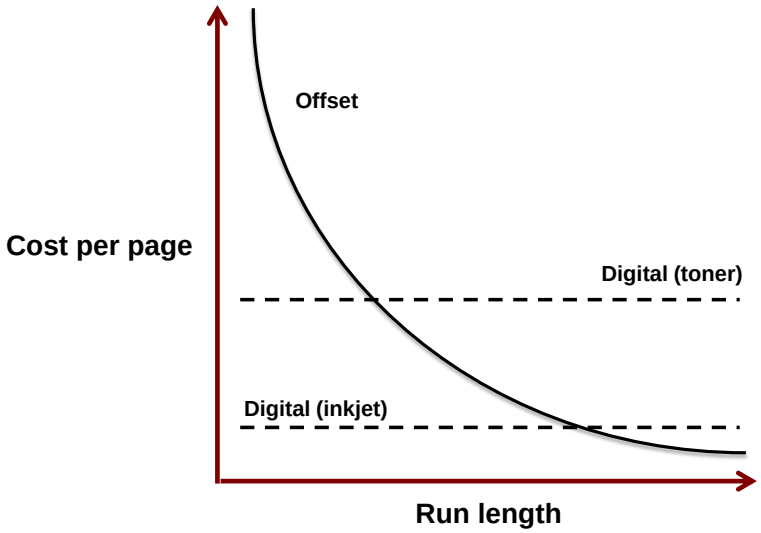
Introduction

The digital print revolution can be described in many ways, but one perspective that is extremely important to understand today is that the revolution has occurred in stages. The stage we are experiencing now is an extremely disruptive one that is being enabled by high-speed and productive inkjet technologies that bring all of the values of digital print to an entirely new level. In this white paper, InfoTrends will explore how inkjet technologies are having—and will continue to have—a huge impact on the way print is leveraged in today's fast-moving, multi-channel world.

The Value of Offset Print

We will set the stage with a look at the value of offset lithography. The Figure below illustrates a familiar cost versus run length cross-over curve diagram that compares offset and digital print. Offset presses facilitate an effective long-run manufacturing process that is very good at making many copies of the same thing. Unfortunately, because a lot of the cost is built into the plates and make-ready, it is not that cost-effective for short runs.

Figure 1: Cost Versus Run Length



Digital print devices that use toner have a different curve with a flat cost structure, making them very effective for short run and quick turnaround work. They also can print a new image on every sheet (rather than reproducing the same image over and over again, as offset does). This means that variable data, personalized printing is possible with digital in ways that conventional offset presses cannot compete with. True on-demand printing becomes possible as well.

With the entry of production digital inkjet, the run length cross-over point moves digital print into new territory where it is now very competitive with offset for many applications and suitable for higher volume print. At the same time, it also retains all of the existing digital print advantages such as electronic collation, just-in-time manufacturing, and workflow automation, in addition, of course to very high speeds and productivity.

The actual cost cross-over point varies from one print application to another and depends on a number of factors (such as the number of colors, the format, the paper type, and the run length), but overall this description describes one of the most important differentiators between offset and digital print.

Yet despite the disruptiveness of digital print, offset has important benefits. Besides being a very effective manufacturing process for longer runs, offset presses are also capable of printing at very high quality levels on a wide range of paper stocks. Capabilities such as spot or flood coatings, exact matching of brand colors through the Pantone Matching System, metallic and fluorescent inks, and other special effects are also possible with offset. Because of their productivity, substrate range, quality, and special effects, offset presses will be used in production environments for many years to come.

The Value of Digital Print… and Why It Is Disruptive

The competition between a relatively new technology (like digital print) and a well-established technology (like offset) is an interesting one with historical implications that go back to when letterpress was the dominant printing technology for many applications. Back then, offset won out for a variety of reasons, including the ability to automate processes. Electronic prepress also benefited from the arrival of offset, and ultimately made it possible to compress the prepress process into the highly automated computer-to-plate workflow that we see in offset environments today.

What values does production digital print have over offset? InfoTrends breaks digital print's disruptive values into the following categories:

- **Short runs and quick turnaround work are feasible:** One of the first areas where production digital print was disruptive was in its ability to cost-effectively produce short runs. This was primarily because digital print devices did not require platemaking and make-ready. Turning short-run jobs around quickly spawned new markets in quick, retail, and digital print. Traditional commercial printers sometimes scorned these lower-end copier/printers, but these devices met a need that offset presses had a hard time filling.

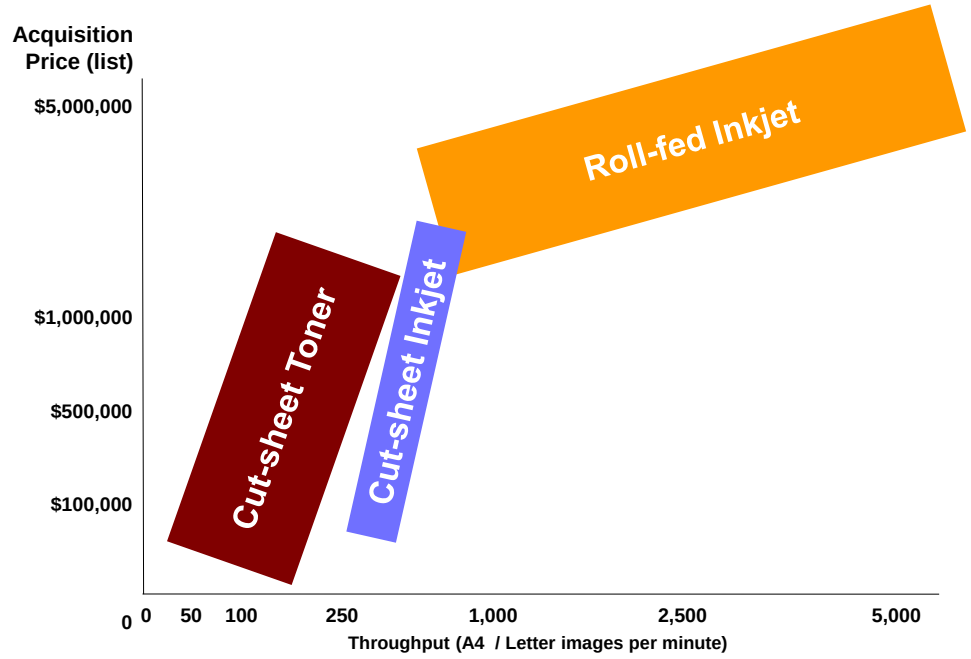
- **Every sheet can be different:** Unlike offset, where the printing plate makes many copies of the same image, a digital printing device can print different text and images on every sheet. While this capability can be used for high levels of 1:1 personalization, it is also useful for content segmentation (where a longer print run is broken into multiple shorter runs targeted to sub-groups) or time segmentation (where a longer print run is broken out into shorter runs that are spread out over time). It can be used for something as simple as a black plate change (which would stop an offset press, but not a digital one) or as complex as tagging or coding that can be used as a security feature to individualize documents and identify where they have come from.

- **The printer is a virtual document repository:** With production digital print, the output device takes on aspects of a press (for manufacturing) but also as a printer (for producing just the amounts needed, when they are needed). Digital printing spawned the term "on demand" to describe the ability to print materials as needed (e.g., an on-demand book that is only printed when an order is in hand). Just-in-time manufacturing takes this on-demand concept a step further, making it easier for marketers and publishers to fill their supply chains as demand requires, rather than making a big gamble on a long print run that must be warehoused. With a database of print-ready files, a production digital printer becomes a virtual document repository.

Why Is Inkjet Even More Disruptive?

Production digital printing using inkjet technology has some interesting advantages over toner-based technologies—one is speed and the other is format. A look at price and speed in the production color digital print market today shows an interesting split between the two technologies.

Figure 2: Price and Speed in Production Color Digital Printing



Cut-sheet color toner devices generally have speeds less than 200 pages per minute and are represented by products ranging from light production color offerings to production color printers, averaging hundreds of thousands of impressions per month in short-run, quick turnaround, and print-on-demand applications.

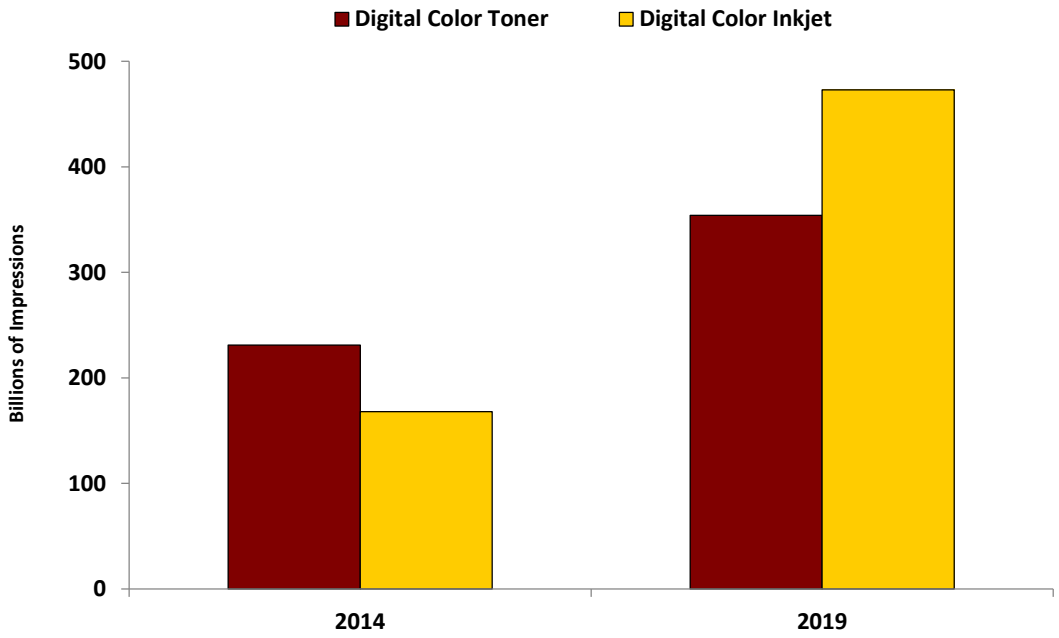
In about 2008, very fast roll-fed inkjet printers began entering the market. A key turning point was the ability to print 600 dot-per-inch resolution (and higher) at very high speed (comparable to offset presses). These are typically multi-million-dollar investments that are capable of printing millions of impressions per month. The running cost and throughput of these roll-fed inkjet devices are bringing them into higher and higher volume use in applications such as transaction, books, and direct mail.

A much more recent development is a group of cut-sheet inkjet products with speeds faster than toner but with acquisition prices below those of roll-fed inkjet systems. As higher quality levels are achieved (and inkjet is capable of very high quality levels—consider photo printers as an example), production color cut-sheet inkjet products are gaining ground in commercial print, publication, and packaging applications.

The format advantage that inkjet has over toner-based products relates to its ability to build wide imaging arrays composed of many inkjet heads, typically in multiples of around four inches. Roll-fed color inkjet systems support web widths of 20 to 30 inches, but much wider widths are possible. Cut-sheet color inkjet systems in B2 format have

doubled the imaging area of most cut-sheet color toner systems, though a few vendors have also gone to larger formats with electrophotography. Another important point to consider is that color digital print using both toner and inkjet continues to grow.

Figure 3: Global Digital Production Color Print Volume by Technology



Global digital production color volumes totaled about 400 billion impressions in 2014. InfoTrends expects them to exceed 825 billion by 2019. Production color inkjet accounted for 42% of the total production digital color volume in 2014 and will account for 57% in 2019. This remarkable turnaround occurs despite the fact that digital color toner is also growing at a 9% rate. These numbers speak to the tremendous growth potential in production color inkjet systems.

What is driving this growth? Initially, it has been in applications like transactional documents, direct mail, and books. A few key categories predominate:

- **Offset preprint replacement:** Sites that are using offset-printed shells (e.g., pre-printed forms) for transactional print and direct marketing have the opportunity to eliminate the shells and institute a "white paper in, full color out" workflow. Rather than using pre-printed shells for the color component of the document and then adding the monochrome variable data with an electrophotographic device, they can do this easily in one step using color inkjet systems. This eliminates the logistical nightmare of keeping preprinted stock up-to-date and in sufficient quantities.

- **Cost-effective production of mixed black & white and color content:** End-users are reluctant to pay a premium for documents printed on color devices, particularly when the document may include significant subsections of monochrome content. The ability to cost-effectively produce monochrome, light coverage color, and full color pages using a single device is very desirable in the production market.

- **On-demand/Just-in-time production:** Digital print is very well-suited to on demand or just-in-time production of promotional and publication applications. Nevertheless, the run lengths, volume levels, and range of required substrates can make it difficult to address these workflows with roll-fed devices. A cut-sheet inkjet device brings a strong level of application flexibility to on-demand and just-in-time production workflows at cost levels that can be very competitive with color electrophotography.

- **Filling the cost/productivity gap:** Products with a relatively low cost of acquisition, but which have a high level of productivity, present a disruptive opportunity between the high end of cut-sheet color electrophotographic products and the low end of roll-fed color inkjet systems. The key is that the system's cost, productivity, and quality levels must be appropriate for the target application.

With improvements in quality and the ability of some inkjet systems to print on a wider range of substrates, there are additional application opportunities. Two of these stand out:

- **Commercial print:** Many promotional applications (e.g., brochures) require coated papers to give them some extra shine and appeal. Commercial print applications like brochures are a great example of this. To succeed in commercial printing environments, inkjet technologies must be able to print cost-effectively and at high quality levels for high-coverage commercial printing applications.

- **Packaging:** Production digital print has had success with in the label market, but it is only beginning to have an impact on folding carton, corrugated, and flexible packaging. The future is bright as production color inkjet systems take on these new applications where process improvements could potentially enable users to reinvent how packaging is created.

Water-Based and UV Inkjet Technologies

The interaction between the ink and the substrate (e.g., the paper, board, plastic) is an important aspect of inkjet print quality. Not only must the ink be able to be jetted effectively through the heads, but it has to adhere to the substrate. In document and package printing, two types of inkjet inks are dominant:

- **Water-based:** Water-based (a.k.a. aqueous) inkjet inks use dyes or pigments as their colorants. For higher quality work, pigmented water-based inks are more common. Water-based inks tend to be more effective on uncoated papers because the water can be more easily absorbed. On coated stocks, the coating serves as a barrier. For water-based inkjet inks to adhere to coated stocks, some type of primer is generally required. The primer can either be built into the paper (these are called inkjet-treated stocks) or applied after paper manufacturing. Some system configurations enable the print service provider to add this priming solution on-site, which provides some flexibility to use stocks that aren't already pre-treated. Either way, adding a primer to a paper stock has an economic impact on the running cost.

- **Ultraviolet (UV):** Rather than being dried by heat or air (as is the case with water-based inkjet), UV inkjet inks are adhered to the substrate through a curing process that uses high-intensity UV light. This curing process dries the ink and helps it form a very durable bond with the substrate. UV inks have the advantage of being able to print on a range of untreated stocks without priming. This opens up new opportunities for inkjet in commercial printing and packaging environments. Substrate flexibility is an important aspect of an inkjet technology's suitability for any application. This includes not only the nature of the substrate (i.e., smooth versus textured) but also the ability to handle the appropriate sheet size.

Applications for Inkjet

InfoTrends breaks out the broad range of print applications into seven categories. The advantages of digital (and specifically high-speed inkjet) vary from one to the next.

- **Promotional:** Promotional applications such as brochures, direct mail, catalogs, inserts, and coupons are one of the biggest production color inkjet opportunities. Production digital print's ability to customize and personalize each individual document makes it particularly well-suited for this category. For those devices that have the format to support larger applications, posters and signage are important too.

- **Publishing:** Publishing documents such as books, manuals, magazines, newspapers, newsletters, and directories are another large opportunity. Greeting cards also fit in this category and can be a suitable application for inkjet

technologies capable of printing on heavier coated papers. For any of these applications, digital printing's ability to print on-demand or just-in-time is also extremely valuable.

- **Transaction:** Transaction documents such as bills, statements, and checks have benefitted from inkjet technologies, particularly roll-fed ones due to production digital print's ability to eliminate the use of pre-printed offset shells. This enables service providers to go from white-paper-in to full-color out in a one-step process that does not require warehousing of pre-printed shells.

- **Packaging:** Packaging accounts for a relatively small amount of production digital print today, yet labels, flexible packaging, folding cartons, and corrugated packaging are all very well suited for the benefits of production digital print. Table tents represent another application that are similar to packaging in structure and can be produced by inkjet devices that support heavier coated stocks.

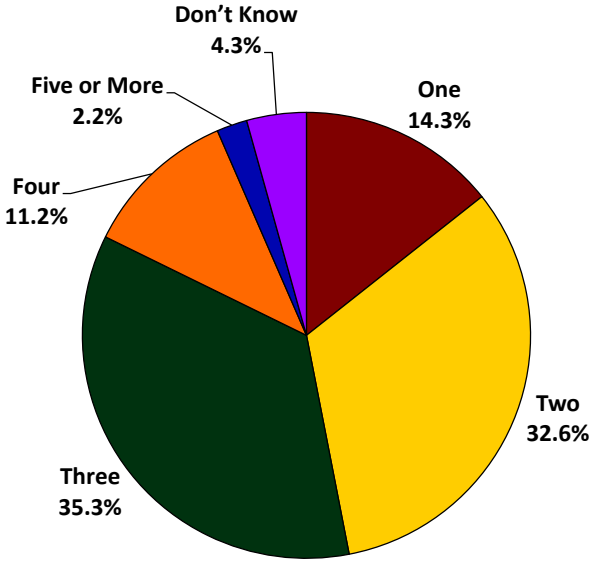
- **Other:** Three other application categories (general office, utility, and consumer) are not as large as the previously mentioned categories, but they do include some attractive applications for inkjet. General office documents include letterhead, proposals, reports, presentations, and business cards. Utility documents include forms and security prints (such as tickets and identity cards). Consumer applications cover fine art and photo merchandise. Suitability of inkjet for any of these categories depends on matching the possible substrates, quality levels, economics, and process benefits.

General Office	**Business Cards** **CAD/Rendering** **Letterhead, Other Office Documents** **Presentations, Proposals, Reports**
Promotional	**Brochures** **Catalogs** **Direct Mail, Inserts, Coupons** **Posters, Banners, Signage**
Publishing	**Books, Magazines, Manuals** **Directories** **Greeting Cards** **Newspapers/Newsletters**
Transaction	**Bills, Statements** **Checks** **Sys-Out** **TransPromo**
Utility	**Forms** **Proofing** **Security Print**
Packaging	**Flexible Packaging** **Folding Cartons** **Labels**
Consumer	**Fine Art** **Photo Merchandise**

How Does Digital Print Fit with Other Disruptive Market Forces?

To be truly effective, print must work well in conjunction with other media. In the InfoTrends study entitled *Micro to Mega: Trends in Business Communications*, over 1,000 small and medium-sized businesses (SMBs) were asked about the number of media types that were used for a typical customer communication/marketing campaign. Across all of these SMBs, the average number of media types used in a campaign was 2.6. In addition, respondents who blended the use of multiple media types reported that 49% of printed marketing materials used in the previous twelve months were somehow linked to online digital channels.

Figure 4: How many different media types does your company use for a typical customer communication/marketing campaign?



N = 1,085 Total Respondents
Source: *Micro to Mega: Trends in Business Communications*, InfoTrends 2015

Production digital print has the flexibility to be used effectively in these types of campaigns, which speaks to its overall disruptive impact whether it is used in a standalone fashion, or increasingly, in combination with other media types like mobile messaging, Internet, phone, radio, television, or print advertising.

What Is the Right Fit for Your Business?

The key question for anyone considering the purchase of a printing technology is that it needs to be the right fit for the desired application (or applications). Market-changing process improvements can only be achieved when the technology provides the desired running cost, productivity levels, print requirements (e.g., color and other effects), format

size, substrate suitability, and workflow automation tools. Each of these is tested on an application-by-application basis. What comes next, then, is process improvement that enables true business transformation. Using digital printing and finishing technologies in combination with workflow automation tools allows service providers to create new products and offer new services. In the right combinations, this can be truly disruptive.

InfoTrends' Opinion

Production digital print using toner-based devices has been disruptive because it provides a new outlet for short-run and quick turnaround work, while also introducing the concept of variable data. In a relatively short period of time, these devices replaced small format offset presses for many applications. A new class of high-speed digital products entered the market with roll-fed inkjet systems capable of high productivity for applications like transaction, direct mail, and books. These systems brought the disruptive capability of inkjet to a new level. Now, higher quality inkjet systems (both cut-sheet and roll-fed) have entered the market and are bringing production digital print's disruptive message to a broader range of applications across general commercial, publication, promotional, and packaging print. This is truly an exciting time for our industry!

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Jim Hamilton is Group Director responsible for InfoTrends' Production Hardware consulting services in the areas of production copying and digital printing, wide format, and labels & packaging. Mr. Hamilton is responsible for market research, providing forecast analysis, supporting the consulting service, and creating analysis reports.

Comments or Questions?