

Digital Transformation of Commercial Printing

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Abstract

Digital printing is a rapidly growing segment of the commercial printing market. Color digital production presses offer high image quality, and enable personalized print as well as very fast turn around short run print, both of which are high value products. The strengths of digital printing are complementary to those of analog printing, which excels at longer run lengths.

Digital Print in Other Market Segments

Over the past two decades, several market segments have almost completely converted to digital printing technologies. Examples include personal printing of documents and images as well as office workgroup printing. Photocopiers are one of the more recent of these segments to transform – until the current decade, analog optical exposure systems were still common, but now digital scanning and exposure have become the norm. Transactional print is another segment which has been dominated by digital print for a number of years. Dry toner electrophotography and ink jet printing are the technologies of choice in these markets. With these technologies, every page printed can be unique – there are no printing plates and there are no setup costs when the content changes from page to page.

Worldwide, 9% of all of the pages printed are digital at present. A large proportion of these digital pages are generated in the office market.

Commercial Printing

Commercial printing is currently a ~ \$ 600B /year worldwide market, and is dominated by analog printing presses which use technologies such as offset lithography, gravure, and flexography. Analog commercial printing has been a traditional manufacturing industry, with long print runs (because of the high set up costs which can amount to hundreds of dollars each time a new set of printing plates is installed on the press), and extended warehousing of the printed documents. Typically, 50% of the printed output has been eventually scrapped, with obsolescence of the content being a major contributing factor.

The emergence of digital commercial printing is occurring in the context of major changes which are transforming the commercial print industry. Until recent decades, commercial printing was craft-based, with significant skill being required to deliver consistent high quality output. However, file generation, prepress, and CTP plate generation have become fully digital, making these stages of the process much more automated and predictable. Printing presses have also become substantially more automated. As a result, printing has now changed from a craft-based endeavor to a sales-driven manufacturing process with significant commoditization.

Another major change is the dramatically widened geographic scope of competition between print providers. This change has been driven by the worldwide connectivity provided by the internet, and this is now being furthered as well by the emergence

of remote proofing. Unless required lead times are short, local print providers do not necessarily have an advantage any longer.

These changes are driving consolidation in the printing industry. For example, according to TrendWatch Graphic Arts, the overall number of printing establishments in the US dropped 4% between 2002 and 2004, but the number with greater than 50 employees grew 3%.

In response to these changes, forward-looking print shops are now becoming more specialized and are changing from sales-driven manufacturing operations to marketing-driven service providers. Capabilities ranging from direct marketing campaign management to fulfillment are important to many of these value-added services, and digital print is a key element in many cases.

Improvements in Analog Commercial Print

Analog commercial printing technology is itself being improved to increase its ability to print short run lengths cost-effectively. Presses are being designed to enable faster plate changes. Color control advances include the setting of motorized ink keys based on the data from the print file, as well as closed-loop control of ink keys during the press run based on measurements of color patches. Anilox inking is now an option for certain presses, which eliminates ink keys and can achieve stable color with dramatically fewer scrap startup sheets.

Digital Print Technologies

The analog to digital transformation of commercial print is now in the early stages. Several thousand color production digital presses have been installed around the world by all manufacturers, and digital is by far the fastest growing segment of commercial print, with the volume of print output increasing at >40% per year. One driving force behind this transformation is the emergence of digital printing presses with very high image quality and with both speed and cost which are competitive with analog presses for short print runs of less than a few thousand copies. With digital presses, the output quantity can be limited to just the number needed, avoiding obsolescence and waste. A second driving force is data-base-generation of targeted or customized variable data printing. Targeted marketing materials have substantially higher value to the customer. Digital print applications differ widely in their requirements for image quality, cost, run length, and so on. As a result, several different print techniques are being used in current digital presses.

Dry electrophotography uses a laser-imaged photoconductor to create images from electrically charged particles of dry powder which contain colorants and polymers. These images are transferred from the photoconductor to the paper, and then fused onto the paper. This technology is in very widespread use in both copiers and laser printers, monochrome as well as color, covering a wide range of print speeds. Digital presses are available from several vendors which use high end implementations of this technology. These presses have incorporated advanced techniques to achieve color quality close to that of offset.

Liquid electrophotography uses a laser-imaged photoconductor to create thin images from viscous liquid ink which contains charged particles containing colorants and polymers. These images are conditioned on an intermediate transfer blanket and then transferred to the paper with heat and pressure. One vendor, Hewlett Packard, has developed the Indigo product line of digital presses using this technology. This process produces thin images, approximately equal in thickness to offset, resulting in high image quality and image characteristics very similar to that of offset print.

High speed commercial ink jet printing has been extensively used during the past two decades for a relatively narrow range of applications, printing monochrome text such as mailing addresses. In this decade, these commercial ink jet systems have expanded into full process color, allowing the printing of color images at higher speeds than liquid or dry electrophotography. The image quality of these high-throughput systems has been steadily improving. The high image quality commonly achieved today on low cost personal ink jet devices is a clear future goal, and numerous efforts are underway to develop commercial ink jet systems which simultaneously achieve high-speed and high image quality. It is likely that technological advances will be successfully incorporated over time into high speed commercial ink jet systems leading to significant image quality increases in coming years.

Digital Print Applications

A wide range of commercial print applications are currently being addressed by digitally printed output. Key markets include short run marketing collateral, targeted variable data direct mail, photo specialty products, books, and labels.

Drivers for Future Growth in Digital Print

Continued advances and refinements in digital commercial print engines are resulting in a wide range of improvements including higher throughput, increased automation, and lower cost per page. Equally important are advances in other areas. One key enabler for digital print is automated workflow software, ranging from web commerce to preflight to job management to accounting. Many existing workflow approaches were designed for long print runs and are inefficient for short runs or variable data jobs. Software for automated content generation of variable data jobs is another important stimulant for the growth of digital print. Automated and calibrated color management will be an additional key to further digital growth. For example, improved color will be facilitated as improved color management techniques are adopted, such as those specified in version 4 of the ICC color management system.

Conclusions

Digital commercial printing technology allows fast and economical printing of variable-data targeted material, as well as short run print on demand. These capabilities are complementary to those of analog commercial print, such as offset, which excels at long runs. Digital print can enable a business based on services rather than manufacturing, and can achieve higher margins than analog print, which has become largely commoditized.

Author Biography

Dr. Eric Hanson is the Acting Director of the Digital Printing and Imaging Laboratory of Hewlett Packard Laboratories, in Palo Alto, California, where he has managed research investigating advanced digital printing since 1984. He is currently the President of IS&T, the Society for Imaging Science and Technology. He received a Ph.D. in physics in 1976 from the University of California at Berkeley and has been awarded 18 US patents.