Application of Color Management to High-End Lithographic Printing

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Background

The graphic communications industry has been in a state of disruptive change for over three decades as electronic and digital processes have replaced the photomechanical methods that were used previously. Every phase of the traditional graphic workflow from photography, image editing, proofing, platemaking, printing, and binding through addressing and labeling has felt the impact of this change. In addition, the overarching management functions of estimating, scheduling, procurement of materials, process control, and job tracking have undergone similar transformations utilizing the new tools provided by the digital age. By the mid-1990s, an entirely digital workflow became feasible for high-volume graphic production. The last pieces needed to complete this digital loop were digital photography and devices for the laser imaging of aluminum printing plates. Today, it is not uncommon to encounter graphic reproduction companies that utilize entirely, or nearly entirely, digital workflows.

New digital printing techniques, principally inkjet and electrophotography, stand out among the recent technological developments in that they offer new hard-copy production options that have distinct advantages over traditional printing methods. They are environmentally friendly, produce little or no waste, and can image variable data to provide personalized graphic products. Inkjet has the further advantages of being extremely versatile in terms of image size, substrates, and the variety of inks and other fluids that can be applied. To date, however, no digital printing process has been developed that rivals the quality and low cost of traditional methods for run lengths over 1,000 copies.

Another noteworthy development of the digital age has been the proliferation of electronic publishing across the World Wide Web and via CD-ROMs and DVDs. Today, it is common to utilize a variety of different media to communicate with your desired audience. Often the same digital assets (images) are used in several different output modes with the expectation that the quality and appearance of the images will be consistent between all of the different media used. Achieving this goal is the purview of color management.

Color Management

Color management was coined as a term with the formation of the International Color Consortium (ICC) in 1993. This consortium of eight member companies was formed to provide interchange standards for color files between different computer systems and software products. The goal of color management is to provide consistent color appearance across all stages of reproduction and output devices.

The basic architecture for color management is to translate the device-dependent color rendition of an image in different output and display media into a perceptually-

based color space, labeled the “profile connection space”. A similar translation is made for the device-dependent color response functions of digital cameras or scanners. To achieve these transforms, software is used to create a profile (characterization) of a device. The profile can be attached to the image file or reside in an operating system or raster image processor and is used to interpret the information in the image file. Within the profile connection space, the image data is mapped from the color space of one device to another, guided by a user-supplied rendering intent. For example, the user must determine whether he wants to achieve a perceptual match between color spaces or, as much as possible, an accurate colorimetric transform.

In its fourteenth year, color management has perhaps reached adolescence, but it is clearly still shy of mature. There are areas of success such as scanners, monitors, and certain output devices, but there are other areas that have proved to be much more elusive, including high-quality lithographic printing. The difficulties in successfully implementing color management in lithography are both technical and behavioral.

High-Quality Lithographic Printing

This paper distinguishes “high-quality” lithographic printing (usually sheetfed) from publication printing (usually web). This distinction is crucial because the two different processes operate under different management paradigms. The sheetfed industry follows a competitive paradigm where each printing system is adjusted to achieve optimum quality output, and high quality is often a selling point for a given company’s services. The publication industry, by contrast, follows a cooperative paradigm where each printing system is adjusted to match industry wide quality standards so the output from several different printing plants will have the same color appearance. The publication industry has developed standard characterization data so that third-party proofing vendors and others can produce products that will fit into the periodical production workflow.

The traditional approach to color reproduction with sheetfed lithographic presses has been to adjust the press to match a color proof that the customer has previously approved. Ideally, the proof was calibrated to the color reproduction characteristics of the press system so that, when a match is obtained, the press is producing optimum quality output. Once the best visual match with the color proof has been achieved, a sample is taken and usually signed by the customer to serve as the master target for the rest of the pressrun. The color control bar on this *OK sheet* is measured to obtain the target density values for the rest of the pressrun. In this way the printing press is used as a final means of adjusting the color balance of the reproduction to suit the taste and goals of the customer. Therefore, the target densities for one pressrun (or even one ink key zone on a given press form) might differ from the target densities for the next pressrun (or the other ink key zones on the form).

In order for color management to be effective, the printing system has to be run to the numbers (as with publications) and not adjusted for each pressrun (as with sheetfed). This is the main sticking point for implementing color management in sheetfed lithography, although there are other significant hurdles as well.

Among the major printing processes of lithography, gravure, and flexography, lithography is the process with the greatest inherent color variability from sheet to sheet. This is due to the fact that lithography is the only process that does not have a physical

demarcation between the image and non-image areas. Instead, litho relies on an interaction between ink, fountain solution, and printing plate to distinguish the image and non-image areas. The rheological properties of the inks change during a press run, making lithography a process control challenge under the best of situations. Color management, however, relies on a profile generated from a single impression and assumes the relationship of colors in that print are typical of the output system over time. This is a highly suspect assumption with lithographic printing.

The situation is further confounded by the many different substrates that customers choose for their jobs and the wide variety of coatings that are applied to printed products. Some printers who are implementing color management have dozens of profiles stored in their RIPs for different ink, paper, and press combinations. Overall, high-quality lithographic printers view output profiles as a means to improve the appearances of proofs made for their presses. It will serve to make image files that are easier to match on press. Color management is not seen to provide inflexible aim points to which the press will be adjusted during a production run.

The Great Debate

The lithographic printing industry today is engaged in a debate (some would say transformation) that involves color management. The background for this debate is the growing competition from digital printing and electronic media for the dollars that might otherwise be spent on printed products. The increasing internationalization of print production, as well as the increasing automation of press and color controls, are also significant factors. The point at issue is whether high-quality lithographic printing should become a set commodity rather than a graphic art. In short, should lithographic presses be run to set aim points that match industry-wide characterization data, or should the practice be continued where each printing system is run to achieve its highest attainable quality and adjusted to satisfy the communication goals of the client.

The debate is not typically articulated and discussed in technical forums, but advanced as different proposed initiatives that interest groups push within the industry. It is often difficult to decipher the benefits to the printing community from the clear self-interest of the advocates. The situation is further confounded by the propensity of printers to claim adherence to a quality standard or label, but in practice to operate pragmatically in the best interests of their customers. Assuming the situation does not dramatically change in the near future, it is difficult to imagine color management reaching its theoretical capability to provide predictable color appearance in high-quality lithographic printing.