Author's Note: This Best Practices Document was prepared for a client during my tenure with American Color. Any information that is personal or proprietary to the has been redacted by the author; the client is referred to as "Client Name," the name of the client's digital asset management intranet will be referred to as the "DAM Application."

Best Practices in Color Management

Prepared for <Client Name>, Inc by American Color

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Executive Summary

There are many components of a strong brand. Color is one of the most important, however it is one of the most difficult to control. This is because of the multitude of creative technology products—computer monitors, digital cameras, graphic software, and printing presses—that have been developed independently of one another. Each employs its own methods for describing digital color specifications. It's difficult to preserve the integrity of color among all these devices and media without a strategy for managing color.

Color management is especially challenging for a large organization with such a prominent international presence as <Client Name>. The <Client Name> Corporation and its affiliates are reliant on numerous graphic designers and print vendors around the world; each is likely employing a slightly different mix of creative production technologies. This is further complicated by the fact that is several regional standards for the printing of color materials that are currently in practice.

In the absence of color-quality controls an organization suffers on two fronts. First, the costs associated with inefficient workflows and wastes. There have been several studies (by Gistics, Heidelberg among others) on the Return on Investment of color management strategies. The results have both similar and staggering. The annual cost of a color management strategy is approximately $150 per device (digital cameras, monitors, printing presses), yet three-year return is estimated at 1,000% to 2,000%.

The second risk is a little harder to quantify, though its costs are substantial. For example, if Coca-cola, a company with a very strong global brand, were to release a world-wide print campaign, they would expect that their familiar red logo have a consistent look regardless of the publication or the country. Now, imagine if in some publications the logo was reproduced with a washed-out 'salmon' color, giving the consumer the perception of an older and faded product. This would cause enormous damage to the company's brand equity that it has spent well over a century building.

Thus, color management is an important facet in the preservation of an organization's brand integrity. Color management allows an organization to fortify its global brand, while achieving substantial cost savings. Even greater returns can be realized by <Client Name> when the best practices of color management are integrated into <Client Name>'s Digital Asset Management System (DAM) strategy.

Purpose and Scope

This document will begin by providing a working definition of color management. In order to help the reader better understand the principles of color management this definition will be followed by an explanation of some key concepts of color. This section will also discuss the challenges of color management within a large organization.

The Introduction will be followed by descriptions of the industry's best practices in each of the phases that comprise the creative production process. It is beyond the scope of this document to engage in a tactical-level discussion of product recommendations and implementation of color management controls. However guidelines to promote optimal color management's practices are provided.

The *Color Management in Practice* section that follows will build on these best practices by illustrating how the lifecycle of an image flows from creation through the approval process.

The final section *Color Management and the DAM* will describe how <Client Name> can leverage the forthcoming Digital Asset Management System to enhance a color management workflow among its affiliates to help build brand equity by ensuring color fidelity throughout the organization.

It is not the intent of this document to endorse or recommend any specific products. Occasional references to industry standard products (such as Photoshop) are mentioned in order to provide readers with a frame of reference.

Introduction to Color Management

Like many industry-specific terms, “color management’ is so liberally applied that its usage is subject to conflicting interpretations and debate. Thus, it is necessary to begin with the establishment of a working definition. For the purpose of this document, color management is defined as “the organizational process of integrating technology, workflow, and human resources to ensure the highest possible degree of color fidelity among all devices and media that are involved in the process of creating, editing, reviewing and printing color imagery.”

In order to better understand color management strategy it is necessary that some readers be introduced to some of the key concepts of color. This will not be a physics lesson, but a brief overview of some terminology and principles of color. For more detailed explanations, please see the *For Further Learning* section. Readers who are already acquainted with color management may feel free to skip ahead to the next section, Best Practices.

Visible color is made of components that are based on a ***color model.*** For the purpose of this document, the focus will be on two primary models: ***RGB*** *and* ***CMYK***. A number of devices that ***transmit*** light such as computers monitors and digital cameras display color composed of three primary color units: **R**ed, **G**reen and **B**lue; these are said to be *RGB* images. Printed materials ***reflec****t* light and are made of four primary colors: **C**yan, **M**agenta, **Y**ellow and Blac**k**—*CMYK.* Since print is a CMYK medium, commercial presses discharge variable amounts of Cyan, Yellow, Magenta and Black inks in order print a page.

The number of individual colors that can possibly reproduced by a device or medium is known as the device’s ***gamut***. In the printing industry the term gamut is often used interchangeably with ***color space.*** Technically they are not the same, but for the purpose of this document, they will be considered synonyms (much to the chagrin of color scientist). Color models contain numerous color spaces; for example the RGB model contains color spaces (Adobe 1998, Apple RGB, sRGB).

The gamut of RGB devices, such as computer monitors, is far larger than that of CMYK devices such as printers. Thus, the bad news is that 100% accurate color management across all devices is physically impossible. Certain colors are said to be “out of gamut” if they cannot be reproduced on a specific device. The good news is that it is possible to make your input devices aware of the limitations of your printing press through the process of “gamut mapping.” For example, if a computer determines that a file contains colors that cannot be reproduced in a printing press; the computer can translate these colors into suitable surrogate colors that are within the press gamut. This is where ***profiling*** comes in.

A ***color profile*** is a data file that contains explicit information about the color-reproduction capabilities of an input or output device at a given moment in time. Color profiles for every input or output device adhere to the standards of the International Color Consortium.

The International Color Consortium (**ICC**) was created in 1993 to address color management issues by establishing a system of universal standardized color. The ICC’s founding members included Sun, Fuji, Apple, Microsoft, Adobe and Kodak. ICC (ICM for Microsoft products) ‘profiles’ were developed to help ensure color accuracy among devices. The profile allows a device to ‘look up’ the proper color behavior expected of another device. For example, a production artist can be provided with a profile from a printer that will allow the artist to determine how a digital photograph will render on that particular printer.

Before a device is profiled it must be calibrated. The process of calibration returns a device to an objective standard. This is much like older bathroom scales often had to reset to back

zero. Many devices such as scanners and digital cameras are self calibrating, doing so on start up. Other devices, such as computer monitors require regular calibration schedules if color fidelity is going to be ensured. Once a device has been calibrated a profile can be generated

Description of Best Practices

This section of color management steps through each phase of the asset-production process: acquisition, editing, approval, output and outlines conditions that promote a successful color management strategy.

Acquisition is the process of capturing or creating digital images. Nowhere is the "Garbage-in-Garbage-out" adage truer than in the area of color management of digital photography. A bad scan or digital photograph will likely result in a poor end-product despite the talents of a retoucher and the technology of Photoshop. To ensure the highest quality product the following are required of scanners and digital cameras.

1 Proper Ambiance
   a Lighting rules of traditional photography apply to digital world
   b Scanner room should have neutral color walls, no windows

2 Device calibration
   a Scanners should be calibrated at least once a month
   b Cameras should be calibrated at photographers discretion

3 Images should be captured at adequate resolution
   a Technically resolution does not affect color, though a low-resolution photo will reproduce poorly on paper—it may appear streaked or 'milky'
   b Drum Scanners are preferable to Flat-bed scanners. Drum scanners allow scanning in transmissive mode thus providing for a better representation of an RGB image than a flat-bed which scans in reflective mode.

Editing is more commonly known as 'retouching." With few exceptions, editing is almost always done in Photoshop. To ensure color integrity the following are recommended*:*

1 Ideal work areas should be free of sunlight. Room lighting should remain at a consistent level.

2 The work area should be a neutral color. (Note some color management companies actually sell paint).

3 Users should work in Photoshop's full screen view

4 LCD monitors are preferred to CRT models
   LCD's are not prone to magnetic distortions from phones and stereos

5 Monitors should be calibrated every two weeks.
   Software calibration is not recommended. A 'suction-cup' device, mounted directly onto monitor will provide more accurate results.

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Description of Best Practices (continued)

Approval is the stage where image(s) are reviewed and ultimately approved. The term “hard proof” refers to a print generated by a high-end ink jet printer that is intended to match the final product as closely as possible.

1 Any proofing device should be in an area that is climate controlled. The device should have adequate ventilation. Heat and humidity can cause significant color shifts and the area should be properly air conditioned and well ventilated.
The proofing devices should be calibrated daily.

2 For hard proofing, a color-viewing booth is recommended; this ensures proper lighting and neutral colors, for review of a Chromalin, Matchprint, etc. A viewing booth should be in an area that is free of sunlight.

3 For soft proofing the conditions that are required for the Editing phase should be observed in the reviewing phase. If edits are required, they should be made in the Adobe RGB 1998 color space (this will be demonstrated in the next section).

Printing as the name suggests, is the phase where a digital file is actually printed on a commercial press.

1 Heat and humidity also effect press performance. Similar to digital proofing devices, pressrooms require climate control and proper ventilation.

2 Commercial press calibration is a time-consuming and complicated procedure, however, this should be performed at the first sign of a shift in calibration

Color Management in Practice.

Following is an outline of color management in action. This hypothetical example is written under the assumption that all environmental controls described in the previous section are in place.

1 You should install the profiles of all of your output devices on your computer
2 Open the image(s) in Photoshop. If the profile of an image does not match your current working space, you should select “Use embedded profile”
3 At this point, you should assign the preferred working space (under color settings choose ‘Adobe RGB 1998’) as your working space.
4 If you type the letter “f” this will set Photoshop’s full-page view. This will provide a neutral-color background (‘canvas’) that will allow for more accurate representation of the image’s color
5 At this stage, retouching is performed.
6 When retouching is complete, you should make a duplicate of the file. The fine adjustments to color will be made to the duplicate. It is important to save the original—if there are changes to the image later, you will want to make them in the Adobe RGB 1998 color space.
7 Photoshop’s soft proof features allow you to preview an image how the final output of the image will look. Go to the “Proof Setup/Custom” menu under “View” and select the profile of your printing device. “Use Black Point Compensation” should be checked.
8 The setting for Intent will determine how out-of-gamut colors will be handled by the printing device. There is no hard-and-fast rule for this setting, it is largely determined by the colors that make up the image in relation to the output device.
9 In the Window menu select “Gamut Warning” You may see some of the colors disappear from the image. This means that your image contains colors that are out the printing device’s gamut. If this is the case, this may require a slight adjustment to the color output level (menu: Image/Adjustments/Levels)
10 If you are satisfied with the quality of the soft proof, you can either send the file to a digital color-proofing device, or you can submit an electronic file for soft proofing by others. You can send Photoshop files or you may choose to output a PDF for approval routing. Remember if changes are required, you should make them to the original RGB image that you saved.
11 If the image is approved, go ahead and convert the image to your destination profile (menu: Image/Mode/Convert to profile). Remember, the settings for the Intent will be determined by the results of your findings in Step 11.
12 If there are changes to image. You should return to step 5
13 At this point the file is ready for printing. The files can be can be shipped to your print provider.

Color Management within the DAM Framework

Before beginning the outline of Color management within the DAM, a summary of current practices in DAM Application is provided.

In the traditional DAM Application application, color management is practiced in the sense that all photography (TIFF, PSD and JPEG) are assigned the Adobe RGB (1998) profile to ensure that they occupy a device-independent color space. Files stored in this format, make excellent source files for conversion to Web and PowerPoint formats, and can be saved in CMYK format by the multitude of print vendors employed by <Client Name> and it's affiliate organizations.

In the <Client Name> <Client Division> Communications application, files that are ingested into the DAM Application system are saved in CMYK without an embedded profile. <Client Name> <Client Division>'s usage of DAM Application is archival in nature; jobs are submitted to DAM Application following the close of a production cycle, thus the images have already been rendered as CMYK by Prepress. These images have been targeted specifically for that the presses in Ada; thus the images in the <Client Name> <Client Division> Communications have a limited reuse value. Also, since these images have to converted to RGB for PowerPoint and Web, color data may not reproduce as accurately from an RGB ***"Digital Master."***

Going forward, the practice employed by <Client Name> <Client Division> and <Client Name> <Client Division> of preparing photographic files as RGB with the Adobe RGB 1998 profile should be continued though the foreseeable future of <Client Name>'s digital asset management endeavors. This device-independent color space provides the best opportunity for reuse of images among international press standards as well as digital media vehicles such as PowerPoint and QuickTime.

As mentioned in the previous section, images for the <Client Name> <Client Division> Communication are stored as CMYK images at the end of the production cycle. It is recommended that the <Client Name> <Client Division> <Client Division> adopt the practice of providing RGB images for the DAM's gatekeeper to provide an optimal level of reuse potential for their digital files.

The principles of the color management workflow within the DAM framework are essentially the same as those described in the previous section, though the key difference is that users will work within a DAM 'project workspace' which is essentially a collection of files that is managed by the DAM servers, though not viewable by the general DAM population. Furthermore, steps in the routing and approval process are automated thereby promoting new efficiencies.

A Color-Managed Workflow for the DAM

This hypothetical example is written under the assumption that all environmental controls outline in the *Description of Best Practices* section are in place. Steps in the workflow that are unique to the DAM scenario are designated in italic.

1 Profiles of all of your output devices should be installed on your computer

2 All images for your job should be contained within your project workspace. If you are using pre-existing images they should be copied from the public DAM into your workspace.

3 A designated member of the project team should tag (in batch) the assets in the project workspace with job-specific metadata:

- *a Job #*
- *b <Client Division>*
- *c Attributions (Art Director, Photographer, Designer….)*
- *d Description of Job*
- *e Key Contacts*

4 As needed, check the images out of your workspace so that you may perform edits on them.

5 Open the image(s) in Photoshop. If the profile of an image does not match your current working space, you should select “Use embedded profile”

6 At this point, you should assign the preferred working space (under color settings choose ‘Adobe RGB 1998’) as your working space.

7 If you type the letter “f” this will set Photoshop’s full page view. This will provide a neutral-color background (‘canvas’) that will allow for more accurate representation of the image’s color

8 At this stage retouching is performed. Proofs can be sent to office color printing devices (such as a Canon color copier), however these proofs should never be used to make color-critical decisions.

9 When the image is retouched. You should check it back into your project workspace. This will save a file (version 1.0) to where you can always revert. To begin the soft proofing process, check the file back out of your workspace. Note, each time you check a file into the system, you’re creating a new version of the file (1.1, 1.2, etc). You’ll be able to revert to any previous version of the file if you should need to. The fine adjustments to color will be made to the duplicate(s). If you need to make edits to the file, you should restore version 1.0.

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A Color-Managed Workflow for the DAM (contintued)

10 Photoshop's soft proof features allow a preview of an image to see how the final output of the image will look. Go to the "Proof Setup/Custom" menu under "View" and select the profile of your printing device. "Use Black Point Compensation" should be checked.

11 The setting for Intent will determine how out-of-gamut colors will be handled by the printing device. There is no hard-and-fast rule for the setting-that is largely determined by the colors that make up the image in relation to the output device.

12 In the Window menu select "Gamut Warning" Some of the colors disappear from the image. This means that the image contains colors that are out the printing device's gamut. If this is the case, this may require a slight adjustment to the color output level (menu: Image/Adjustments/Levels)

13 At this point, if satisfied with the quality of the soft proof, either send the file to digital color proofing device, or submit an electronic file for soft proofing by others. If you choose to send the files electronically, the DAM systems will generate an FPO's directory and send an e-mail to each approver in your group that will notify them as to the location of the files.

14 If the image is approved, go ahead and convert the image to your destination profile (menu: Image/Mode/Convert to profile). The settings for the Intent will be determined by the results of your findings in Step 11.

15 At this point the file is ready printed, you should "Submit for Production" this will bundle the high-resolution files in a directory and notify the staff in Prepress of a new job in queue

16 Upon job completion, original or revised images should be assessed for 'sharability' among the core DAM users. If the project's production staff deems any of the assets sharable, the RGB versions of the file should be tagged as such. This will trigger a notification to DAM gatekeepers of assets for review.

17 At the Gatekeepers' discretion assets will be designated for sharing among the general DAM user population.

- *a Metadata will be added accordingly*
- *b Images/thumbnails and metadata will be quality checked*
- c *Asset will be released for viewing by the general DAM population*

Color Management and Screen Images

If color management for printed materials is challenging, it might be said that color management for Web is maddening. However, with print media, an organization has the ability to control each phase of the color management process and proper adjustments can be made for changes in environmental conditions and various print media.

With Web graphics, the medium is a computer screen. There are millions of computer screens. There is no possible way that an organization can control the viewing conditions for every computer monitor on the planet. This is further complicated by the fact computer platforms (Mac, Windows, Unix…) do not recognize the exact same individual colors. The solution is what is known as 'Web Safe' colors.

Web safe colors are represented by 216 individual colors that are common among all computer platforms. The easiest way to save an image in Web safe colors is to use Photoshop's Save for Web feature. This will automatically down sample the image to the safe index of 216 colors. Note, to ensure that the Web-ready image is representative of the original; you should begin with an RGB original, and not an image that has already been converted to CMYK.

It is recommended that as much as possible the low-resolution Web graphics are derived from high-resolution RGB print graphics. This is purely an organizational efficiency issue. Images created specifically are of a limited reuse value. Because these images are low resolution (72 dpi) and are only composed of 216 colors, they are will produce poorly on most print vehicles.

However a high-resolution, image that occupies the AdobeRGB (1998) can easily be converted into CMYK image for printing, or a low-resolution 216-color JPEG that is suitable for a Web site or a PowerPoint presentation. The key is that the digital master must maintain awareness of all it descendents. And these descendents must be aware if changes are made to the digital master. This will provide the opportunity for updates that can be handled automatically, or through a sophisticated workflow process. This process manages color in the sense that all changes to the digital master, including color, can more efficiently be reflected in all the descendent files.

The best way to promote the awareness of the digital master and its descendents is through metadata. It's recommend that <Client Name> employ the 'Source' element from the Dublin Core in its metadata strategy. The Dublin Core is a framework for describing digital object. The Source element will serve to maintain a relationship among a digital master and all the files that are derived from it. Thus if a change occurs to the digital master, a workflow trigger could be activated to all parties who derived files from the master. This will help to maintain a consistent look among images regardless of the medium of the content owner.

Resources

Color management
by Hal Hinderliter, president, Hal Hinderliter Consulting Services
http://americanprinter.com/mag/printing_color_management/index.html

Why Color Management?
James C. King Adobe Systems Incorporated
www.color.org/whycolormanagement.pdf

Color management
By Abhay Sharma
http://americanprinter.com/mag/printing_color_management_2/index.html

Color management: What are you waiting for?
BY DAVID L. ZWANG Contributing editor, American Printer
http://industryclick.com/magazinearticle.asp?magazineid=22&releaseid=6760&magazinearticleid=111854&siteid=22

Optimized Color Management
By Joanne Whitcher, Eastern Regional Editor Graphic Arts Monthly
http://www.gammag.com/Current/index.php?art=gam0503Fcolormgmtpress

For Continued Learning

Color Management Glossary
http://www.coloreal.com/PS/colormm_glossary.asp

Apple Color Management Seminars
http://seminars.apple.com/cgi-bin/WebObjects/ASPRegistration.woa/wa/solCheck?s=205&path=/seminarsonline/colorwf/apple/index1.html&eventID=31721

Dry Creek Photo Online Tutorials
http://www.drycreekphoto.com/