## about the Center

Rochester Institute of Technology (RIT) was selected by the Alfred P. Sloan Foundation in 2001 to become one of the Sloan Industry Centers, now numbering 22. The Printing Industry Center at RIT is a joint program of the School of Print Media and RIT's College of Business, emphasizing Sloan's long-standing tradition of applying a broad multidisciplinary approach to industry investigations and findings.

Dedicated to the study of major business environment influences in the printing industry brought on by new technologies and societal changes, the Printing Industry Center at RIT addresses the concerns of the printing industry through educational outreach and research initiatives. The Center creates a forum for printing companies and associations worldwide to access a neutral platform for the dissemination of knowledge that can be trusted by the industry, to share ideas, and to build the partnerships needed to sustain growth and profitability in a rapidly changing market.

More information on the Printing Industry Center at RIT and its research activities can be found online at http://print.rit.edu.

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The PrintReview is produced quarterly exclusively for Affiliates of the Printing Industry Center at RIT. Membership is free upon request. To register, go to: http://print.rit.edu/affiliates/ or call 585-475-4231.

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R·I·T Printing Industry Center

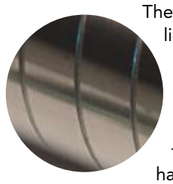
# print review

[ for Affiliates of the Printing Industry Center at RIT ] Volume 2: Winter 2005

this quarter in:

## news

### Professor Awarded Sloan Foundation Fellowship



The Printing Industry Center is delighted to announce that one of its researchers, Dr. Sandra Rothenberg, assistant professor at the Rochester Institute of Technology's (RIT) College of Business in the Department of Management, has been selected as an Alfred P. Sloan Industry Studies Fellow.

Dr. Rothenberg is one of only six faculty from across the country to receive this prestigious grant, awarded for the first time this year. Other recipients included faculty from: Columbia University (Pharmaceuticals), Massachusetts Institute of Technology (Biomedical Technology), New York University (IT Services), Northwestern University (Freight Transportation), and University of Michigan (Passenger Airline).



These competitive fellowships granted by the Alfred P. Sloan Foundation are intended to provide support and recognition to highly qualified scholars in the early stages of their careers on the basis of their exceptional promise to contribute to the field of industry studies, to the advancement of knowledge, and to U.S. industrial development and economic competitiveness.

Dr. Rothenberg's research will focus on environmental management and offshore outsourcing in the printing industry. She has previously authored/coauthored six research papers for the Printing Industry Center. Dr. Rothenberg's biographical and research information are available at http://www.cob.rit.edu/directory/bio.html?eid=32.

### Release of 2004 Research Monographs

The Printing Industry Center has released the initial research monographs from the 2004 program year research agenda. Research papers now available include:

- Selling Small and Smart: The Future of the Sustainable Enterprise
- An Investigation Into Printing Industry Trends
- Digital Printing Success Models: Validation Study (2004)

New research monographs will be released periodically over the next few months. To download these research monographs and get more information on the research agenda of the Center, visit http://print.rit.edu/research/.

## Investing in Digital Color Printing

Print services providers have been hearing that the cost of digital color printing is declining, but they need to understand that the business model goes beyond the cost of equipment and consumables. Not only do printers need to purchase equipment, maintenance support and consumables, they also must build the right infrastructure to deliver value-added digital color services to customers.

The Printing Industry Center at RIT surveyed 40 users of digital color technology to assess the real investment that was required to develop a successful business model. The 2003 report, entitled *Investing in Digital Color . . . The Bottom Line* (PICRM-2003-10), explains how the level of investment is directly related to the target market and application mix. Four clear market segments and investment levels emerged from the research.

#### Level 1: Quick Printing and In-Plant Printing

In the quick printing community, the acquisition of digital color equipment has centered on the fast delivery of colorful documents, with the primary customer base being the walk-in retail storefront. To support the primary applications (business cards, stationery, brochures), quick printers have digital color copiers that produce from 12 to 60 pages per minute and associated RIP technology, but no substantial information technology (IT) staff support. Based on interviews with Sir Speedy, Kinko's, and Triangle Graphics, the average quick printer spends about $0.10 on infrastructure per dollar spent on digital color equipment.

While the franchise segment of the quick-printing industry continues to contract, it nevertheless generated total sales in 2002 of more than $1.66 billion. The quick-print franchise corporate headquarters makes the infrastructure investment decisions that set the stage for what can be provided locally,

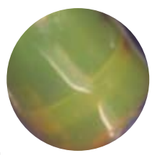
*continued on page 2*

## Investing in Digital Color *continued*

Another key finding was that IT is becoming critical to success. Firms that had implemented an Internet on-demand or fully customized communications model also employed the largest number of IT professionals. And third, the average digital color monthly print volume was significantly higher for those firms at market segment levels 3 or 4. Monthly impressions exceeded one million for those firms with a combination of good infrastructure and a solid base of IT professionals.

#### Help for the Print Services Provider

To make digital color profitable, the firm should assess the level of infrastructure investment after the target market and application mix are clearly identified. There is value in all four digital color business models, but firms can migrate up the value chain, ultimately deriving greater revenue streams from more advanced services.



Higher revenue growth potential is linked to expanded service levels that integrate database supply-chain management, Internet customer-facing applications, and document customization. This requires support infrastructure and appropriate IT staffing. For the printer without a substantial infrastructure already in place, application-service-provider (ASP) solutions are offered by third-parties that manage software-based services for customers (e.g., TotalWorks, JG Sullivan, PrintCafe, Printable).

Success requires more than making color prints better, faster and cheaper. To help print services providers, equipment vendors need to stop discussing the cost per sheet and start talking about the pathway to profitability. They need to assist their customers with more advanced applications including ASP options that give print services providers the ability to "rent" infrastructure. And as part of the sales process, vendors must make sure that the digital color printer has a business plan that reflects the true costs of building a successful business.

on the Web *view the full research monograph online at: http://print.rit.edu/research/*



this quarter in:

## research

1

### Critical Enablers for Successful Digital Printing

The initial assumptions of the research report, *The Role of Value-Added Services in Successful Digital Printing* (PICRM-2003-02), were based on exploratory research conducted by the Printing Industry Center at RIT in 2002, which identified four common characteristics of successful digital printers.

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### Inkjet Inks for Textile Printing

Decorating fabrics for clothing or shelter has a long history, and has evolved into today's textile printing industry. The combination of hundreds of fabrics, dyestuffs, and printing technologies makes understanding the properties of inks critical for excellent results. This article takes a look at the research of RIT School of Print Media graduate student Jorge Uribe on textile inkjet ink formulations.

*continued on page 3*

## Critical Enablers
*continued*

Successful digital printers:

- understand their customer base well
- define themselves as more than just printers by offering value-added services
- have balanced business models
- have well-defined Internet strategies.

To understand this more thoroughly, we surveyed a total of 147 digital and non-digital printers from a panel of commercial printers in 2003. We defined "successful" digital printers as those who answered yes to the question, "Is digital printing meeting your expectations?" Of the 75 responding digital printers, over 70% indicated that digital printing was meeting, and in many cases exceeding, their business expectations.

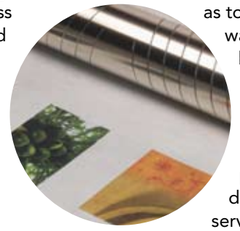
### Understand the Customer

Firms successful with digital printing are those that understand their customer base and develop solutions targeted to specific market segments. Almost one-third of the successful digital printers in our study built a industry-targeted business model, while only 19% of those who were less successful had done so. Prior to a major investment in technology, the successful firms identified customers and prospects. Successful firms build business based on customer needs.

### Add Value-Added Services

Print services providers have traditionally been defined by output technology, such as commercial color, sheetfed, web offset, or large format. But our research showed that, across the board, printers are increasing their focus on value-added services to protect their customer base, grow revenues, and increase profitability. In the survey, 53% of the successful digital printers reported significant increases in non-print services revenues over the past three years, versus 27% of those less successful. The primary focus of successful digital printers is building service portfolios and positioning their companies to provide business communications solutions and services.

### A Balanced Business Model



A clear management vision led four successful digital printers we interviewed to build a support infrastructure consistent with that vision, and put in place before they invested in a single print engine. They hired strong technical resources to deliver value-added services, and had the financial resources to stay the course. These digital printers are reaping the benefits of these strategies, as evidenced by double-digit revenue growth in a down economy. In analyzing these firms, we saw an extensive investment in databases, digital asset management, workflow, list management, and creative support for template-driven solutions.

We also found that digital printers continue to rely on multiple revenue streams (Table 1). However, successful digital printers rely less on traditional offset technologies in their overall revenue streams than do less successful printers and non-digital printers.

### Internet Strategy

The Web is a critical enabler for streamlining processes that involve client interaction. The successful firms have embraced the Web and leveraged it to reduce operational costs as well as to expand reach. There was a significant difference between successful and less successful digital printers regarding the number of Internet services offered and the percentage of respondents who offered these services. These services included ordering online, FTP drop boxes, and integration with supply-chain management systems.

### Conclusion

Our survey data reveals that the level of implementation by the average printer is still quite limited. To energize the market, firms should identify target markets, assess how to fully web-enable their businesses, and acquiring the infrastructure needed need to deliver the more complex personalized applications that drive the digital color market.

Table 1. Sources of Current Revenue for Commercial Printers

| Sources of Current Revenue | Non-Digital Printers (n=72) | Digital Printers (n=75) | Successful Digital Printers | Less Successful Digital Printers |
|---|---|---|---|---|
| Offset Printing | 80.6% | 57.1% | 52.7% | 67.5% |
| Color Digital Printing | 5.4% | 12.0% | 13.6% | 7.2% |
| B&W Digital Printing | 9.9% | 15.7% | 17.0% | 11.0% |
| Large-Format Printing | 4.6% | 6.8% | 6.3% | 5.7% |
| Non-Print Services | 15.8% | 14.4% | 13.8% | 16.0% |

on the Web *view the full research monograph online at: http://print.rit.edu/research/*

## Investing in Digital Color
*continued*

and the franchisee generally cannot afford to evolve to a more service-centered digitally-enabled market model.

For companies with in-plant operations, the primary technology infrastructure emphasis is on file-transfer support, digital color copiers, and RIP technology. With more than 10,000 U.S. in-plants, the market invests about $0.30 for every dollar spent on digital color equipment based on its need to serve a multiplicity of end users. However, in-plants are already starting the migration to higher-level production digital color, and will need to improve their infrastructure to support more advanced applications.

### Level 2: Commercial Print

Traditional commercial print firms placed the initial focus for their digital color investment on short-run, quick-turnaround, on-demand jobs. Their emphasis was on delivering "virtual litho" quality with digital color technology. These firms have added online access to marketing support materials, combined with databases for repetitive print-on-demand capability. Their goal now is to become an integral part of the customer's supply chain for marketing materials. The overriding value proposition for online print supply-chain management includes content currency, inventory management, timeliness, and reduced inventory obsolescence. For every dollar these printers spent on digital equipment, another dollar was required for additional infrastructure, including software and staff support.

### Level 3: Internet On-Demand Services

Internet on-demand services can be defined as web-to-print marketing systems that provide an easy-to-use browser interface. Customer service and marketing collateral can be customized to specific groups and then personalized with information provided in a database, creating one-to-one marketing pieces. Such applications have demonstrated success in digital service providers such as RT Associates, with a 23% year-over-year growth rate, and Lexinet, who saw a 34% increase in revenues.

To support this level of application development, these firms invested heavily in infrastructure. Mimeo.com is a digital color organization with its document production facility in Memphis, adjacent to the runway of FedEx's and UPS's shipping hub. Mimeo's equipment investment was approximately $2 million, and its infrastructure costs have exceeded $6 million. In most instances, these firms spent a minimum of $2 on technology infrastructure and support for every dollar they invested in digital color technology. And at least 10% of their employees have IT backgrounds.

### Level 4: Fully Customized Communications

Service providers at this level support their clients' Customer Relationship Management (CRM) initiatives, and have leveraged digital technology to produce high-quality, variable data campaigns. They have the ability to build documents that include variable text, pictures, graphics, and barcodes, and to merge data. Using conditional logic, a dynamic document is created in which the entire layout varies with the input. The result is a document designed for the individual recipient. These firms can publish documents as printed pages, e-mails, web pages, PDF documents, SMS messages, XML files, or faxes.

Firms delivering applications at the highest levels of complexity, like Salt Lake City-based Rastar Digital Marketing and Royal Impressions of New York, indicated that for each dollar they spent on digital color equipment, they spent $2.00 to $3.50 to support the application. These firms employ programmers and marketing specialists who can relate to the corporate marketing executive.

### Key Findings

Across all of the firms we surveyed, for every dollar spent on digital printing equipment, an average of $1 was also invested on infrastructure, including networking, software, server technology, and support. The fastest-growing establishments had the highest levels of investment in infrastructure (see Table 3).

Table 3. Annual Growth and Ratio of Investment of Selected Firms

| Firm | 2002 Growth | Ratio* |
|---|---|---|
| RT Associates | 23% | 3.5:1 |
| Digital Marketing Inc. | 30% | 2:1 |
| Lexinet | 34% | 2:1 |
| Royal Impressions | 41% | 2:1 |
| Mimeo | 100% | 3.5:1 |
| PsPrint | 50% | 1:1 |

* Ratio of Technology Infrastructure Investment to Equipment Investment

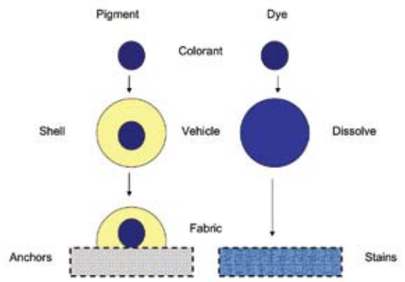
*continued on page 4*

## Textile Printing
*continued*

### Basic Ink Properties and Textile Printing Challenges

Printing inks vary widely in chemistry and use, though all inks are composed of colorants, vehicles, additives, and carrier substances. Colorants are divided into two groups. Pigments are colored particles that are insoluble in the ink vehicle and need a binder to attach to a substrate. Dyes are organic compounds that are present in molecular form and soluble in the vehicle. They penetrate the fibers and stain them in the process. Vehicles (binders) are resins dissolved in mineral oil to anchor the colorant to the substrate, aid in ink drying, and bring the colorant into printable form. See Figure 1.

Figure 1. Colorants




Most printing inks used today are pigment-based due to their higher stability, easier handling, and independence of the substrate. However, both inkjet printing and some types of textile printing still use dyes. Textile printing by itself brings a range of new challenges to printing. Textiles have physical properties not present in paper—they stretch and are flexible, and have porous and textured surfaces. Textiles will be exposed to harsh conditions like washing, exposure to direct light, heavy wear, abrasion, and perhaps dry-cleaning. Finally, fibers have much greater absorbency than printing papers.

The key for proper printing of textiles lies in the selection of the dyestuffs according to the fiber content of the fabric, as shown in Table 2.

### Demands on Textile Inkjet Inks

Dye-based inks are widely used for textile inkjet printing. They offer bright colors and work well with water for low viscosity and high purity formulations. However dyes tend to be unstable, to lack light fastness, and to spread through the fibers, generating poor quality prints. Pretreating fabrics with pad liquors and post-steaming or heat fixation are common practices to insure better quality and fastness.

Alternatively, pigments are easier to apply, more stable, and provide overall better color fastness. However, proper ink formulations of pigment particles in the nano and micro levels have been extremely difficult to achieve. Appropriate pigment formulations require at least 15% of polymer binders in the mix to maintain acceptable fastness. This increases the viscosity of the inks, causing nozzle clogging.

Recent research has focused on improving pigmented inkjet inks. Georgia Institute of Technology has tested nanolatex and microlatex compounds as binders with some success for both inkjet and xerography. Microreactor technology is an alternative that enables precise and controlled synthesis of colorants, generating very small particle size and narrow distribution of high-purity pigments. Also, novel multi-functional polymeric dispersing agents (MFDA) can be used to replace the typical binders, providing increased dispersion stability and a permanent attachment to the pigments, generating no agglomerations and controlled viscosity of the inks within the printheads.

Table 2. Dyestuff-Fiber Combinations

| Colorant | Fiber | Interaction (Bonding) |
|---|---|---|
| Reactive dye | Cotton, viscose rayon, silk and wool | Covalent bonding |
| Acid dye | Silk, wool and polyamide (nylon) | Electrostatic, Hydrogen bonding |
| Dispersed dye (sublimation) | Polyester | Hydrophobic – Solid state mechanism |
| Pigment | All fibers | Complex polymer bonding mechanism |

### Innovative Products

So-called 'smart' or 'intelligent' clothing is a reality. Sensory Perception Technology (SPTTM) adds tiny droplets to fabrics, surrounded by waterproof particles. They are washable and cleanable, and are only activated by movement and touch. SPTTM droplets can contain moisturizers, deodorant, fragrance, fresheners, mosquito repellents, and even anti-tobacco agents.

Nuva® is a compound made of fluorocarbon emulsions that, when added to fabric, decreases its surface tension, creating water- and oil-repellent clothing. Rayosan® compounds are special UV absorbers that attach to fabric and improve its protection against sunlight.

### Conclusion

Although the textile printing market is only about 0.1% inkjet in 2004, by the year 2010 the use of inkjet is projected to jump to 10% of the textile market. The future of textile printing and ink formulations will surely be full of challenges and possibilities, limited only by our imaginations.

on the Web *read the full article at: http://print.rit.edu/e_review/200412ereview.html*