Design to Production: The Critical Interface

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A Research Monograph of the Printing Industry Center at RIT

September 2002

No. PICRM-2002-06

R·I·T Printing Industry Center
An Alfred P. Sloan Foundation Center

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With Thanks

The research agenda of the Printing Industry Center at RIT and the publication of research findings are supported by the following organizations:

Rochester Institute of Technology
Alfred P. Sloan Foundation

Adobe Systems Incorporated
Baldwin Technology Company, Inc.
Creo Inc.
RR Donnelley
Heidelberg
hp indigo
IBM Printing Systems
Kodak Polychrome Graphics
MAN Roland Inc.
MeadWestvaco Corporation
NexPress Solutions LLC
NPES
VIGC
Weyerhaeuser
Xeikon America Inc.
Xerox Corporation

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Abstract

The commercial printing industry serves nearly every other business and organization in the economy by maintaining a broad range of capabilities to produce printed goods and related services. Print designers use software tools that best suit their needs for creating file sets to submit to the printer. The process by which these customer files are processed and converted into formats compatible with print manufacturing is complex and heavily dependent on computer technology that has been evolving rapidly over the past several years. As capable as this technology is, the process of file conversion is still far from automated and file conversion normally involves costly error and rework as the printer and client make final adjustments to the process. Some of this is caused by shortcomings in the technology. But much is the consequence of practices deeply embedded in the long-established culture of print purchasing. This paper reports on the current state of the interface between print design and print production as evidenced by information gathered through a number of plant visits, interviews, and a survey of large print buyers all conducted during the first half of 2002.

Introduction

The devil is in the details. In no domain is this truer than in the interface between print design and print production. As jobs become more complex, runs shorter, turnarounds faster, and prices lower, printing companies are realizing that well-engineered production processes are essential to maintaining profitability.

We start with a simple question: "What is the current state of the interface between print design and print manufacturing?" In this paper we will investigate current practices in the commercial printing industry for converting customer file sets into finished data streams compatible with the front end of print production processes. For analog printing processes, the scope of this paper begins with customer files in the front door and ends with correct plates ready to run on press. For digital printing processes, the end point is not a set of plates but a data stream that drives the printing press directly.

Much has been written in the past decade about printing companies at the leading edge of the technology curve. But in an industry as fragmented as commercial printing, it is possible to find almost any story to support almost any claim we might want to make about industry characteristics. For example, some companies have established internet-based "storefronts" that enable them to receive jobs submitted by clients over the network. Other companies provide sophisticated digital asset management services for some of their clients. Still other companies have specialized in niche markets and have built standardized workflows with their customers that allow a high degree of automation of the preproduction process.

The danger in such a highly fragmented industry is that the exceptional stories nearly always get more ink than stories about daily life in the mainstream of the industry. This can lead to alienation of the people in the trenches from the companies, organizations, and individuals that serve the industry.

We decided to take a fresh look at the commercial printing industry through a series of interactions with companies and the actual people who lead and manage them. Our approach was to try to form as clear a picture as we could in the six months we had available of common practice in the industry with regard to the input and processing of customer files as well as other relevant aspects of operations.

We limited our study to companies that had fully implemented computer-to-plate (CTP) workflows. We also limited our study to general commercial printers specializing in lithographic printing. A few of the companies we studied have acquired digital printing presses in the past few years, but this represents only a small percentage of the overall activity influencing our findings. We did not impose any other selection criteria on the companies included in the study.

Although this study concentrates on the design-to-production interface, we approached the companies with a broad range of questions related to business strategy, management philosophy, accounting practices, process control, waste reduction, and other issues. The interview guide we used is included in Appendix 1.

The purpose of this study is to establish a set of research questions that the Printing Industry Center believes are critical to the future of the industry. In the final section of the paper, we describe research projects designed to address the most important of these questions in the coming year.

RESEARCH METHODOLOGY

We conducted numerous plant visits and interviews starting in January and extending through July 2002. We visited commercial printing companies in three geographic areas: Rochester, New York, northern New Jersey, and Chicago. The companies ranged in size from approximately $4 million to $50 million in annual sales.

Commercial printers typically service several hundred different customers ranging from small one-time jobs to large accounts with constant repeat business. The range of estimates of average number of unique customers per year over the past five years among the companies we studied was from 200 to 1,200. The largest single customer in terms of percent of annual business at any of the companies accounted for roughly 40 percent of the business of the firm.

We also visited two Rochester-based companies that specialize in label and flexible packaging printing, as well as one prepress company and three advertising agencies. In addition to these plant visits and on-site interviews, we also conducted numerous discussions at RIT or over the telephone with industry practitioners who had interesting things to tell us about the industry in which they work.

A few of the companies we interviewed asked us to sign a confidentiality agreement before they would agree to talk to us. We decided to treat all of our discussions with the same level of confidentiality as was stipulated by the most demanding agreement we signed. We have therefore left all company names and any information that might identify a specific companies out of this paper.

In addition to company interviews, we also conducted a survey of major print buyers who were participants in a one-day seminar program sponsored by Pictorial Offset Corporation in Carlstadt, New Jersey. The survey focused on the color approval process.

This paper also references some statements made during a focus group that the Printing Industry Center hosted for the Xerox iGen3 development team with five major in-plant managers currently running digital printing operations. Although this focus group was organized by the digital color printing research team, much of the discussion dealt with workflow problems and proposed solutions.

Research Findings

The following section details our research findings. We present these in a narrative format that begins with a general discussion of the state of prepress technology within these companies and the attitudes we found toward new technology.

PRINTERS AND TECHNOLOGY

In the past few years, we have expended a lot of energy talking about process integration and the technologies that will enable the industry to leap to the next level of productivity. No single technology taken alone is capable of causing such a leap to occur. CTP devices without workflow software that incorporates preflighting, trapping, imposition, etc., is rather useless. Only when all of the component technologies required to create a new system come together, does the industry experience a quantum leap in productivity.

There is solid evidence everywhere we look that CTP represents one of these leaps in productivity. The process of converting customer files to press-ready plates can now be accomplished with far less labor and in less time than before. All of the printers we studied have experienced this quantum leap and were unequivocal in their enthusiasm for the technology that has made it possible.

ATTITUDES TOWARD "FUTURE" TECHNOLOGY

Even though the printers we talked to are quite enthusiastic about technology that serves them well today, there is little interest in "technologies of the future." For example, when we asked printers what they thought about JDF (Job Definition Format), we were met with a range of responses from stone-cold silence to skeptical shrugs. One comment worth repeating was uttered by a prepress manager with a wry smile on his face: "Will JDF prevent customers from changing their minds at the last minute?"

As a robust information packaging format, JDF will undoubtedly have many uses in the future. But there is clearly a lot of misunderstanding about exactly what JDF is. One problem is that printers have historically shown little interest in enabling technologies for their own sake. Printers get interested in technology only when it delivers something tangible to them.

A good example of this is PDF. For many years PDF was promoted as an all purpose solution to problems ranging from customer input to prepress production. PDF is even used as the encoding language for the portable job ticket format that is a precursor to JDF. Yet it wasn't until PDF became the internal format embedded in several of the most popular CTP-workflow systems that PDF came alive for printers.

A common question about JDF that we hear from printers is, "What does JDF do?" This question may be partially grounded in a fundamental misunderstanding of what JDF is. But the question also reflects a general disinterest among printers in future-oriented technologies that do not solve immediate business or production problems.

The vast majority of commercial printers will buy JDF when JDF is embedded in practical subsystems that deliver tangible and immediate ROI (return on investment). But they will not necessarily know or care that they are buying JDF. They will be buying modules that preset their printing and finishing processes to reduce setup costs, or modules that allow their customers to submit corrections without hassle or exorbitant cost overruns.

There is clearly a downside to premature promotion of new technologies such as JDF before they are ready to deliver tangible benefits. In some of the companies we studied, we found individuals who play the role of "technology guru." These individuals retain their guru status by keeping up on emerging technologies — the more difficult to understand the better. In a few cases, the company guru was an owner. However, most small companies do not have the resources to spend the time necessary to properly understand and track emerging technologies such as JDF. Vendors who are too far out ahead of the market with their promotional messaging risk being perceived by their more pragmatic customers as purveyors of high-tech "snake oil."

The skepticism about the potential value of JDF has been fueled by the association of JDF with many of the outrageous claims that were being promulgated during the "dot.com" craze. Claims that Internet-based integrative technologies were going to deliver wheelbarrows full of new revenue as a result of productivity gains were tied to powerful new technologies that had XML written all over them.

Printers never believed that they would be the beneficiaries of technologies that would install them at the chooser level on their customers' desktops. Some of the printers we interviewed have participated in Internet-mediated reverse auctions. One company told us that they would spend a lot of money preparing for an auction, only to find that the bidding always fell below their lowest possible price. When we asked of all of the printers we interviewed, "What would you most like to learn about your competitors?", the response in three cases was, "We would most like to know how in the world they can afford to charge such a low price." With an industry running so far under total capacity, reverse auctions are death, and everyone knows it. Insofar as JDF is associated with past bad experiences with Internet-enabled business, it triggers a negative reaction among printers that will be difficult to overcome.

INPUT FORMATS

All of the companies we studied said that they would accept input files from any document creation applications their customers used. The most prevalent input formats are authoring application file sets. The leading authoring application today is QuarkXPress™. A small percentage of customers of the companies we studied are submitting PDF at this point. There is a clear preference among the printers we interviewed for application file sets because they are most easily corrected.

CTP: A TRUE REVOLUTION

All of the companies we studied had CTP systems with workflow systems at the front end and digital color proofing. Generally, companies are highly satisfied with the workflow systems they have and do not believe that other systems offer any potential advantages. Choice of system seems to commonly come down to natural evolution of legacy systems. We repeatedly heard comments like, "We bought the ____ because we were always a ____ shop." All of the companies we studied had only one CTP device with little concern about the need for redundancy. (The general excellence of the hardware available today is reflected in the ambivalence of print buyers toward the equipment owned by the printing companies they hire. When we asked print buyers, "Does the brand of press equipment that printing companies own affect your choice of printer?", 82% answered in the negative.)

The three major technological improvements given by the printers we studied leading to productivity increases in the past five years are CTP, workflow systems, and computer system speed and capacity increases.

Among the companies we studied, the earliest adopters of CTP technology bought first-generation machines in the 1995-96 time frame. These companies were on the "bleeding edge" because front-end systems were not well developed at that time. Over a period of five years or more, these early adopters have slowly acquired the technology to properly support the CTP systems. Faster computers, larger capacity storage, faster networks, and workflow systems, have all dramatically improved. Because the supporting technology lagged behind the CTP devices, early adopters did not realize significant productivity gains all at once.

In contrast to the early adopters, companies who made the complete transition to CTP in the past two years have enjoyed a much more dramatic and immediate increase in productivity as a result. One of our focus companies held back on the acquisition of a CTP system for two years before the company was sold to its management team by its parent. The parent company was unwilling to make significant capital investments in the company while it was looking for a buyer. When the new owners finally made the investment in CTP, the payback on the system came quickly.

It appears obvious that from the first year that CTP technology became available to the present, the payback time for the investment in CTP and supporting systems has decreased. It would be very interesting to do a correlation study between the date of initial investment in CTP technology and the period of ROI.

Workflow systems have brought huge gains in productivity. The normalization of input file formats to a common standard has greatly increased the versatility of printers with respect to customer file types that can be handled. One of the prepress managers we interviewed said, "We have yet to find a customer file that our workflow system can't handle." We found a high level of satisfaction among the companies we studied with the capabilities of their prepress workflow systems.

It is only very recently that computing power is catching up to the demands of high-resolution graphic file handling. The "dot.com" crash actually accelerated the improvements in computing infrastructure in many printing companies by flooding the market with vast quantities of high-powered information technology at bargain-basement prices. One company we studied acquired most of its high-end servers and workstations from eBay liquidation sales.

The required computing power for any given application is more a function of processor speed and memory than of any other factors. Without enough of either for a given task, computers are not able to keep up with the work pace of the people operating them. Without adequate amounts of memory, computers often slow to a crawl or crash. Worse are the subtle problems that introduce artifacts in processed images that are not detected until the job is running on press or even later.

There is a strong sense among the prepress production people we interviewed that the information technology infrastructure is finally getting to the point where it can fully support the applications that they are using. It appears that this is a threshold phenomenon. Below the threshold of enough computing power for any given application, productivity is dramatically curtailed. Above the threshold, productivity gains become incremental with increases in processor and network speed.

Again, companies that invested early in CTP technology, long before the computing infrastructure could support the technology, did not see the kinds of dramatic gains in productivity that later CTP adopters have seen. For the early adopters, CTP devices were like an F-16 fighter jet in the driveway — of limited use unless you also have the supporting infrastructure.

JOB TURNAROUND

All of the companies studied have achieved significant improvements in their ability to quickly process customer files and return color proofs. In most cases, companies are now producing the first set of color proofs in 24 hours or less. Two companies we interviewed made special mention of their "in by five p.m., proofs by eight a.m. the next morning" capabilities.

When we asked about job turnaround times, nearly all of our subjects focused on the time that elapses between job submission and delivery of the first set of contract color proofs. In our survey of print buyers, we asked how many contract proofs on average the printer makes before receiving their final approval. The median response was two.

It is clear from this survey response that the clients normally use the first color proof to inform their final adjustments to the color in the files. In the words of one prepress manager we spoke to, "Customers tweak their files after they see our first color proof."

This issue of the role of the contract color proof in the design process is important. 60 percent of the print buyers we surveyed said that they first saw an accurate representation of the color appearance of the final printed product on the contract color proof made by the printer.

Question: At what point in the design process do you first see a color proof that accurately shows the color appearance of the final printed product? Respondents were given four choices:

1. On one of our company's color monitors
2. On a desktop color proof made by us, not the printer
3. On a contract color proof made by the printer
4. On press

As you can see in Figure 1, more than 75 percent of the respondents claim to first see what the colors in the job will actually look like at the contract proofing stage or later. Less than 25 percent of the respondents are seeing accurate color before they see the first contract proof.

CONTRACT PROOF TO PRESS CALIBRATION

All of the printers in our study have digital contract color proofing systems. All of them require a customer sign-off on their own color proofs, regardless of whether contract proofs accompany the job files. All of the printers have calibrated their proofing systems to match their presses. The terminology used for this calibration differs from plant to plant. We heard terms like "fingerprinting," "calibrating," "balancing," etc. We did not hear anyone use the term "color management" to describe the process of calibrating proofing systems to match press conditions.

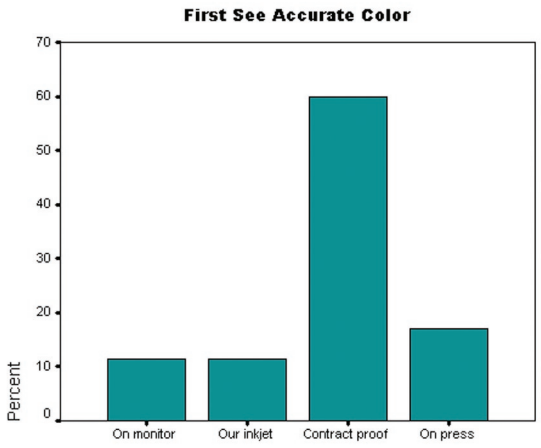


Figure 1: When Do You First See Accurate Color?

When we asked whether the proof-to-press color agreement they were able to achieve was adequate to satisfy their customers' expectations, every printer we interviewed answered in the affirmative. The percentage of jobs for which the customer conducts an on-site press OK appears to be trending downward. Printers reported percentages between 20 and 50 percent. In our survey of print buyers we asked, "For what percentage of your work do you conduct press OKs at the printing company?" The median response was 40 percent. The range of responses to this question was interesting — from 0 to 100 percent. See Figure 2 for the distribution.

This distribution reveals an important fact about print buying — one that we should try to understand better. It is clear from our interactions with printers and with print buyers that the current generation of digital contract color proofing systems do a very good job of matching the appearance of the images that will be rendered by printing presses when they are properly calibrated. Both printers and print buyers expressed a high degree of confidence in the accuracy of the color proofing systems they were using. Why then is there such a wide distribution of responses to the above question? Why do some buyers conduct no on-site press approvals and some do it for every job?

The answers to these questions cannot be explained by technology capabilities alone. There are business cultural issues that must come into play. Press approvals are mandated in many cases regardless of the need. Every company we visited made a point to show us their facilities supporting the customer press approval process. Regardless of the size of the plant, the general rule about these facilities is that they are very comfortable, well furnished,

bordering on opulent in some cases. Some are decorated like theme restaurants (see Figure 3).

In our survey, more than 20 percent of the respondents said that they first viewed accurate color on their own color monitors or inkjet proofs. Thus, we know that some companies are making effective use of color management technologies to visualize the final product early in the production cycle.

It is important to distinguish among three different types of color, presenting three different sets of challenges. These are process color, Pantone® colors, and special colors, such as metallics and fluorescents, outside of the Pantone set. Current digital color proofing technologies are able to provide an accurate enough simulation of process color work to serve the majority of clients and obviate the need for press approvals. Most of the printers in our study told us that the trend for process color work is away from press approvals. The majority of customers are signing off on digital proofs and trusting that the printer will match the proof.

Pantone colors present a more difficult challenge. However, proofing technologies such as Kodak Approval Recipe Color and Matchprint Custom Color are capable of providing an accurate simulation of most of the Pantone set.

Special colors outside of the Pantone set that cannot be simulated by any digital color proofing system present an even greater challenge. These can only be simulated by actual ink drawdowns. Some printers report that their customers forego the press OK even when the job contains special colors. The most commonly identified factor in eliminating press approvals beyond the obvious technological factors is trust: "Our customers trust us to do the job right." We heard this assertion expressed in several of the companies we visited.

In all cases in our study, the importance of the digital color contract proof made by the printer is paramount. The majority of print buyers are relying on the printer-made contract proof to provide the first accurate view of the final appearance of the job. Printers are relying on the accuracy of the proofing system to ensure they can meet the visual expectations of their customers. Digital color proofing is good enough to eliminate the need for press approvals for the majority of jobs produced by a typical commercial printing company.

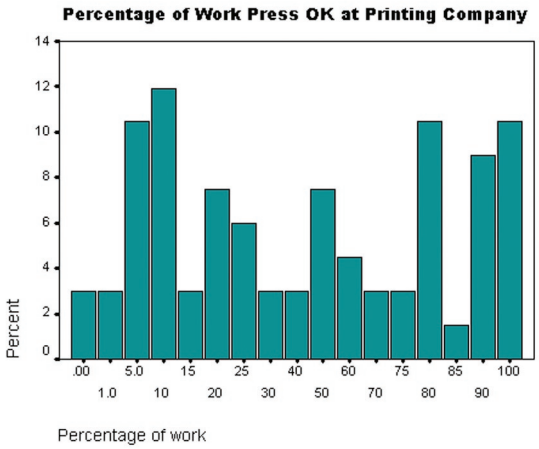


Figure 2: Percentage of Work Requiring Press OK at Printing Company

Figure 3: Customer service room at Mercury Printing, a commercial printing company located in Rochester, New York

USE OF CONTRACT PROOF AS DESIGN TOOL

There is strong evidence that print buyers "do not know what they want until either they see it or they see what they don't want." The majority of buyers surveyed are waiting until they view the first color proof produced by the printer before they know precisely what they want. Because additional iterations through the proofing process produce additional revenue for the printer, there is not a particularly strong incentive for printers to help their customers calibrate their own color proofing systems to give a more accurate first view of the job.

In our survey of print buyers, more than 75 percent said they viewed two or more contract color proofs made by the printer before signing off. Only 22 percent said they viewed only one proof on average. This would seem to correlate well with the percentage of buyers who claim to view accurate color on their monitors or on their own inkjet proofs (22.8% total). However the correlation is not that strong. Respondents who claimed some success with color management require almost as many contract proofs (1.7) as respondents who did not claim success (2.0).

The key to providing accurate color visualization prior to contract proofing is clearly color management. When we asked print buyers about how well they understood color management technology, 40 percent of the respondents said they did not fully understand it. Another 10 percent claimed that they had tried and failed to make color management technology work and nearly 50 percent claimed that they had successfully implemented "some form of color management" (see Figure 4).

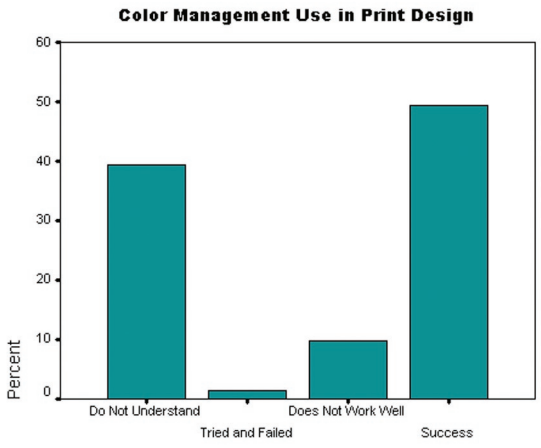


Figure 4: Color Management Use in Print Design

If we carefully ponder all of the information we have gathered about current practice in color specification and approval, some interesting probabilities begin to emerge. There may be a significant opportunity for some print buyers to have a better preview of the final appearance of their jobs than they currently have. But, current color management technology is probably capable of reducing the number of contract proofs that the printer makes before receiving final approval. Current color management technology is probably too complicated for many print buyers to use effectively. If print buyers were better educated about the capabilities and techniques of current color management software, they would probably be able to reduce the cost and/or increase the efficiency of their print media buy.

OTHER PROBLEMS WITH CUSTOMER INPUT

Color is only one aspect of a print job that is problematic. In each of the printing companies we studied, we asked what the single most common root cause of rework was in the prepress operation. "Human error" was the universal answer. According to the printers the error almost always occurs before the job gets into the printing plant. "Designers don't know how to design for production," is a refrain we heard time and time again. It is worth noting that this has been a common lament among printers since the first desktop publishing files appeared in the mid-1980s.

Printers who have been in the business for a long time and can remember the days before desktop publishing tend to fall back onto comparisons with the way things used to be. "You always used to know exactly what the job was supposed to look like. Now you never know for sure." The prepress manager at one of the commercial printing companies we visited made this statement, which underscores one of

the ironies of the digital age. Digital technology enables designers to create perfect files as input to the print production process. But digital technology also provides endless opportunities for designers to produce broken files that need to be fixed before they will work. The fixing of flawed files still accounts for a major amount of rework in print manufacturing. The total value of rework attributed to flawed customer files across the industry has not been quantified.

The file-fixing process has been significantly streamlined by preflight software. Preflighting is a standard procedure in all of the companies in our study.

When we asked printers what percentage of their customers submit files containing RGB color data, the answer was nearly unanimous. "It is very rare that we see RGB, and if we do it's usually a mistake." Some of the printers we interviewed said that they never see RGB files.

"PLAIN VANILLA" CMYK

How do print buyers create CMYK color files? Among the printers in our study the universal response to the question was, "We have no idea how they make their CMYK files." In no case did the printers we interviewed supply their customers with profiles for their presses. The vast majority of CMYK color image files would appear to be made using the default Photoshop mode conversion from RGB to CMYK. We suspect that very few users ever go beyond this most fundamental approach to color transformation.

Most commercial printing clients are therefore using default color lookup tables and relying on the contract proof made by the printer to visualize the final product. Some clients are using some measure of color management to obtain a better prediction of appearance earlier in the production cycle.

Nearly half of the print buyers we surveyed claimed to have achieved some success with color management. The exact nature of this success is not clear. For example, when we average the number of contract proofs these buyers view before final signature, the number is only slightly less than for the buyers who said that they have not been successful using color management (1.7 versus 2.0). A more comprehensive study of current practice among print buyers with existing color management tools is recommended.

HOW IMPORTANT IS COLOR ACCURACY?

The effective communication of color intents from client to printer has been a topic of heated debate since the advent of off-press color proofing. One factor that adds considerable complexity to the debate is a poor understanding of the importance of color accuracy across the many markets served by the printing industry.

In an interview with an account manager for a printing company specializing in direct mail, we asked what percentage of the company's clients conducted press approvals. The account manager estimated that about 40 percent of jobs still include a client press approval. We asked whether the account manager believed that the extra expense incurred by the print buyer to conduct the press approval added anything to the response rates they experienced. The account manager said, without hesitation, "No."

HOW GOOD IS GOOD ENOUGH?

This leads us into an area of research that we believe is critical to the future of the industry. There is clearly a lot of money being spent by print buyers to obtain "premium" color print quality. In our survey of print buyers, we asked the respondents to agree or disagree with the following statement: "Good enough color" is never good enough for our applications. Nearly 70 percent (68.6) of the respondents agreed with this statement. When asked to agree or disagree with the statement "Premium-quality color is critical to the image of our company," 89 percent of the respondents agreed (see Figure 5).

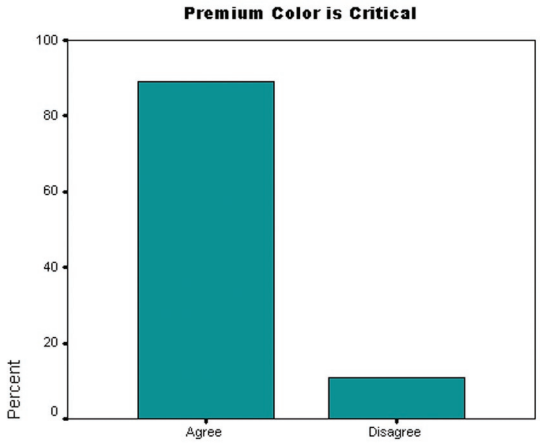


Figure 5: Premium Color is Critical

What justifies these convictions? What exactly is "premium-quality color?" Only a small percentage of our survey respondents (3 out of 77) declined to either agree or disagree with the statement regarding premium-quality color. The vast majority of respondents seem to indicate that they know what it is and that it is important.

This reminds us of what US Supreme Court Justice Potter Steward said in 1964, when asked to define "obscenity." Stewart said, "I know it when I see it." The underlying reality in color print buying is that the client does not know what he wants until he sees something physical. In common practice today, that something is the contract proof made by the printer. Print buying is like buying a bottle of wine in a fine restaurant. The purchase is agreed to only after the wine has been tasted. But unlike the wine tasting analogy, where the first bottle is rarely rejected, in print buying the first proof is usually not acceptable. Print buyers are like wine tasters who routinely send the first bottle back but pay for it anyway.

The printer does not necessarily find this arrangement to be problematic. If the client is willing to pay for correction cycles after seeing the first set of proofs, the printer will happily regard his contract proofing service as a profit center. Viewed from the micro-economic perspective of the printer, more proofing cycles is a good thing. But these cycles increase the cost and reduce the ROI of print when compared with other media.

The true meaning of the expression "premium-quality printing" is not clear. In many cases, small changes are made based on subjective preference that has no connection to any measurable quality of the finished product, as an end user will value it. The justification for these changes may be based solely on the preferences of the buyer. Among other skills, print buyers are paid for their ability to demand and verify premium-quality service.

This tendency of print buyers to be difficult to please is reinforced by the capabilities of the human visual system to detect small differences in color appearance when objects are viewed side by side. The end user will never judge the quality of a printed product by comparing it to the proof. In some cases, such as in packaging, end users will see printed products side by side with copies from the same or different press runs. This argues for strict control of production processes. But it calls into question the true value of the effort spent tweaking the pre-reproduction process in the last stages. How much of the effort associated with press approvals in a given market actually translates into increased effectiveness of the product? Given the capabilities of current color management technology, are press approvals really necessary in direct mail applications, for example?

Significant expense is associated with fine-tuning during the last stages of print pre-

production in almost every product category. This fine-tuning is done in reference to the perceptual capabilities of the print buyer. What the buyer sees and what the end user sees are quite different. What matters to the success of the product in the marketplace is entirely a function of what the end user sees. Understanding the tolerances around end user perceptions is key to establishing targets for automated manufacturing processes that do not require hands-on fine-tuning. In the absence of understanding what the end user requires, the need for hands-on fine-tuning will never go away, regardless of improvements in technology.

What do end users see? How does this translate into quality requirements for print manufacturing? The Printing Industry Center will be assembling a panel of print buyers to complement its existing panel of commercial printers. Print consumers are a third population relevant to this line of research. Print consumers have been largely ignored by the industry in the past. There appears to be much potential opportunity for print buyers and print producers alike to learn more about the perceptions, preferences, and behavior patterns of print consumers.

CONTRACT VERSUS JOB-ORIENTED BUSINESSES

All but one of the companies we studied described their businesses as job-oriented. One company, a printer specializing in label and packaging applications, said that the majority of their business was contract-based with the typical contract negotiated and renewed annually. All of the companies we studied are implementing practices to increase customer loyalty. The two approaches are through improved service and through offering new value-added services.

The job-based companies tend to emphasize improved service. The most frequently mentioned improved service is quick turnaround of estimates, contract proofs, and the job itself. Of these three, it appears that the quick turnaround of proofs is the most critical point of competition. Several companies told us that they had either a 24-hour or overnight turnaround of customer files to proof (in by five p.m., out by eight am the next morning).

Figure 6: A Chicago-area printing company, March 2002

This is consistent with our discovery that the average job involves two rounds through the contract proofing cycle. The ability to give quick feedback to the client is important, because the first set of proofs usually leads to additional work on the client side.

A few of the printers we studied offer Internet-based proofing services to their customers. This enables them to get their first look at the proofs without having to wait for physical delivery. In some cases, print buyers are willing to give their final OK after seeing only an electronic proof supplied by the printer in conjunction with their own color-managed hardcopy proof. The printers who have had success with this kind of proofing all stressed the importance of trust in the relationship with their customers. "They have learned to trust that we will print the job correctly," is how one of them expressed it. This trust is often earned after a weaning process where customers see with their own eyes that the printer can consistently match the proof.

Another important category of improved service has to do with consultative sales. Traditionally, printing sales has been more personality-driven than data-driven. This has changed dramatically. Now clients are driven

by the bottom line more than ever, and salespeople have discovered that they can often succeed at winning a contract by questioning the assumptions of the RFQ and offering alternative solutions to the ones implied therein. Understanding what the client is trying to accomplish with print and being able to offer creative ideas that deliver better ROI than the original concept is often what distinguishes the successful commercial printing company today. Straightforward bidding on print jobs given the overcapacity of the industry inevitably leads to commoditization and low profitability.

A commercial printer producing labels for a major customer offered us an excellent example of how companies that seek to provide their customers with solutions can create new opportunities for themselves. The customer had been ordering labels printed on a medium-quality coated glossy paper for several years and never complained about the quality of the printing. During a visit to the customer's plant, a representative of the printing company observed labeling-machine line operators opening boxes of labels and routinely discarding the topmost labels in the box. When asked why they were not using the topmost labels, the operators said that they jammed the machines. When the problem was studied it was discovered that the topmost labels absorbed just enough moisture to curl slightly and cause the labeling machines to jam. The printing company was able to demonstrate that by upgrading the substrate from glossy paper to a more expensive plastic film, the total cost per unit of labels to the customer would actually be reduced.

Providing tools and techniques to assist the sales force in problem-solving for potential clients is one way for suppliers to increase value to their customers. Sponsoring research to better understand the effectiveness of print across all markets is highly recommended. In the final section of this paper, we will propose some research projects to address this need.

Even if the most important ingredient to profitability for a printer is to "keep the cylinders turning," the path to profitability might very well be to help individual clients figure out how to reduce the number of cylinder rotations to achieve the same net effect. Most of the printers we studied had stories to tell of losing clients through their own or someone else's mishandling of the relationship. All of the printers stated this as their greatest fear. Helping maximize ROI on their print investment is perhaps the most valuable value-add a printer can offer customers.

Printers who have long-term contracts with specific clients are more likely to be aggressively developing value-added services such as data warehousing, inventory management, etc. The benefits are twofold. First, clients are willing to pay for services when they can understand and quantify the value. The most sophisticated printers even calculate the ROI for their clients. This is relatively easy in the case of clients who have a rigorous approach to understanding their own costs. It is more difficult with less sophisticated clients who are looking for the lowest cost per thousand on a print order. The second benefit to developing and offering value-added services is to make it more difficult for clients to take their business to a competitor. As one company owner talking about providing inventory management services for key clients put it, "Our goal is to get as deeply as possible into our customer's business. Once you do this, you've got a customer for life." Thus, value-added services may provide the printer with additional revenue, additional security, or both.

We do not mean to imply that job-oriented commercial printers are not trying to create new services for their customers. They are simply less able to make some kinds of investments in the absence of long-term contracts. The new services they do create are more generic and broadly applicable.

For the majority of small- to medium-size job-oriented companies, technology to make it easier to input, process, and prep customer jobs is still largely viewed as a cost of doing business to stay competitive. Some have begun to sell IT services to their customers and are developing strategies to sell these services to grow new businesses around them. One company officer responsible for making new investments in IT infrastructure told us, "The question we constantly ask ourselves is how do we make it easier for our customers to do business with us?"

Making the leap from the "cost of doing business" justification for new technology acquisition to a more entrepreneurial approach is difficult for companies that have a long history of purchasing technology to extend current capabilities as opposed to building new businesses. The predominance of the former approach in the industry has led to chronic overcapacity, commoditization, and low profitability.

INVESTMENT PHILOSOPHIES

Among the companies we studied, there are two general approaches to investment. In some companies, the owner or small group of people surrounding the owner make major investment decisions intuitively. In the balance, decision-making is more formalized and quantitative. We have seen companies where large capital purchases are made with little formal study or analysis — at least of the kind that shows up on a piece of paper.

There appears to be a correlation between the formality of the capital purchasing decision process and the sophistication with which the company tracks costs. Companies that have a solid understanding of their costs can easily predict the ROI for a new piece of equipment with good success. Companies that do not track and understand costs very well are more at risk to make bad investments.

This may all seem obvious to the reader, but many companies do not track costs in a formalized way. If the company is small enough, it is possible for a single person (usually the owner) to keep mental track of costs. Once a company reaches a certain size, this is no longer possible. Yet we have observed several larger companies (in the $10 to $20 million range) where management decision-making is still largely intuitional. When we asked the question, "What process was used to decide to buy a major new piece of equipment?", the answer given in some cases was that the owner went to Drupa or Graph Expo and just bought it. In other cases, we were shown elaborate documentation containing meticulous analysis justifying the purchase. The smallest company we found taking this latter approach is in the $3 to $4 million range and has recently been taken over by the founder's son, an industrial engineer and graduate of one of the country's leading MBA programs.

We have also observed two distinctly different approaches to extending the range of services offered to customers. Some companies are moving aggressively to bring upstream and downstream services in-house quickly. On the upstream end, some companies are expanding their capabilities to include digital asset management services to offer their clients. On the downstream end, several of the companies we studied have acquired more comprehensive finishing and mailing capabilities. In contrast to the companies seeking to broaden their range of services through acquisition, other companies are intentionally staying focused on their core competencies and building more tightly integrated relationships with external suppliers. One company CEO was very clear with us about his strategy in this regard. He said, "In an economy where there is huge overcapacity of finishing and distribution services, why would I want to bring those things inside?"

KEY INGREDIENTS OF BUSINESS SUCCESS

These observations reinforce the need for research to establish models of successful commercial printing companies of the future. Will in-house asset management and distribution services be mandatory for all companies? To what extent will printers be providing creative services for their customers? How proactive will printers become in helping their customers maximize the effectiveness of their print media buys? Does it make sense for printers to also offer digital media production services?

In our sampling of printers, we find many of them moving to expand the range of services they offer their customers, but few who have made the philosophical leap from service provider to solution provider. Those who have made the leap have broken from the pack and find themselves in a whole new realm of business requiring an entirely new way of thinking.

There is good reason to believe that companies that seek to expand the range of services they offer their customers in the absence of this philosophical change are simply overextending themselves without a long-term strategy for growth.

There has been much talk of the need for printers to "diversify" their product and service offerings to continue to grow as media-buying patterns change and electronic media take market share away from print. But diversification alone is leading some companies into dangerous waters where they are seriously overextended and even more vulnerable to competition than before. Companies that diversify services as part of a coordinated strategy to become solution providers for their customers have a distinct advantage and appear to be far more likely to succeed in the long run.

Companies that have made the leap from value-added services to solutions also have a different view of competition. Traditional-minded companies see themselves as competing primarily against other printing companies. Companies that conceive of themselves as solution-providers are less likely to worry about other printing companies and more likely to focus on how to create unique new businesses that will serve their customers better. They are also more likely to understand that competition is not limited to other printing companies. Anyone with capital and a good idea is a potential competitor.

There are some clear messages for vendors from printers who have made the philosophical leap from service-provider to solution-provider for their customers. One progressive printing-company owner gave the following assessment: "It amazes me how little as an industry we integrate our components. I'm disappointed in my vendors in how little they know about what we are trying to accomplish."

In some cases, the lack of coordination even within the same vendor company is problematic, particularly when equipment manufacturing and financing divisions cannot work together to help the customer solve a problem. Vendors who strive to understand their customers' business challenges and provide intelligent solutions are held in extremely high esteem by the printers we interviewed.

CONCLUSIONS

The past ten years have brought dramatic improvements in the efficiencies of the operations that convert customer data into print-ready files and plates. The technology employed by print designers and in the prepress department of the typical commercial printing company today makes it possible to nearly completely automate the file-conversion process. Yet a large amount of rework is still generated as customer files are prepared for print production.

The industry still depends heavily on skillful and expensive manual interventions exercised at the eleventh hour (and even twelfth hour in some cases) to make final corrections or changes critical to the successful completion of a job. These correction cycles are built into standard operating procedures and are more or less expected to occur. Some of the cost is passed back to the print buyer, with sufficient mark-up to produce additional revenues for the printer. The printer also inevitably absorbs some of the cost. As runs become shorter, these costs do not necessarily scale down. (An hour of rework because of a missing font problem costs the same, regardless of the length of the run.)

Much of this rework is attributable to human error at some point in the design or file- preparation process. Some human error is unavoidable, but some is abetted by poorly designed, overly complicated software. Other error may be traceable to lack of knowledge. For example, nearly 40 percent of the print buyers we surveyed admitted that they did not fully understand what color management is.

Print buyers are demanding premium levels of quality without knowing how this will improve the performance of the printed product in the marketplace. Little objective research has been conducted on the relative contributions of different characteristics of print to its effectiveness as a medium of communication. Without such research, the buyer's eye becomes the only standard for determining whether the required quality level has been achieved. With a better understanding of how print is actually perceived by the end user, printers would be in a far better position to help their customers make better print-buying decisions and get higher return on their print investment.

Research Questions for the Coming Year

RESEARCH QUESTIONS

A number of important questions arise out of the study we have conducted during the past several months.

1. Where should RGB-to-CMYK transformation take place?

2. If printers do not know how to work with RGB, does this effectively prevent them from offering useful digital asset management services to their clients? Is there a significant opportunity for commercial printers to build new businesses with digital asset management services for their clients?

3. How are print buyers effectively using color management to improve their ability to predict final appearance? What shortcomings do they perceive in current systems? Why is there such a weak correlation between the successful use of color management and the number of contract proofs required?

4. To what extent is error leading to rework in prepress rooted in technology deficiencies versus organizational deficiencies? Customer files often need to be fixed by the printer before they are ready to feed into the production system. Most of the printers in our study said that this is still a major problem leading to cost overruns that are either passed back to the customer or absorbed by the printer. What does the typical frequency distribution of errors look like today and what are the ultimate causes of these errors? When we asked about this during our interviews, the most common cause given was "human error," but why do humans make so many errors?

5. How much money does this industry spend chasing color precision that has no ultimate value?

6. To what extent do printers believe that the perfectionism of their clients is justified?

7. How do print buyers measure and assess the response of end users to the printing they buy? How does this correlate to the requirements they impose on the print-buying process?

8. How much variability currently exists in brand color reproduction in the real world and how does this compare with specifications set by the buyers?

9. Printers have been installing CTP devices since their introduction in the mid-1990s. Since then, supporting information technology has vastly improved. Since the mid-1990s, how have the payback periods changed for investments in CTP systems?

Annotated List of Works Consulted

Some of the most current information about the relationship between print buyers and printers is available online at the web portal, Whattheythink.com. Some of the surveys they have conducted that are relevant to this study are:

"Part One: Number of Printers Used By Print Buyers: How Much Business Does the Number One Printer Get?" 19 Aug. 2002. *WhatTheyThink.com*. 16 Sept. 2002 <http://members.whattheythink.com/home/surveys.cfm>.
This survey shows a strong correlation between the dollar amount of printing a company buys and the number of printers employed annually.

"The Printer's Web Site: What Print Buyers Want." 12 June 2002. *WhatTheyThink.com*. 16 Sept. 2002 <http://members.whattheythink.com/home/surveys.cfm>.
This survey rates the value of various Web-based services printers offer to their customers, such as checking job status, ability to submit jobs, obtaining estimates, etc.

"To Proof or Not to Proof: Current Stats and Future Trends." 4 April 2002. *WhatTheyThink.com*. 16 Sept. 2002 <http://members.whattheythink.com/home/surveys.cfm>.
This survey of printers explores the various types of proofing systems they use, and the technologies in which they are likely to invest in the future.

"Isolating Key Initiatives That Print Buyers Desire from Their Printers." 12 March 2002. *WhatTheyThink.com*. 16 Sept. 2002 <http://members.whattheythink.com/home/surveys.cfm>.
This is another survey probing the needs and wants of print buyers.

The most recent analysis of the comparative capabilities of color proofing systems can be found in:

Gentile, Deanna and Hal Hinderliter. *Digital Proofing Study (Part VI) A GATF Research and Technology Report*. Pittsburgh: GATF, 1999.

A recently published study of CTP user satisfaction can be found in:

Hal Hinderliter. *GATF 1999 Survey of CTP User Satisfaction, A GATF Research and Technology Report*. Pittsburgh: GATF, 1999.

Appendix 1: Interview Guide

INTERVIEW GUIDE
PROCESSES, PRODUCTIVITY, AND PROFITABILITY

I. Brief Overview and History of Company

II. Business Strategy

A. What is the company's overall business strategy?
B. Who is your competition and what major issues do you have dealing with it?
C. What are the industry conditions in general? Which ones give you trouble in particular? How do you deal with them?
D. What are the critical success factors in your business?

III. When building/expanding/organizing your plant, what and how did you plan to reduce waste and increase efficiency in your workflow?

A. What were the major issues & problems?
B. What were some of the major tradeoffs in technology choice?
C. What were the key environmental concerns?
D. Before making this transition did you benchmark other companies?

IV. Has your plant been running as planned?

A. What has not worked and where?
B. Are you performing as expected? If not, why?
C. Were there any surprises along the way?

V. What technology and management practices do you currently use to reduce waste and environmental impact?

A. How has new technology affected the efficiency and productivity of your operations?
B. What are the largest sources of waste in the production process?
C. What are your quality control practices?
D. How often do you measure, track, post and analyze data on waste related issues such as material use, resource use, quality, spoilage. Who has access to this data?
E. How much inventory do you have on hand at any given time? Do you have established goals regarding inventory reduction?
F. What are your formal and informal policies regarding internal auditing, worker participation, training, continuous improvement, JIT manufacturing?
G. What are your accounting practices? (Do you use standardized costs? If so, where do these standards come from? Who is charged for materials and waste? How do you make capital investment decisions?)
H. Are there any unique aspects to your employee relations?

VI. What are your primary goals and vision for your company in the future?

A. What new technologies are you looking at and why?
B. What are your goals regarding spoilage, waste, and environmental performance?
C. What do you predict your largest challenges will be?

VII. What did we miss?

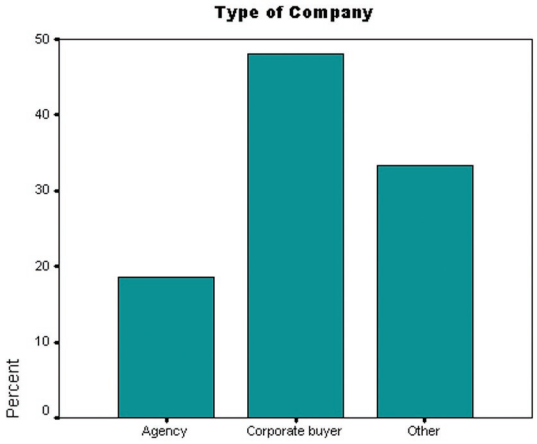
A. If you were able to ask anything of your closest competitors, what would you ask?

Appendix 2: Survey of Print Buyers

THE PRINTING INDUSTRY CENTER AT RIT PRINT BUYERS SURVEY AND SUMMARY OF RESPONSES MAY 9, 2002

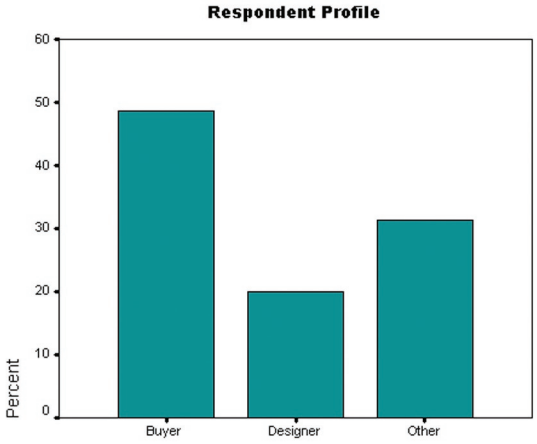
Your Company (Circle one):

Agency
Corporate buyer
Other_____

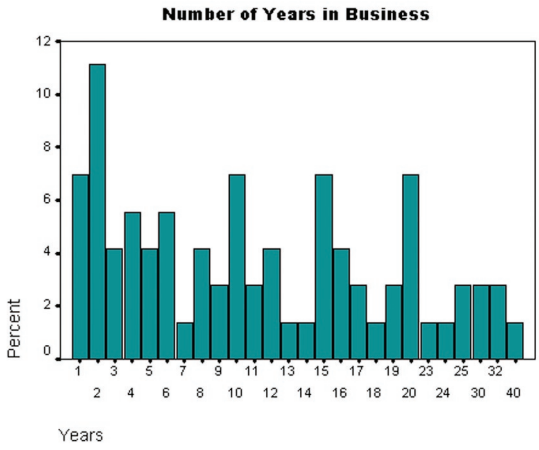


You (Circle one):

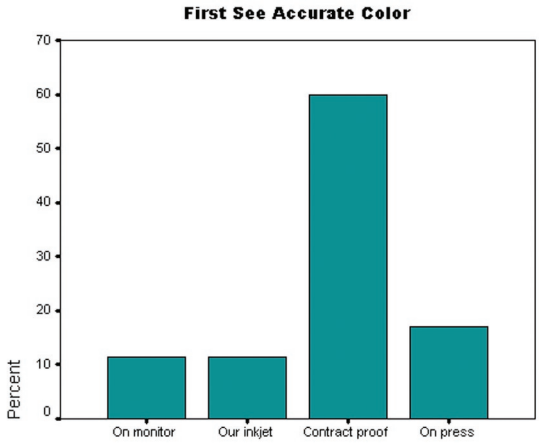
Buyer
Designer
Other_____



Appendix 2: Survey of Print Buyers

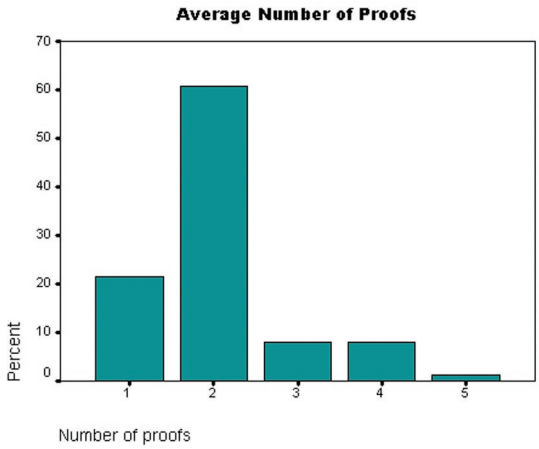


How many years have you been in this business?



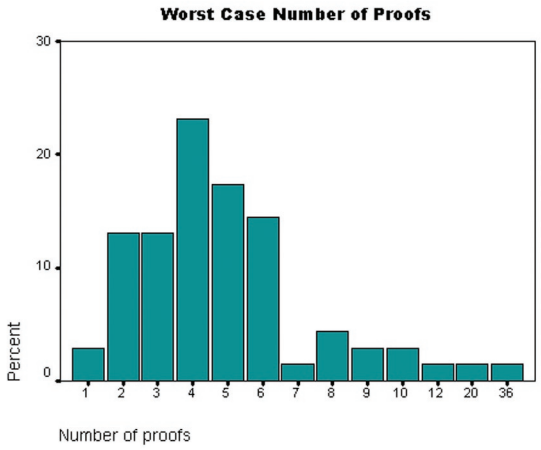
At what point in the design process do you first see a color proof that accurately shows the color appearance of the final printed product? (Check one)

1. ___On one of our company's color monitors
2. ___On a desktop color inkjet proof made by us, not the printer
3. ___On a contract color proof made by the printer
4. ___On press

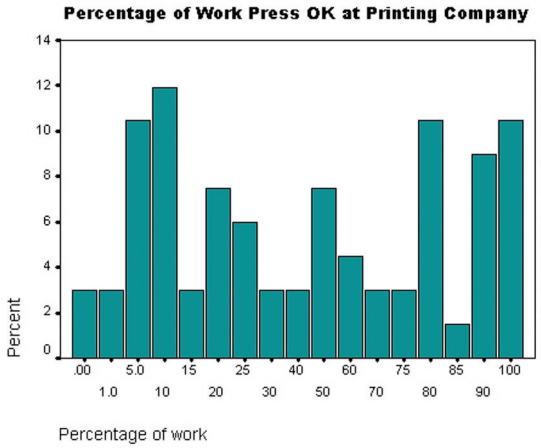


How many contract proofs do printers usually make for you on average before the final signature?

How many contract proofs did the printer make before receiving a final signature in the worst case you can remember?

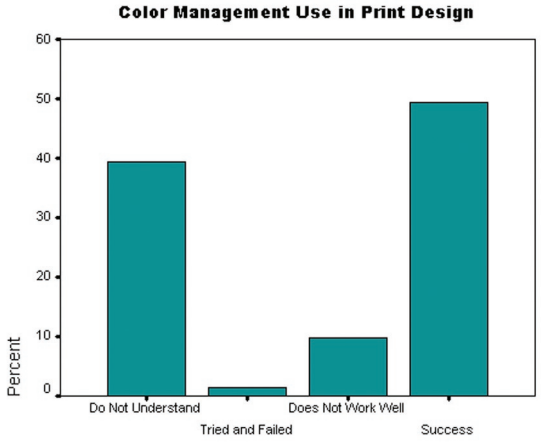


For what percentage of your work do you conduct press OKs at the printing company?

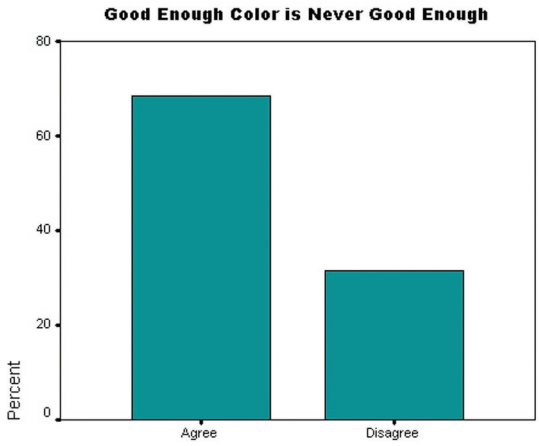


Which statement is most true for your company? (Check one)

1. ___We do not fully understand what color management is.
2. ___We have tried and failed at implementing color management.
3. ___Color management is a nice idea that does not work well enough for our needs.
4. ___We have been successful implementing some form of color management.

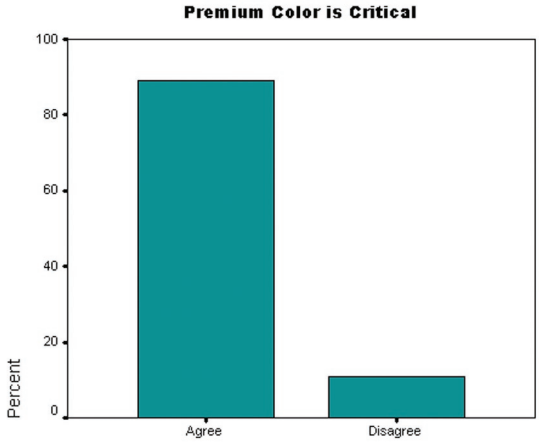


Appendix 2: Survey of Print Buyers

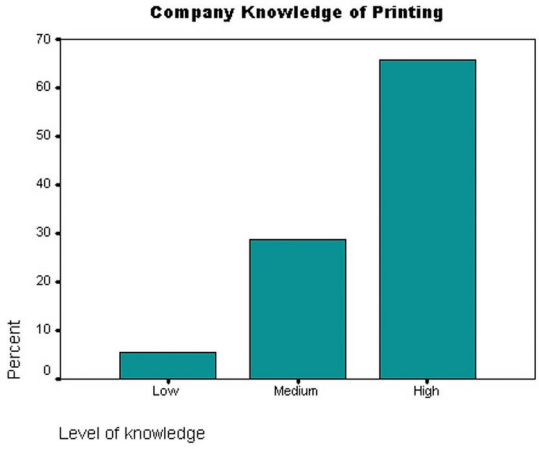


Please indicate whether you agree or disagree with the following statements:

1. "Good enough color" is never good enough for our applications.
   ___Agree
   ___Disagree



2. Premium quality color is critical to the image of our company.
   ___Agree
   ___Disagree

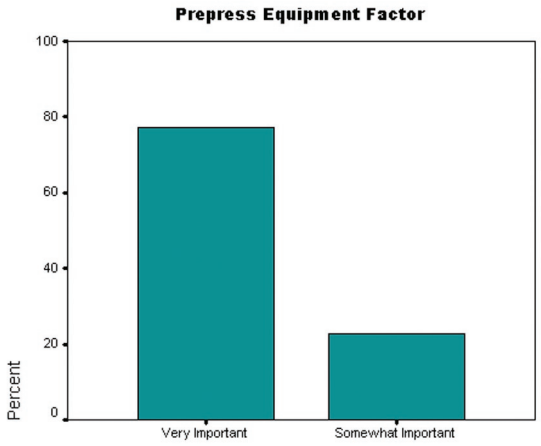


Rate your organization's level of understanding of the technical aspects of the print production process (Check one):

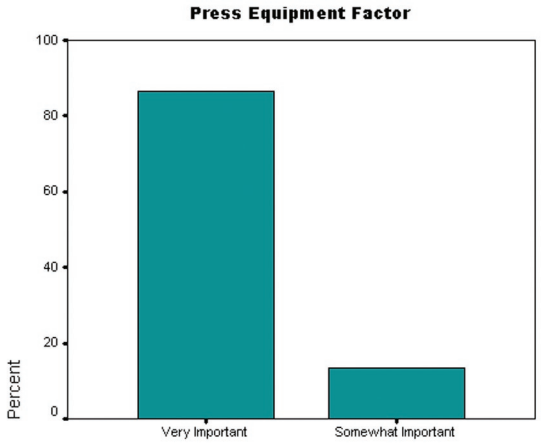
1. ___Low
2. ___Medium
3. ___High
4. ___Perfect

Please rate the following factors contributing to the color quality of the final printed product. (Circle one)

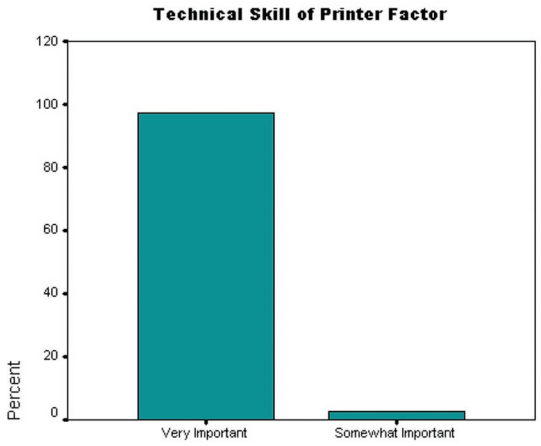
The printer's prepress equipment:
___Very important
___Somewhat important
___Not important



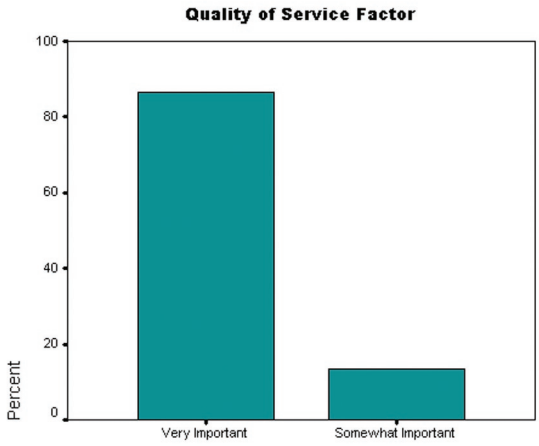
The printer's press equipment:
___Very important
___Somewhat important
___Not important



Technical skill of the printer:
___Very important
___Somewhat important
___Not important

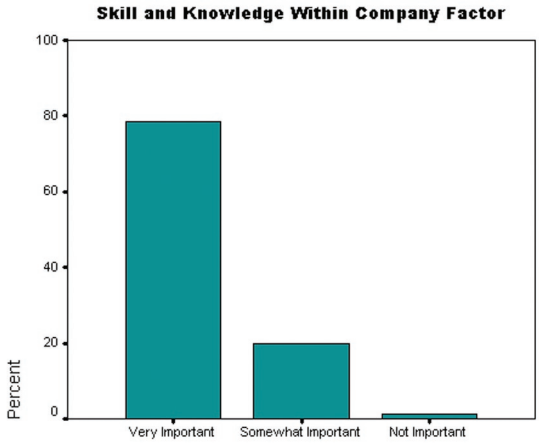


Appendix 2: Survey of Print Buyers



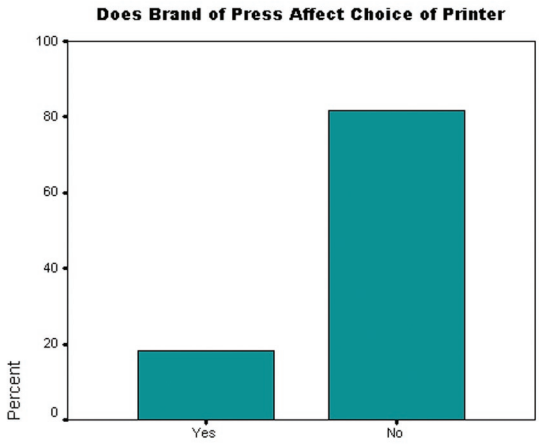
Quality of service offered by the printing company:

___Very important
___Somewhat important
___Not important



Skill and knowledge within your company:

___Very important
___Somewhat important
___Not important



Does the brand of press equipment that printing companies own affect your choice of printer? (Y/N)

If yes, which brand of press do you think is best?

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