The Cut-sheet Inkjet Color Revolution

Market Opportunities for Canon’s Niagara

Service Areas

On Demand Printing & Publishing
On Demand Printing & Publishing Europe
Business Development Strategies

Comments or Questions?
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Executive Summary

Continuous-feed inkjet devices have been a huge factor in driving offset pages to digital. These devices have also created greater opportunities for cost effective and personalized digital color. They have been central to business transformations happening in the transaction, direct mail, and book markets. Bringing higher levels of productivity and cost effectiveness to cut-sheet designs will open up additional opportunities. The flexibility of cut-sheet inkjet products will help them succeed in the “Zone of Disruption” that currently exists between cut-sheet electrophotographic and continuous-feed inkjet color printers.

InfoTrends believes that a cut-sheet inkjet color revolution is imminent in the production digital printing market. A massive change has already occurred in continuous-feed production color digital printing, and many of those benefits could transfer to cut-sheet products. To date, however, the few cut-sheet inkjet products on the market have not been able to match the success of the continuous-feed inkjet models. A recent development has the potential to change this: Canon has shown a cut-sheet color inkjet technology demonstration called “Niagara” that has capabilities that could be very attractive to transactional printers, direct mailers, book printers, commercial printers, and other production printing sites.

Key Findings

- A cut-sheet inkjet color revolution is beginning, and its path will follow the advances made in continuous-feed color inkjet since 2008—with early successes in transaction, direct mail, and books.

- A “Zone of Disruption” opportunity exists between cut-sheet electrophotographic and continuous-feed inkjet color printers that can be exploited by compelling cut-sheet inkjet designs.

- Canon’s Niagara is well placed to address these opportunities because of its high speed, productivity, substrate range, integrated finishing, running cost, and quality levels.

Recommendations

- “Zone of Disruption” product offerings should not have an acquisition price of more than a million dollars and should have impressive levels of productivity.

- End users investigating cut-sheet inkjet should target the right mix of productivity, running cost, format, substrate choice, workflow, and quality levels suitable for their print applications.

- Vendors must keep end users’ needs in mind to help them drive new applications and/or transform their business models through process improvement and operational efficiency, just-in-time manufacturing, as well as the creation of unique (rather than mass manufactured) content.
Introduction
Inkjet printing technologies have had a huge impact in the production document printing market. Steady growth in continuous-feed color inkjet has been driven by:

- High productivity, low running costs, and suitable quality
- Process automation and business transformation
- A move toward color documents

There is ample reason to believe that similar shifts could be accelerated by cut-sheet inkjet designs. In this white paper, InfoTrends will explore the reasons why the time is right for cut-sheet color inkjet designs to succeed in the market.

Value Propositions: Offset, Electrophotography, and Inkjet
The cost versus run length cross-over curve diagram (Figure 1) should be a familiar sight to anyone in the graphic arts industry. It speaks to some very basic truths about different printing processes. Offset presses are an effective long-run manufacturing process that is very good at making many copies of the same thing; yet, because of the high cost of plates and make-ready, it is not particularly effective at short runs. Electrophotographic devices (digital toner) have a different curve with a very flat cost structure that makes them quite 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. Generally, about 500 to 1,000 copies of a document are required before offset becomes more cost effective than digital toner, though it depends on a range of factors (e.g., document type, color usage, and the number of pages).

Figure 1: Cost per Page and Run Length
The introduction of high speed and very productive continuous-feed inkjet systems has brought digital print into volume bands that are competitive with offset at much longer print runs. This new cross-over point makes inkjet very competitive with offset and suitable for higher volume print. At the same time, high-speed inkjet devices also retain all of the existing digital print advantages, such as electronic collation, just-in-time manufacturing, and workflow automation. These advantages give digital print the ability to automate document processes and provide process improvements that are not possible with conventional printing processes.

**Continuous-feed Inkjet Growth**

It was this combination of high productivity, low running costs, and acceptable quality that laid the foundation for the rapid growth in high-speed continuous-feed color inkjet systems. Continuous-feed color inkjet placements have risen steadily since around 2008.

**Figure 2: Adoption of High-Speed Continuous-Feed Color Inkjet (Worldwide Print Engine Placements, 2005-2013)**

![Graph showing continuous-feed inkjet growth](image)

*Source: InfoTrends Quarterly Tracker*

Another impact that inkjet has had on the continuous-feed market is a significant shift from monochrome to color devices. In 2006, most of the continuous-feed printers sold were monochrome. Over the years, the ratio began shifting toward color. By 2013, more color continuous-feed units were sold than monochrome ones. This was not only a black & white to color shift, it was also a technology shift. As the color continuous-feed inkjet units came in, they replaced monochrome electrophotographic ones. Since these continuous-feed inkjet devices were being used a lot in transaction environments where the workflow typically involved offset pre-printed forms, not only was monochrome toner losing volume to inkjet—offset presses were also losing volume to inkjet.
Reflected in page volume, this type of color migration translates to a 14.8% compound annual growth rate (CAGR) from 2013 to 2018 for color pages in the United States. At the same time, black & white pages are in decline at a 5.8% CAGR.

**Figure 4: Growth in Production Digital Color Pages (U.S. and W.E.)**

Source: InfoTrends U.S. and Western European Production Printing & Copying Market Forecasts: 2013-2018

Much, but not all, of the growth in production color volume can be attributed to inkjet. According to InfoTrends’ 2013-2018 U.S. and Western European Production Printing & Copying Market Forecasts, production color volumes totaled about 265 billion impressions in 2013 and will grow to more than 500 billion by 2018. By 2016, production color inkjet volume will exceed that produced by color toner devices.
Production color inkjet accounted for 36.6% of the total production digital color volume in 2013. (This is quite impressive since there was hardly any production color inkjet volume at all as recently as 2008.) By 2018, InfoTrends expects that production color inkjet will account for 59.1%, and all of this is happening despite the fact that color toner continues to grow, as well.

**Figure 5: Digital Color Toner and Inkjet Volumes Compared (U.S. and W.E.)**

Source: InfoTrends U.S. and Western European Production Printing & Copying Market Forecasts: 2013-2018

High levels of productivity and very competitive running costs have been keys to the success of continuous feed color inkjet. Three print applications have also been central drivers: transactional print, direct mail, and books.

**Figure 6: Print Application Volume**

High-speed Continuous-feed Color Inkjet (10M+ Color Duty Cycle)


Source: InfoTrends Digital Production Printing Application Forecast

InfoTrends uses color duty cycles to classify high-speed digital color systems. The top category contains those devices that have a maximum monthly recommended volume (i.e., duty cycle) of more than 10 million letter-sized impressions. This is where high-
speed continuous-feed color inkjet devices fit. InfoTrends estimates that these devices produced nearly 108 billion A4/letter size impressions in the United States and Western Europe in 2013. When broken out by application, transactional pages represent the largest category with about 41% of the volume. Next is Promotional (primarily direct mail) with 28%. In third is Publishing (mostly books) with 27%. For these applications, continuous-feed color inkjet provides a great fit because of suitable productivity, quality levels, substrate use, and economics. Bringing inkjet into greater use in other applications is what is so exciting about the rapidly developing inkjet marketplace.

The Zone of Disruption

The productivity levels of continuous-feed inkjet systems are very impressive. So impressive, in fact, that they are comparable to the speed of sheet-fed offset presses. Getting to that level of productivity was symbolically important because it meant that digital print was no longer relegated only to lower volume applications. Nevertheless, it also created a divide between the two main categories of production color digital print devices.

![Figure 7: The Zone of Disruption](image)

When typical color digital printing systems are graphed by acquisition cost on one axis and throughput on the other, two main categories are clearly delineated: Cut-sheet toner and continuous-feed inkjet. Devices in the cut-sheet toner category typically have speeds of less than 200 images per minute (ipm) and are used for low to mid-volume short-run, quick turnaround, and print-on-demand work. Devices in the continuous-feed inkjet category can produce output at high speeds and very high volume with print resolution up to 600 dpi (and often higher, with additional quality improvements possible through the use of multiple drop sizes). There is a gap of unmet need between these two areas that InfoTrends calls the “Zone of Disruption.”
There are opportunities in the Zone of Disruption for high-speed inkjet products (cut-sheet or roll-fed) that have high levels of productivity, competitive running cost, and an acquisition price less than $1 million. These opportunities are:

- **Offset preprint replacement**: Just as monochrome electrophotographic continuous-feed printers are being replaced by color inkjet ones, so is there a comparable opportunity with cut-sheet. There is a very large installed base of monochrome electrophotographic products that are focused mainly on mail applications, such as transactional print and direct marketing. Many of these sites are using offset-printed shells (i.e., pre-printed forms) for the color component of the document and are then adding the monochrome variable data with an electrophotographic device. This is a technology nightmare for the monochrome cut-sheet toner devices because ink from the pre-printed shells may transfer to imaging or fusing components, causing service issues. To be able to print “white paper in, full color out” with high levels of throughput and compelling cost metrics using inkjet avoids this dilemma. In addition, it eliminates the logistic 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 produce monochrome, light coverage color, and full color pages cost effectively 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 continuous-feed devices. A cut-sheet inkjet device could bring a strong level of application flexibility to on-demand and just-in-time production workflows at more competitive cost levels than 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 continuous-feed color inkjet systems. This type of Zone of Disruption opportunity exists for a cut-sheet or continuous-feed offering. The key is that the system’s cost, productivity, and quality levels should be appropriate for the target application.

**Enter Niagara**

At the PRINT 13 trade show in September of 2013, Canon announced a product concept it called “Niagara,” a B3-format cut-sheet inkjet printer with color speeds of up to 300 ipm. The news generated a lot of excitement, in part because of Canon’s decision to implement B3 format. Inkjet in B3 format was notable because of the many drupa 2012 announcements of B2-format digital offerings (some inkjet, some liquid toner).

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1 The B3 format is 13.9 x 19.7 inches / 353 x 500 millimeters. See the Appendix for a table comparing B1, B2, and B3 format sizes.
Canon’s rationale in implementing Niagara in B3 format was that the smaller format would allow Canon to price the device significantly lower than the B2 digital competition, thereby making the product accessible to a much broader audience. In addition, a B3-format device could be designed to have immediate access to finishing capabilities from Canon’s Océ VarioPrint 6000 series. Tapping into existing finishing capabilities means that production sites could easily leverage familiar and efficient automated document workflows.

**Figure 8: Canon Niagara**

![Canon Niagara](image)

**Table 1: Niagara Specifications**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>Up to 300 A4 images per minute Up to 3,800 duplexed B3 sheets per hour</td>
</tr>
<tr>
<td>Monthly Volume Range</td>
<td>One to ten million A4/letter images per month</td>
</tr>
<tr>
<td>Colors</td>
<td>Process color device (cyan, magenta, yellow, and black)</td>
</tr>
<tr>
<td>Inks</td>
<td>Océ-developed aqueous inks</td>
</tr>
<tr>
<td>Maximum Sheet Size</td>
<td>13.9&quot; x 19.7&quot; / 353 mm x 500 mm</td>
</tr>
<tr>
<td>Maximum Imaging Area</td>
<td>12.7&quot; x 19.5&quot; / 323 x 496 mm</td>
</tr>
<tr>
<td>Media Weight Range</td>
<td>60 to 300 gsm</td>
</tr>
<tr>
<td>Maximum Input Capacity</td>
<td>9,200 sheets (load while print)</td>
</tr>
<tr>
<td>Maximum Output Capacity</td>
<td>6,000 sheets (unload while print)</td>
</tr>
<tr>
<td>Digital Front End</td>
<td>Scalable PRISMAsync controller</td>
</tr>
</tbody>
</table>
B2 format has benefits for applications such as packages, point-of-purchase signage, and posters, which can take advantage of the larger format, but there is also a lot of value to the idea of a lower cost yet high-speed cut-sheet inkjet device that could make it possible to do the types of “white paper in/full color out” workflows that have been such a tremendous success with continuous-feed inkjet.

The problem with a number of the B2-format digital products or technology demonstrations is that they lacked some basic digital print features. The high levels of automation in production digital print products are made possible by features such as automatic duplexing, electronic collation, in-line finishing, and the ability to draw from multiple paper sources. Without these features, a digital product is simply a different type of print engine sandwiched between traditional offset feed and delivery units. On top of that, some of the units shown were quite slow; so despite their high quality levels, potential buyers struggled to justify the operating costs of a device that costs more than $1 million. Other companies have cut-sheet inkjet designs in the light production space, but Niagara’s B3 format and digital-savvy design make it the first production-class inkjet offering to enter the Zone of Disruption.

Niagara’s paper path gives an indication of the way that Canon engineers faced the technological challenge of moving cut sheets of paper at very high speed while accurately placing tiny droplets of colored ink on them, and then drying those sheets to produce high-quality output on a range of paper types. The paper path also indicates how substrates are pulled from a choice of paper trays at the right-hand side of the device and delivered on the left. Bringing a cut-sheet workflow to high productivity inkjet gives users the advantages typically associated with these workflows: the ability to draw from multiple paper sources, automatic duplexing, and in-line connectivity to finishing devices.

Another factor in Canon’s favor was that the company listened to the voice of the customer in sites producing transaction documents, direct mail, books, and manuals. With this input from the market—drawn from over 150 customer briefings at trade shows like drupa 2012, Graph Expo 2012, and PRINT 13—Canon was able to prioritize features, validate the product concept, and identify business models for acquisition and running
costs. Canon also benefits from the fact that it is using the same inkjet technology across multiple platforms—continuous-feed and cut-sheet. Lessons learned with inks and substrates on the continuous-feed side will benefit Canon’s cut-sheet initiatives. In addition, because the application set for cut-sheet is different than roll-fed, it is also important that Canon has extensive experiences with both types of workflows. It is not just in-line finishing that defines the workflow, Canon’s PRISMA workflow software will be a central building block in enabling the types of new applications and transformed business models that digital advantages such as process improvement, operational efficiency, just-in-time manufacturing, and personalized content can facilitate.

**InfoTrends’ Opinion**

A cut-sheet inkjet revolution is imminent. It will follow the path of the high-speed continuous-feed color inkjet market with its first successes in transaction, direct mail, and book applications. Successes in other applications, such as publications, catalogs, and general commercial print, will follow with the right combination of running cost and the ability to print effectively on coated papers at high quality and high ink coverage levels.

This “Zone of Disruption” opportunity falls between cut-sheet color electrophotography and continuous-feed inkjet, where no current products exist today. Canon is in a good position to take advantage of this opportunity with Niagara because, when the product is released, it should provide high speed and volume capability, combined with integrated finishing and quality levels that will help it succeed in the transaction, direct mail, book, and manual markets. Quality improvements over time will open up a wider range of applications that should make the product attractive to commercial printers, catalog printers, publication printers, and others in the graphic arts market.
Appendix

Cut-sheet digital printing has been most predominant in smaller paper sizes, generally B3 or smaller. This table identifies the sizes of the B1 and B2 format standards, and also includes press terminology that is commonly associated with those formats.

**Table A-1: The B1, B2, and B3 Standard Formats and Terminology**

<table>
<thead>
<tr>
<th>Name</th>
<th>Size (mm)</th>
<th>Size (inches)</th>
<th>Terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>707 x 1,000</td>
<td>27.8 x 39.4</td>
<td>8-up, 40-inch</td>
</tr>
<tr>
<td>B2</td>
<td>500 x 707</td>
<td>19.7 x 27.8</td>
<td>4-up, 29-inch</td>
</tr>
<tr>
<td>B3</td>
<td>353 x 500</td>
<td>13.9 x 19.7</td>
<td>2-up, 20-inch</td>
</tr>
</tbody>
</table>
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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.