



WHITE PAPER **THE LURE OF DIGITAL PACKAGING: A PRINTING INDUSTRY GROWTH AREA**

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INTRODUCTION

A number of years ago I did a study at Cal Poly to identify all graphic communication industry segments.

I came up with 33 industry segments and since have added two (Printed Electronics and Functional Imaging, and 3-D Printing) for a total of 35. They range from long-standing segments, some of which are on the brink of no longer being active, to the latest and most vibrant segments that are defining the present and future of the industry. They are:

Content Creators

1. Print Buyers
2. Web Developers
3. Internet Publishers
4. Graphic Design Companies
5. Ad Agencies
6. Marketing Communicators
7. Multi-media Communicators

Service Providers

8. Commercial Printing
9. Newspaper Printing and Publishing
10. Magazine/Periodical Printing and Publishing
11. Book Printing and Publishing
12. Business Forms and Bank Stationery Printing
13. Financial and Legal Printing
14. Greeting Card Printing
15. Yearbook Printing
16. Folding Carton Printing
17. Flexible Package Printing
18. Corrugated Box Printing
19. Metal Decorating
20. Label Printing
21. In-Plant Printing
22. On-Demand (Quick) Printing

23. Prepress Vendors
24. Trade/Job shops
25. Digital Printing
 - Short-run
 - Variable Data Printing
 - Custom Publication Printing
 - Wide-Format Printing
 - On-demand
 - Demographic Printing
 - Personalization
26. Printed Electronics and Functional Imaging
27. 3-D Printing
28. Specialty and Screen Printing
29. Direct Mail Printers
30. Printing Brokers
31. Post Press Providers

Developers, Dealers, Distributors

32. Equipment & Supply Vendors
33. Hardware & Software Vendors

Education and Professional Development

34. Associations
35. Colleges and Universities

Of these 35 industry segments, 27 have traditionally focused on print. Of the 27, the only industry segments not negatively impacted by the Internet and WWW, but have grown in spite the growth of online marketing, are those related to packaging, and specifically: Label Printing, Folding Carton Printing, Flexible Package Printing, and Corrugated Box Printing. All of the others have declined and some have nearly disappeared entirely.

One might ask: Why has package printing not only endured but has grown, when the Internet and World Wide Web has caused the decline of all other printing industry segments?

I have the answer. However, please understand that this is not a political or social statement, or a value judgment on my part. But this is something that you do not read about in the graphic arts industry press.

The growth and focus on packaging by Original Equipment Manufacturers (OEMs) and service providers (printers) is a statement on the viability of industrial, capitalist and market-driven material interests of the Western World, and rapidly becoming a value in Asia and elsewhere.

You typically do not see this addressed in industry literature, articles, reports, and so on. However, this societal value is nothing new, and it is the reason that nearly every OEM of digital presses is focusing on packaging. There are a few reports that begin to address society's affinity to packaging, such as Smithers Pira 2013 report, *"The Future of Digital Print for Packaging to 2018."* Such reports point out that as populations increase in size, and consumers in industrialized regions enjoy growing income, packaging demand continues to rise. Geographically, Europe/Middle East/Africa (EMEA) and North America are the largest markets for color digital label and packaging presses. Asia Pacific and Japan, and the rest of world, are the smaller but faster-growing regions. Meanwhile, in more developed regions, average household sizes are falling, reducing the size of average print runs and, therefore, playing to the strengths of digital packaging.

While technology advancements must continue, the next area of development has more to do with marketing package printing technology to commercial printers in a way that demonstrates that packaging is a viable and profitable industry segment to enter. Most commercial printers do not yet understand this. Yet, advances in digital printing are rapidly addressing one of the largest concerns packaging print buyers: *reduced time to market!*

NEW METAPHORS AND DESIGNATIONS

The growth and viability of package printing was evident at DRUPA 2016, designated *"The Digital Packaging DRUPA."* For example, production inkjet and toner equipment manufacturers showed numerous new technologies for digital package printing, and particularly for folding cartons, corrugated boards, and labels.

Metaphors beginning with *"Direct-to"* designations have been applied to the modern printing industry for the past few decades. For example, *"Direct-to-film"*, *"Direct-to-plate,"* and *"Direct-to-press"* are a few. Two new ones are *"Direct-to-board"* corrugated printing for printing already pre-formed corrugated boxes, and *"Direct-to-shape."* While in its developmental stages, *"Direct-to-shape"* refers to customized or variable digital package printing that will enable printing directly on a pre-formed package of any type targeted to groups fitting certain demographics.

INDUSTRY GROWTH AND WORTH

The packaging industry is growing rapidly, and does not show signs of slowing down any time soon.

According to the Smithers Pira report, the estimated worth of digitally printed packaging in 2013 was \$6.6 billion, and forecast to more than double to reach \$14.4 billion by 2018.

Labels accounted for the bulk of digital printing market share in 2013, with their value being \$6 billion, or 89.6 percent of all digital packaging. Today, label and packaging converters worldwide invoice over \$2 billion annually for the output of their color digital presses. While about 95 percent of that value is for labels for consumer goods, the folding carton and flexible packaging applications are also growing rapidly through digital printing.

According to Smithers Pira, analog packaging is also growing by about 28 percent per year, and this growth is expected to continue through 2018, while all digitally produced packaging is expected to increase by 375 percent by 2018. This expected growth explains why many OEMs are developing digital equipment for the main packaging industry segments.

INKJET AND ELECTROPHOTOGRAPHY

The three traditional processes for package printing, flexography, gravure, and lithography will continue to be vital and needed, particularly for static and long-run printing. However, their market share will gradually diminish as digital printing processes advance in size, speed, and flexibility.

Digital printing is already well established in label production, and electrophotography and inkjet are enjoying growing shares of market value. These processes are expected to reach over 27 percent in 2018. Of the world market for digital package printing, the Western European market exceeded \$920 million in 2013, with Germany remaining the largest market for all print in Europe. Meanwhile, the United States is the single largest country for print and packaging, and is by the far the most developed market for digital printing. The United States market is forecasted to grow to \$3.38 billion by 2018.

Electrophotography and inkjet are improving in both quality and speed, and larger systems and presses are becoming available that are challenging the dominance of offset, wide-web flexography, and gravure. In 2010, these processes accounted for \$166 million for color digital presses alone, and have been growing by over 10 percent a year since then. Converters now often use color digital presses in tandem with their analog systems, and some converters operate electrophotographic and inkjet presses. Companies such as Agfa, EFI, HP Indigo, Xeikon, Xanté, and Xerox, are only a few OEMs developing electrophotographic and inkjet printing press technologies.

OEM JOINT VENTURES

Realizing the present and future growth potential of digital packaging, companies wanting to capitalize on these opportunities are engaging in joint ventures. This allows getting into these markets without “reinventing the wheel.” For example, Heidelberg has partnered with Fujifilm in developing Primefire 106, Landa has partnered with KBA combining Landa’s S10 technology with KBA’s VariJET Powered by Xerox, Xanté’s Excelagraphix 4200 is using Memjet page-wide inkjet printheads for high-speed output on corrugated board, Komori Impremia NS40 has incorporated Landa nanotechnology.

Additionally, HP has partnered with KBA in developing HP’s PageWide C500 thermal inkjet press for corrugated board, following HP’s joint venture with KBA to offer the HP PageWide Web Press T1100S for preprinted liners. Screen and BHS Corrugated announced an agreement for Screen’s Inca Digital subsidiary to develop a reel-to-printed sheet aqueous inkjet printing option for use in-line with BHS corrugators as an integral part of the corrugated box manufacturing process. Konica Minolta raised its ownership stake in MGI to 40.5 percent with the showing of the MGI Meteor Unlimited Colors, JETvarnish and AlphaJet devices.

PACKAGING INDUSTRY SEGMENTS

Today's package printing industry segments are:

- Folding Carton
- Flexible Packaging
- Labels
- Corrugated

Metal decorating used to be part of this group. However, the application of printed images directly on a metal surface is no longer a viable process, technically or economically. The following is a review of today's segments.

FOLDING CARTONS

Several years ago HP Indigo and several other OEMs introduced B2 sheet-fed digital presses for printing folding cartons.

The folding cartons market is particularly suited and for digital printing because nearly all folding cartons are produced using analog print. It is a large market ripe for penetration by digital processes. Additionally, most of the applications involve single-sided printing on paperboard, and there is little or no concern about contact with food. Hence, the B2 sheet size, typically used for commercial printing, is also suited for folding cartons. Some of the presses developed for this purpose include HP Indigo's 30000, Screen's TruePress JetSX, and Océ's InfiniStream.

The HP Indigo 30000 Digital Press upgrade package increases productivity up to 30 percent and enables numerous folding carton jobs per day. The press allows new high-margin opportunities with synthetic media as well as metallized boards, polyvinyl chloride, polypropylene, and polyethylene terephthalate materials. The Océ product is intriguing because it is roll-to-sheet, specifically a B1 sheet that is the next size up from B2. Scodix's Ultra Pro and E106 also serve the folding carton industry segment.

LABELS

Since 2014, color digital printing has been well-established in packaging, but mainly for printing labels on narrow digital web presses such as HP Indigo and Xeikon presses, and printers from companies such as Allen Datagraph, Primera, and Quick Label Systems.

The HP Indigo Digital Combination Press provides digital printing and finishing on labels all in a single pass. The HP Indigo 8000 offers end-to-end labeling production at double the speeds currently available up to 262 ft. (80 meters) per minute. Due to stringent labeling requirements, the use of late-stage customization to print the final details of a package or label are being used more, a trend led by the pharmaceutical industry.

FLEXIBLE PACKAGING

HP Indigo's 30" digital web press for flexible packaging has been an area of opportunity for about four years, but presents more issues for digital technology than folding cartons do.

To begin with, flexible packaging uses thin, unsupported film media that is often problematic for digital presses, and there is the need to reverse print or surface print depending on the product. Additionally, since most of these packages are used for food products, there are toxicity concerns and FDA regulations that have to be met. However, regardless of these concerns, brands are still seeking the short runs that digital printing enables for flexible package printing. The flexible packaging industry is huge, profitable, and growing, representing over \$50 billion in revenue internationally.

HP Indigo was the first to focus on this market with digital printing applications. The HP Indigo 20000 Digital Press now features an upgrade package that enables compatibility with new substrates, such as

polyethylene and stretchable materials, for a wider range of high-volume flexible packaging, shrink sleeve, and in-mold and pressure-sensitive label applications, including lids and laminated tubes.

Other OEMs are entering this market with press technology. For example, Kodak features an Extended Gamut + Varnish (XGV) technology for flexible film being produced on a narrow web by configuring seven Kodak S-Series inkjet printing systems with an additional station applying a water-based digital varnish. Fujifilm has a new UV LED inkjet press suited for printing on the underside of flexible packaging. Landa Digital Printing is one of the latest entrants to focus on flexible packaging.

CORRUGATED

Corrugated board printing represents another area of promise for high-end presses, because many of today's brands need short runs for their corrugated packaging.

A number of OEMs are competing in this area, including Barbaran, Bobst, CorrStream, Durst, HP Scitex, and Inca. Of these, Durst, HP Scitex, and Inca make inkjet flatbeds that print corrugated in multiple passes. Barbaran makes single-pass systems that print in color at high speeds with line heads of up to 1.26 meters. The introduction of several B1- format (40" plus) cut-sheet production inkjet presses are well-suited for folding cartons.

For products in the corrugated packaging industry segment, such as beverage cans, bottles, cosmetics tubes, etc., brands want short-run printing for them as well, and their printers are only minimally able to meet that need with analog printing presses. Billions of these bottles, cans, and tubes are produced worldwide on an annual basis, and nearly all of them are printed using analog technology.

DIGITAL ADVANTAGES FOR PACKAGE PRINTING

Following the advantages that have been enjoyed by general commercial printing for quite some time, the packaging industry segments are now adopting and enjoying those advantages. They include:

- Short-run
- On-demand
- Variable data
- Demographic printing
- Personalization

However, added to the list, specifically for packaging, is Smart Packaging, a development that promises to revolutionize not only how packages are produced, but how they are used by retailers and consumers.

SHORT RUN

The demand for short-run, digitally printed packages is rising, and digital presses have made it economically feasible to produce printed packages of runs of 5000 or less. The great advantage here is being able to reduce inventory and storage costs, and to produce printed packages in quantities to satisfy the market life of products that sometimes is very short. It allows quick and economic changes in product ingredient and nutrition markings for food products. Such information sometimes change over short periods of time.

VARIABLE DATA PACKAGING

The variable data capability of digital presses also allows for versioning and personalization that inspires rapid consumer responses. Variable data printing is typically identified with short-run printing. However, there are increasing examples of variable data packaging not being restricted to short runs, but used for long runs as well. A classic example of this is the highly publicized Coca Cola case study.

Entitled "Share a Coke," Coca Cola took advantage of the variable data capability of digital presses, and used versioning and personalization for a campaign in 35 European countries involving the printing of over 750

million packages. As part of its campaign, Coca Cola produced over a billion labels; putting the popular notion to rest that digital printing is only suitable for short runs.

The campaign was the largest job on record for HP Indigo label presses, and increased social media engagement and sales by versioning and personalizing the labels to appeal to different demographics in different nations.

If a billion labels can be segmented and personalized for multiple nations, shorter print runs can be versioned and personalized for the demographics of different regions within a nation, and down to neighborhoods and special interests of specific residents. The ability to produce short print runs economically will grow in interest as packaging buyers continue to search for innovative digital methods and ways to engage with present and prospective customers.

PRINT ON-DEMAND

Printing on-demand means less waste, ensuring that new designs, product details, or changes in ingredients do not result in redundant inventory. Technological developments in inkjet and electrophotography have simplified and made print on-demand realistic for packaging. It has made personalization of packages by region, special interests, demographics, and so on, practical for packaging. The concept and promise of print on-demand package printing has inspired OEMs to focus their press technologies and marketing on the packaging industry. As previously noted, nearly every manufacturer of digital printing presses are focusing on this market. Interestingly, it is also a market with resources. Unlike other printing industry segments, packaging printing is growing, particularly for consumer-packaged goods (CPGs) and fast moving consumer goods (FMCGs) produced by large companies that understand brand user and consumer preferences. They have the resources to invest in new technologies to help gain market share. The digital press manufacturers understand this.

PERSONALIZATION

Personalization, or the ability to personalize data within a printed document, via variable data printing, has been an attribute of digital printing for the commercial printing industry sectors for a couple of decades. However, it is new to packaging, and promises to be a major application for label, folding carton, and flexible package printing, and will grow as a major marketing force for selling packaged products.

It is projected that personalized packages could potentially increase product sales from 100 to 1000 percent. Personalization could be by region, for seasonal events, group demographics, past purchasing experiences, and even down to the individual person through new technologies being developed for “Smart Packaging.”

SMART PACKAGING

Another area where packaging has taken on a new role is in the area of “Smart Packaging.” This is where images on a substrate can potentially communicate with the consumer and the consumer with the printed image.

The potential of digital printing is broadening, and packaging companies are only just beginning to realize the benefits offered of personalization, customer engagement, and integration with online campaigns and marketing at the point of sales. Smart Packaging, also referred to as “active packaging” or “intelligent packaging” refer to packaging systems used for foods, pharmaceuticals, and several other types of products. They help extend shelf life, monitor freshness, display information on quality, improve safety for the consumer, and improve shopping convenience.

Here is where through Near-field Communication (NFC), Quick Response Codes (QR), Universal Product Codes (UPC), and Radio Frequency Identification (RFID), the relevance of a package’s information such as nutrition, health, and wellness information will change instantaneously depending on the consumer who

looks at or purchases the product. Advantages of the product to the consumer, as well as warning and cautions, would appear that are relevant to the specific consumer.

As one example, CVS Pharmacy recently developed a promotion called “In-store Alerts.” Through a mobile device CVS app, the consumer can receive notification alerts right in the store, announcing special deals on products of possible interest to consumers based on previous purchasing histories.

A BRIEF CASE STUDY

An example of one of the latest packaging “start-ups,” using the value of digital packaging, is ePac LLC in Madison, Wisconsin.

In its first year of operation, ePac, focused exclusively on flexible packaging, has committed to maintain entirely digital applications from front-end through printing in providing a focus on high speed, short-runs, rapid replacement of package turnover, and minimum inventories for its clients.

Carl Joachim, Chief Technology Officer for ePac, shared that in April of 2016 ePac began commercial operations with a technology platform based on the HP Indigo 20000 press. The company’s applications, including prepress technology, printing, laminating, and pouch making, will use an end-to-end digital workflow for automated production processes. ePac has already installed a second HP 20000 in its Madison location, and has committed to acquire two additional presses to fuel planned growth in North America. Further, Joachim added, work is underway to develop a fully automated platform to mechanize the steps from order entry through file preparation and printing.

Jack Knott, ePac’s CEO, said, “By using digital applications, we built ePac so any company, large or small, can turn around products quickly on the retail shelf, decrease inventory and inventory obsolescence, and grow their top lines. ePac was built to help customers access modern technology for marketing and sales, to reduce the environmental footprint of the process, and to realize the value of digital processes for packaging purposes.”

From its initial planning, the intent was that ePac be an anomaly and a seminal company in demonstrating that a flexible package printer can rely on a total digital workflow with no conventional flexographic or gravure presses.

ePac’s clients already include several major consumer packaged goods companies (CPGs), including Just Born, makers of the famous Peeps candy. In addition, CPGs of all sizes are working with ePac to achieve faster time to market for time sensitive promotions, product introductions, and to produce high quality sales samples.

PRESS COSTS

An interesting development is underway that traditional press manufacturers focusing on the packaging industry should take notice of. These would be OEMs of analog gravure, flexographic, and offset lithographic presses. Many have been the mainstay of press technology for the packaging industry segments of folding carton, flexible package, label, and corrugated board printing. Whereas the advantage of digital presses has been touted to create a short-run market for packaging, the traditional press manufacturers continued to see the need to produce analog presses to serve long runs. Such presses are very expensive and bringing in millions of dollars in revenue to the press manufacturers. Indeed, these traditional presses, many comprised of numerous printing stations beyond four units, cost in excess of a million dollars, and many costing multiple millions of dollars. However, this dynamic is changing with digital presses now being developed to serve the long-run packaging market.

Million-dollar high-end presses are now redefining the role of digital printing in packaging. The number of such packaging presses is growing internationally, and all of them are designed to print larger image areas on larger paper sizes for folding cartons and flexible packaging. Further, there had been the development of high-end digital printing presses that print directly to corrugated board in full-color, and on cans, bottles, packaging tubes, and other packaging shapes. These are all color digital presses, but with prices of between \$1- and \$4-million. Hence, the market for long-run packaging now has “digital options” not previously available, and represent competition and a threat to OEMs of traditional analog presses for packaging. The output speed and productivity of such presses have grown to compete with traditional presses as well. For example, the 1.8-meter-wide EFI Nozomi C18000 LED inkjet press can output up to 9,000 boards per hour. The Konica Minolta KM-C inkjet press can output up to 2,200 cardboard and micro-flute boards per hour.

Some of these press developments have come from industries outside of the printing industry, and particularly from product developers seeking more packaging automation, such as the beverage industry as one example.

The introduction of “million-dollar” digital packaging presses will bring about a fundamental market shift. Placements will be small in relation to digital label press presses, but growth is expected. To justify their cost, their output will far exceed the package printing volume that a digital label press, designed for short-run production, can achieve. Target products for these presses are expected to be bottles and corrugated boxes. Such presses will also appeal to large companies with revenue of \$10-million or more that are new to creating production-level digital printing for packaging, such as can manufacturers and folding carton converters. It is expected that higher-performance digital presses will enter the market at an accelerated rate.

Some manufacturers of such high-end presses, their location, and application are:

Barbaran – Spain – for corrugated
Bobst – Switzerland – for Corrugated
CorrStream – UK – for Corrugated
FujiFilm – Japan – for folding cartons
HP Scitex – Israel – for corrugated
HP Indigo – Israel – folding cartons and flexible packaging
KHS – Germany – Bottles
Konica Minolta – Japan – folding cartons
Landa – Israel – folding cartons
Mark Andy – US – labels
Océ – Germany – folding cartons
Omet – Italy – labels
Screen – Japan – folding cartons
Till Gmbh – Germany – bottles

PAPER CONSIDERATIONS

Related to press costs are paper considerations. Digital presses in B2 formats are starting to make their presences felt, as previously noted, in corrugated, folding carton, and flexible packaging, where analog production still dominates. Although placement of digital presses in the B2 format is presently modest, interest in them and installations continue to grow. For example, there has been an increase in the installation of the 30-inch format size by folding carton printers along with the installation of "half size" analog high-productivity presses over the past few years. For comparison purposes, the following is a table of “B” paper sizes in millimeters and inches.

Table of Paper Sizes From B0 to B10

Size	Width x Height (mm)	Width x Height (in)
B0	1000 x 1414 mm	39.4 x 55.7 in
B1	707 x 1000 mm	27.8 x 39.4 in
B2	500 x 707 mm	19.7 x 27.8 in
B3	353 x 500 mm	13.9 x 19.7 in
B4	250 x 353 mm	9.8 x 13.9 in
B5	176 x 250 mm	6.9 x 9.8 in
B6	125 x 176 mm	4.9 x 6.9 in
B7	88 x 125 mm	3.5 x 4.9 in
B8	62 x 88 mm	2.4 x 3.5 in
B9	44 x 62 mm	1.7 x 2.4 in
B10	31 x 44 mm	1.2 x 1.7 in

FINISHING AND LAMINATION PROCESSES

Finishing processes are very important in producing the complete package. Therefore, with advances in digital press development for packaging must come advances in finishing processes. Finishing is so vital because it influences package design, the placement of products in packages, the storability of packages in stores and in the home, and how packages influence consumer purchases.

Laminations, coatings, die cutting, spot varnishes, folding, scoring, and so on are vital capabilities required in effective package production. For example, the TRESU iCoat 30000 now offers protective and spot varnish in one pass as well as new enhancement capabilities with gold, silver, and other high-viscosity flexographic inks. The HP Indigo 30000 Digital Press is also compatible with HP partner converting solutions for inspection, creasing, folding, and gluing, and integration with AVT's inline inspection system.

Another example is the HP Indigo Pack Ready laminator. This creates a film that does not require curing, so it connects directly to an in-line Form, Fill, and Seal (FFS) machine to produce pouches with no lag time. The lamination process on the Pack Ready laminator combines different films, each providing a different functionality (print quality for shelf appeal, protection of food for longer shelf life, sealant film to melt together via heat, etc.), just as converters do. The quality of the bond strength between substrates being joined is key, as lamination failure could lead to compromised food. This is not acceptable for food manufacturers.

Until recently, traditional lamination for flexible packaging, such as solvent-based lamination, requires a curing process that can require a few days, a week, or even ten days for high-end applications. Such a wait time to cure lengthens time to market. Hence, a huge advantage of digital printing is reduced time waiting for curing to occur. "Pack Ready" lamination requires no time for curing. Its advantage is the combination of film and a specially designed thermoplastic polymer resin layer that HP developed. This is HP-owned intellectual property that the company plans to license to selected "Pack Ready" partners. In this process, lamination speeds can reach 386 feet (100 meters) per minute, and it is solvent-free thereby lacking volatile organic compounds (VOCs) that are irritating to operators. HP claims that the process can be used for high-quality, zero-curing, food-grade package lamination by inexperienced converters or packagers. While not yet commercially available, HP expects it to be next year.

CONCLUSION

The purpose of this article was to bring to light an opportunity for present graphic communication companies in the commercial printing sector. The opportunity is to consider expanding commercial printing services into packaging; a growing segment not negatively impacted by non-print media such as

the Internet and World Wide Web. It was also meant for new companies wanting to enter the graphic communication field and seeking lucrative opportunities in doing so.

The article provided a review of the state-of-the-art of digital package printing along with its applications and advantages. The article's extensive bibliography is meant to provide readers with the sources from which a lot of the information provided comes, and to be a resource for additional background on the development and growth of digital package printing. Each source includes a URL for online access.

Finally, at the outset of this article, the growth and success of the consumer packaging industry is related to the industrial, capitalistic, and market-driven interests and values of the Western World, and the expansion of these values to Asia, Europe, and elsewhere. It is not expected that these interests and values will change, nor will the ongoing growth of the consumer packaging industry in the decades ahead.



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PRESSES FOR PACKAGING

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