2012 ICC DevCon

The Premiere Learning and Networking Event for Users and Product Developers Working with ICC Based Color Management

Color Engineering With ICC Profiles

Bob Hallam

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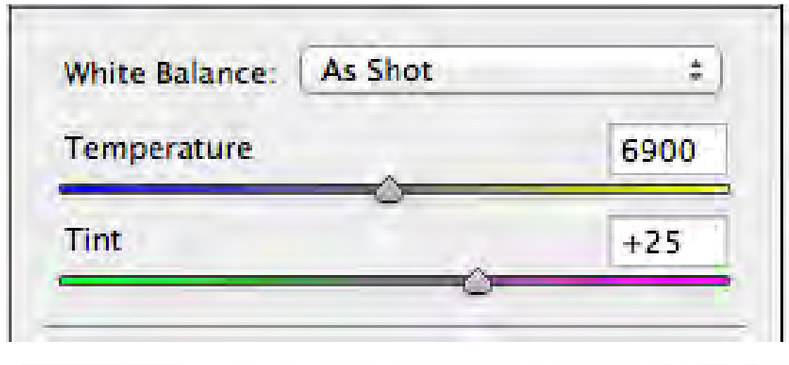
Capture to Consumer

- **Process control at the outset of a print workflow saves cost and can provide the best possible product.**

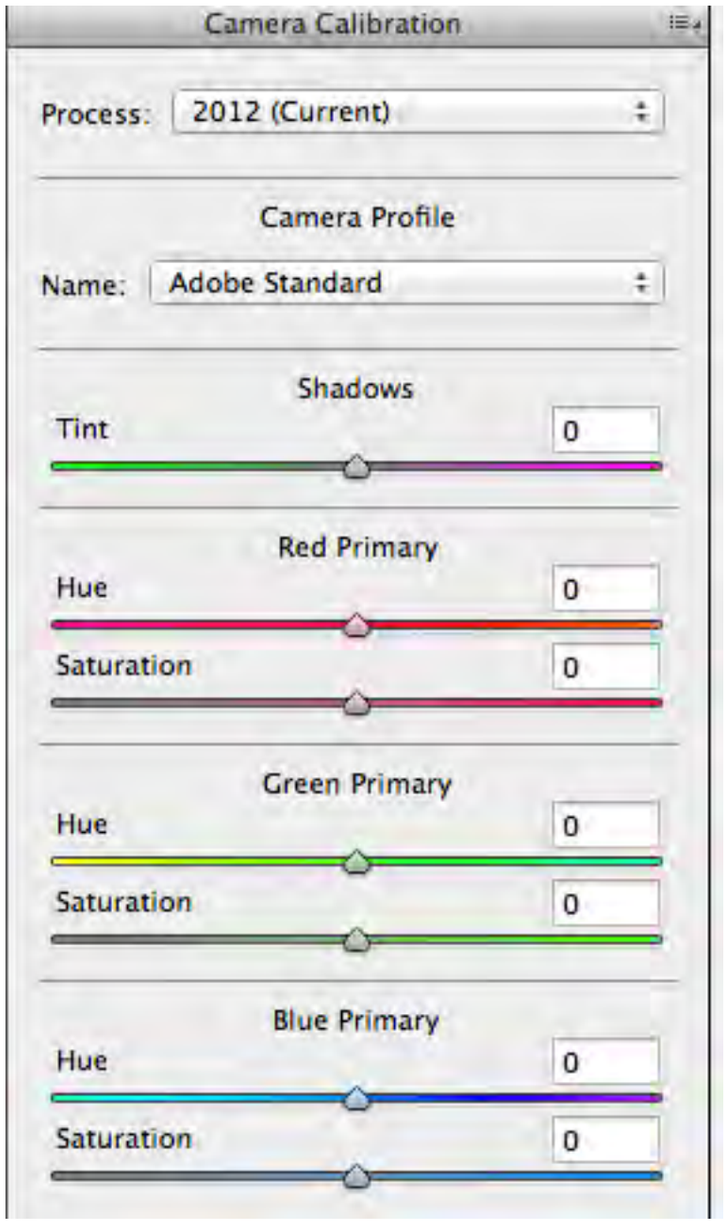


- **ICC Methods or ACR for the most accurate color transforms?**

- **ACR can only adjust for the camera primaries while using a standard color rendering preference profile**

Capture to Consumer

- **ACR Camera profile mapping is illuminant dependent since most all cameras are RGB devices.**
- **There are Java Scripts available that take the standard Gretag Macbeth 24 patch target data and provide a camera calibration in ACR that will provide a good starting point.**



Capture to Consumer

- **ICC profile methods have the potential of adjusting more colors and can potentially provide the accuracy needed in instances where product colors or specific image colors are important to the color processing workflow.**

- **The results are still not suitable for efficient studio catalog photo production.**

Art or Science?

- **In some instances ICC Color Management isn't helpful in achieving greater profits in a digital photo workflow.**

- **In most catalog workflows ICC color management can significantly decrease color correction costs if done properly.**

- **A static ICC profile process doesn't have the flexibility required to produce calibrated scene referred image data. (Neither does ACR)**

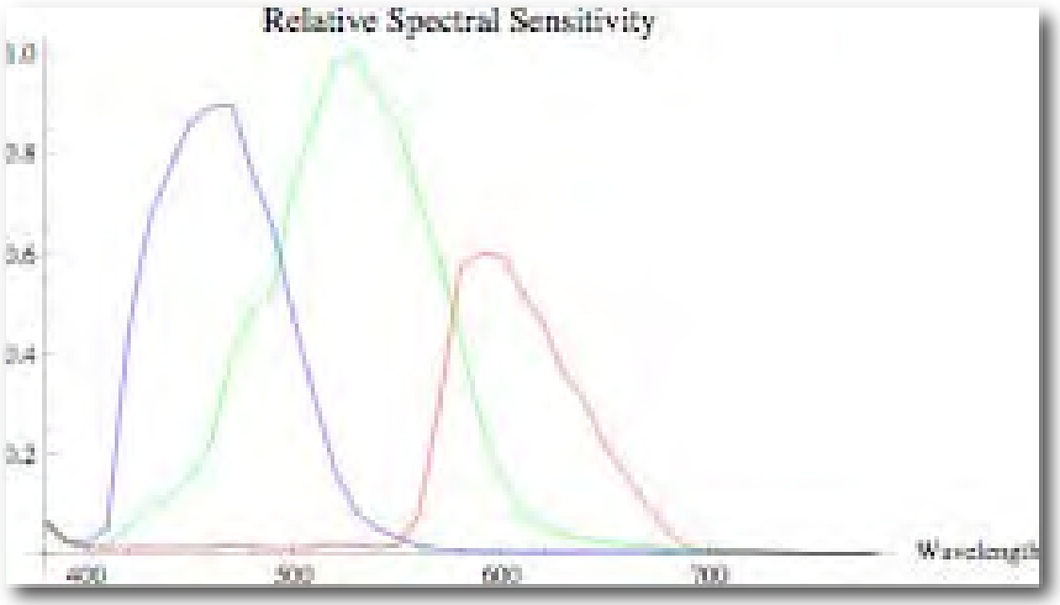
A better solution is required

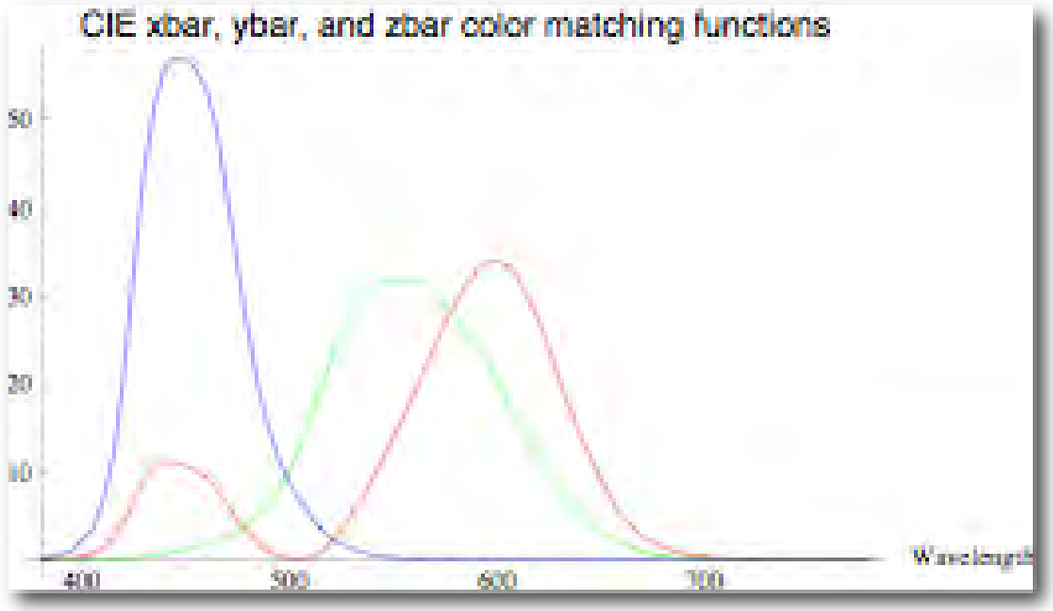
- **Both the human visual system and digital cameras have serious metameric issues. Even with good white balancing a camera rarely produces accurate color in product matching situations under studio lighting.**

- **We have good historic data for the spectral sensitivities of the human visual system, but not for most digital cameras sold to professionals.**

- **The spectral response of a digital camera cannot be measured by using the camera's rendered output data. Therefore, an exact color characterization can only be made by using raw, un-rendered sensor data.**

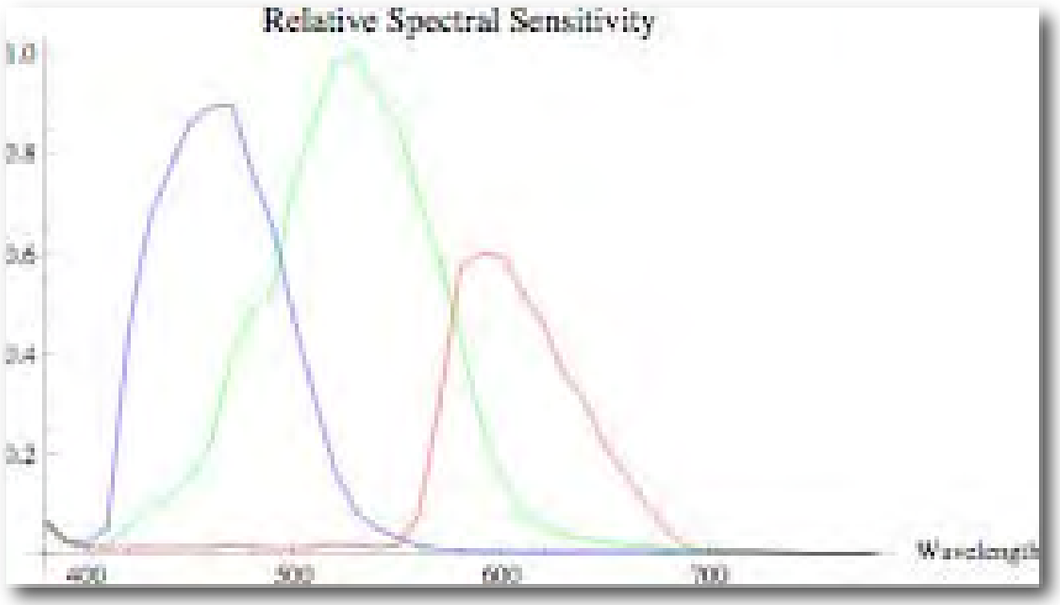
Spectral Sensitivities

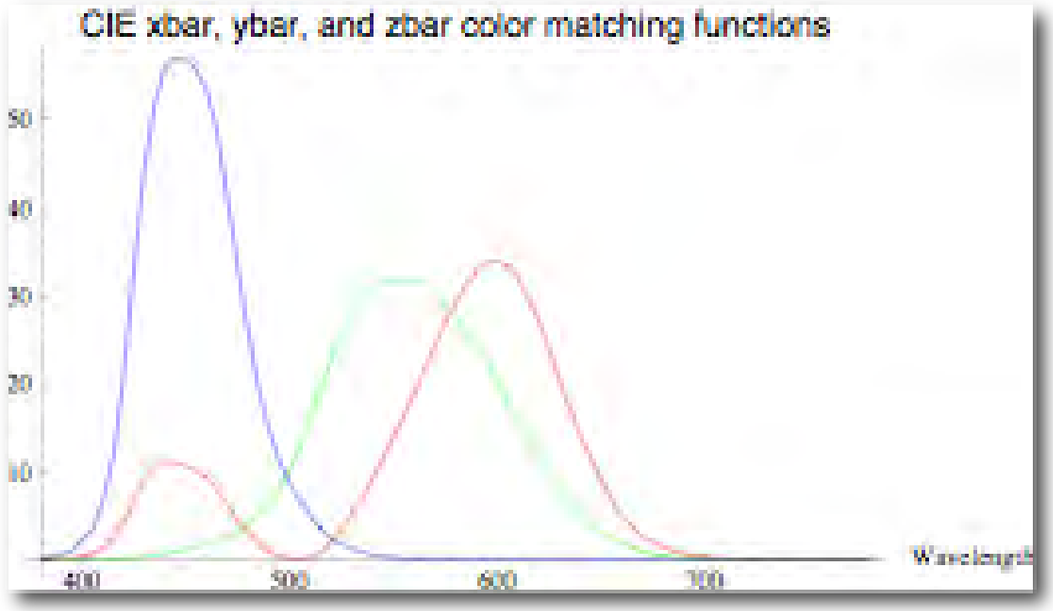




- Determine camera linearity function (OECF)
- Measure camera spectral sensitivities.
- Obtain training data representative of typical subject matter.
- Identify capture and output white points and other viewing conditions.

Spectral Sensitivities





- **Calculate the white balancing matrix from the scene adopted white XYZ to the destination color space adopted white XYZ.**

- **Calculate the linear aim values then calculate the linear camera response to the adopted white and the white balance channel multipliers.**

- **Solve for the camera matrix that transforms from camera LinearRGB to ICC PCS that minimizes errors in a relevant color or appearance space.**

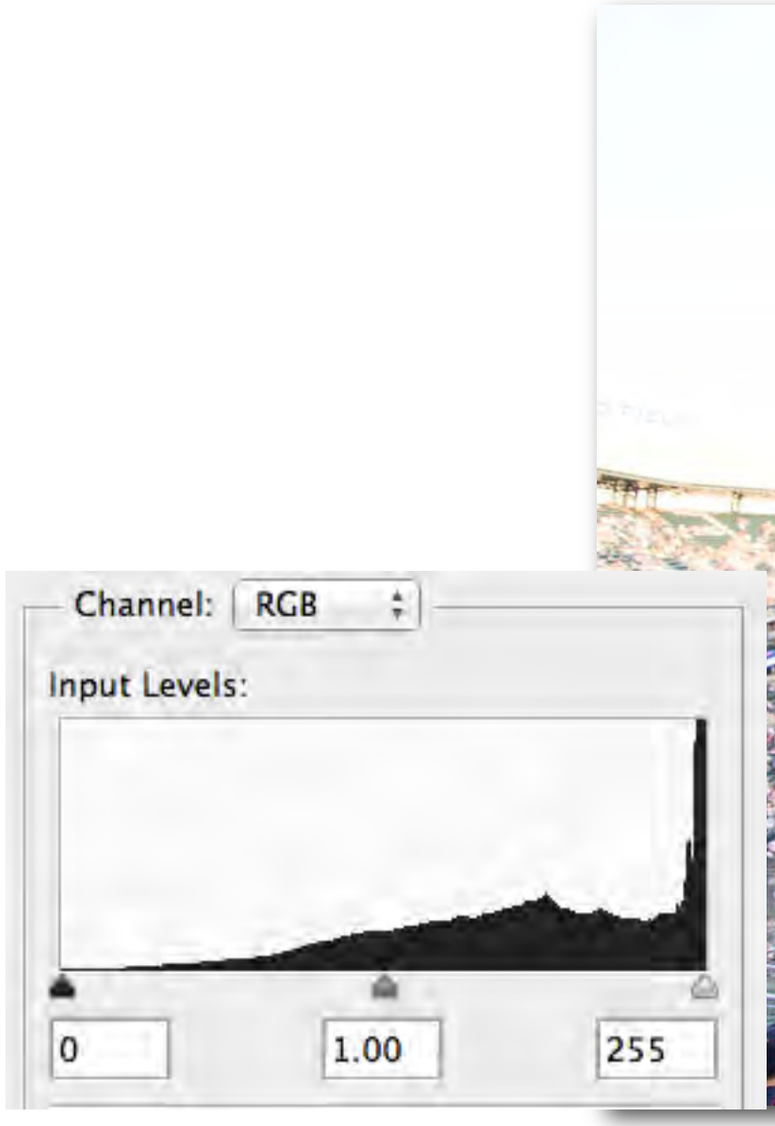
Raw File Conversion Process

- **RAW conversion to white balanced -black subtracted, linear RGB**
- **Get dynamic range, and spatial cross-talk.**
- **Resolution, or image detail, is another image quality parameter best described by a metric, the spatial frequency response (SFR)**

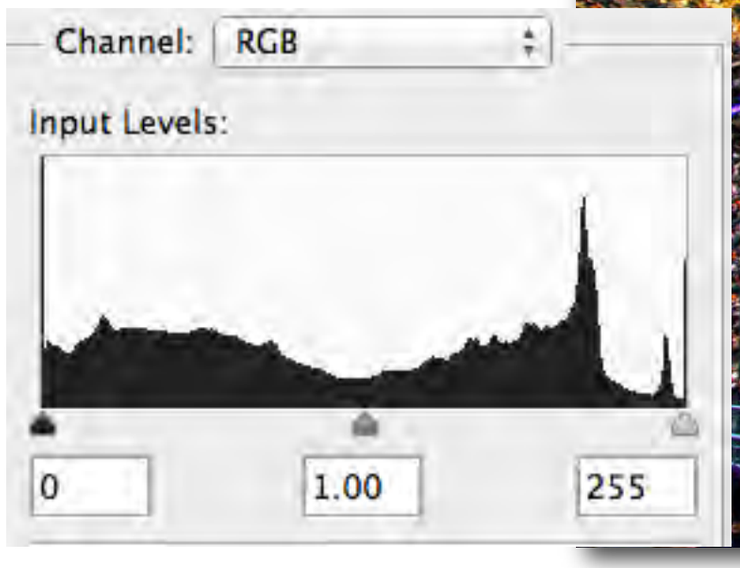
Image Specific ICC Profiles

- **ICCv4 profiles can be made on the fly for an accurate Raw file workflow.**
- **Colorimetric Rendering Intents can be used to produce accurate representations of the original scene, without rendering. Useful for complete creative control over the entire workflow without having to circumvent previous renderings.**
- **Perceptual Rendering Intent can be automatically built and assigned to render the scene to the Perceptual Reference Medium Gamut (PRMG).**
- **ACR uses user inputs to adjust rendering to a device independent color space. Optimal profiles are not built until the image is rendered but the results can not be calibrated as accurately as in an ICC workflow.**

S/N - ETTR Raw File Exposure



ETTR - Rendered & Recovered Image data



Maximizing S/N Ratio

- **With 9 Stops available in a raw file capture, assuming a 12 stop dynamic range and a 14 bit raw file, the data is distributed as follows: The brightest stop = 8192 tonal values**
- **Stop 2 = 4096 tonal values**
- **Stop 3 = 2048 tonal values**
- **Stop 4 = 1024 tonal values**
- **Stop 5 = 512 tonal values**
- **Stop 5 = 256 tonal values**
- **Stop 6 = 128 tonal values**
- **Stop 7 - 64 tonal values**
- **Stop 8 - 32 tonal values**
- **Stop 9 -**

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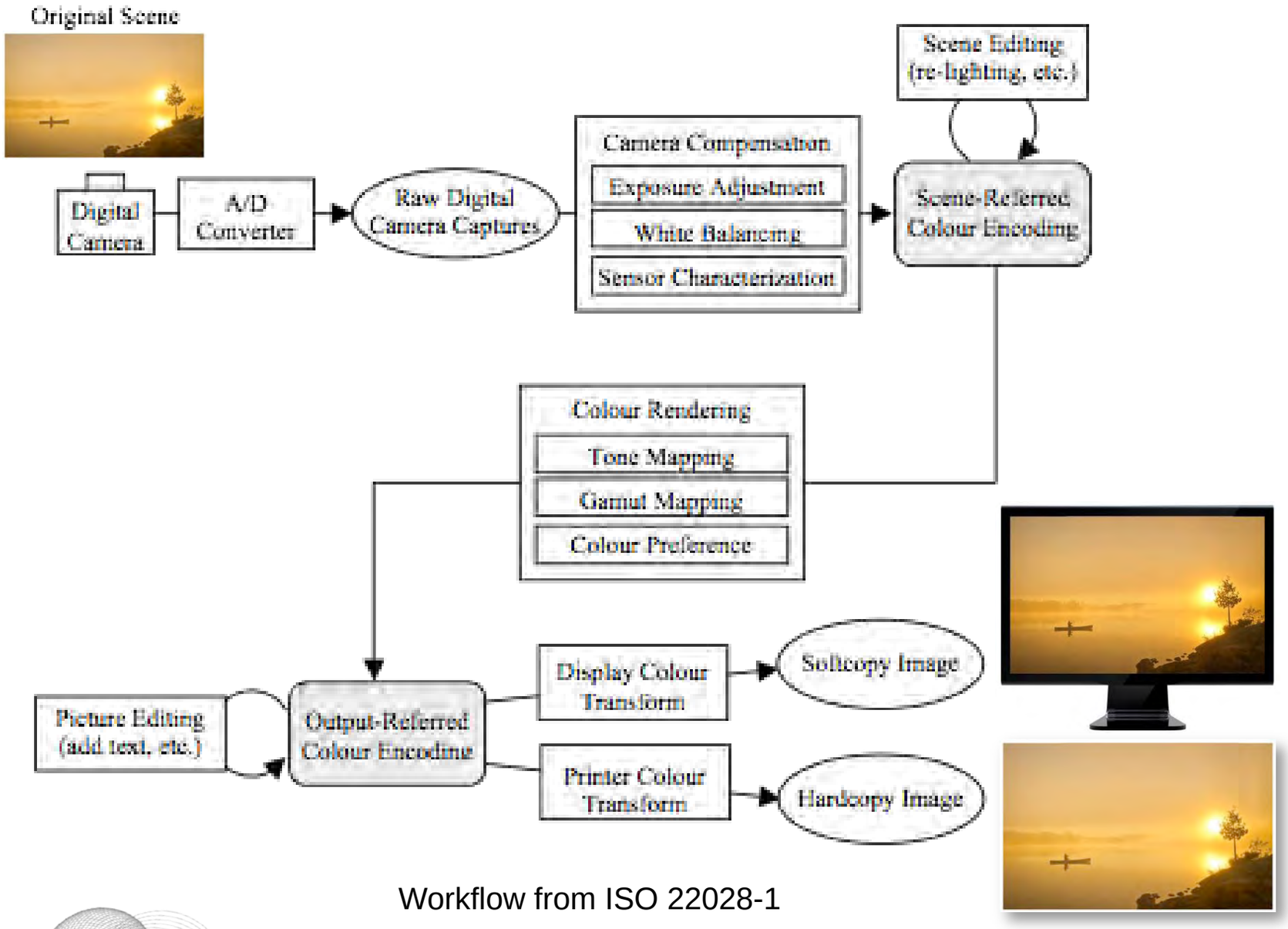
Rendering



Workflow from ISO 22028-1

Rendering Considerations

- **Each user may have different expectations of what makes a preferred photographic reproduction.**
- **Most users won't prefer an exact colorimetric reproductions of the scene even in a product catalog or magazine.**
- **Perceptual Rendering Intent is available to produce a preferred reproduction of the original scene.**
- **Perceptual Rendering Intent can build on the transform in the Colorimetric Rendering Intent with added gamut mapping.**
- **Color Accuracy is not usually a factor in consumer imaging applications, but is significant in Magazine and Catalog photo work.**

Monitor based Proofing

- **ICC v4 Profiles are much more accurate for monitor based proofing.**
  - **ISO 3664:2009 Creates problems in all ICC based proofing.**
  - **The usual measurement matching methods must be replaced for materials with Optical Brightening Agents.**
- **Monitor SPD's will not fit well with calibration aims and rarely produce metameric matches to media white points.**

RGB to CMYK or CMYK+N

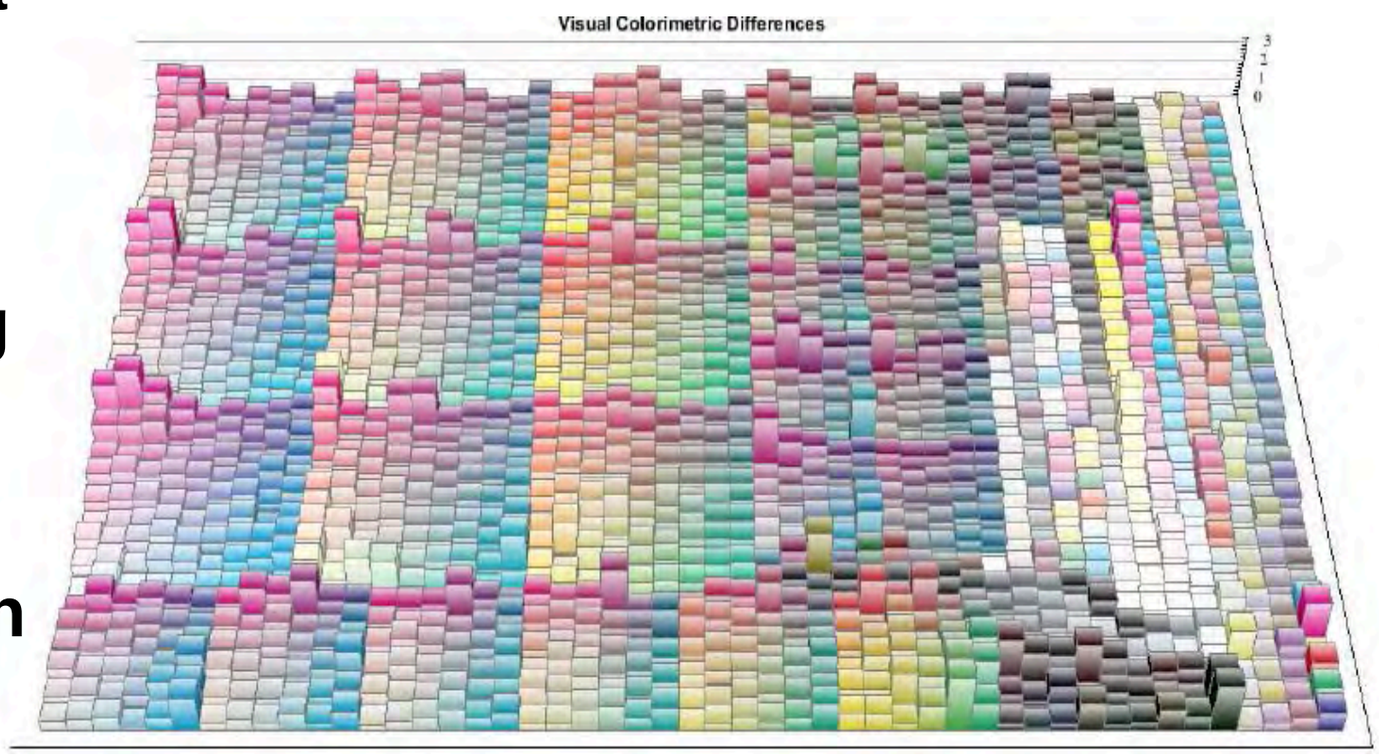
RGB - CMYK profile considerations

- **Converting to the correct CMYK values is a most important step in an accurate print production workflow.**
- **The visual densities of the colored inks using V lambda, shows us that the black ink is most responsible for print image contrast.**
- **Creating separations that are highly black dependent (GCR) make the files more difficult to print to match standard proofs due to normal print process variables like paper absorptivity in Offset printing and incompletely printed cells or skip-dot Gravure, Flexo.**
- **Spectral characterization data should be used at the maximum available measurement resolution to avoid finding out you have an OBA issue that was not obvious, and to provide for future enhancements in profile creation softwares.**

ICC Device Link Profiles - Color Transforms

- **ICC Device Links Provide a more accurate way to convert between CMYK color spaces than a Profile to Profile conversion going through Lab PCS**

- **Link Profile Transforms can retain pure primary and secondary color overprints**



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ICC Device link profiles

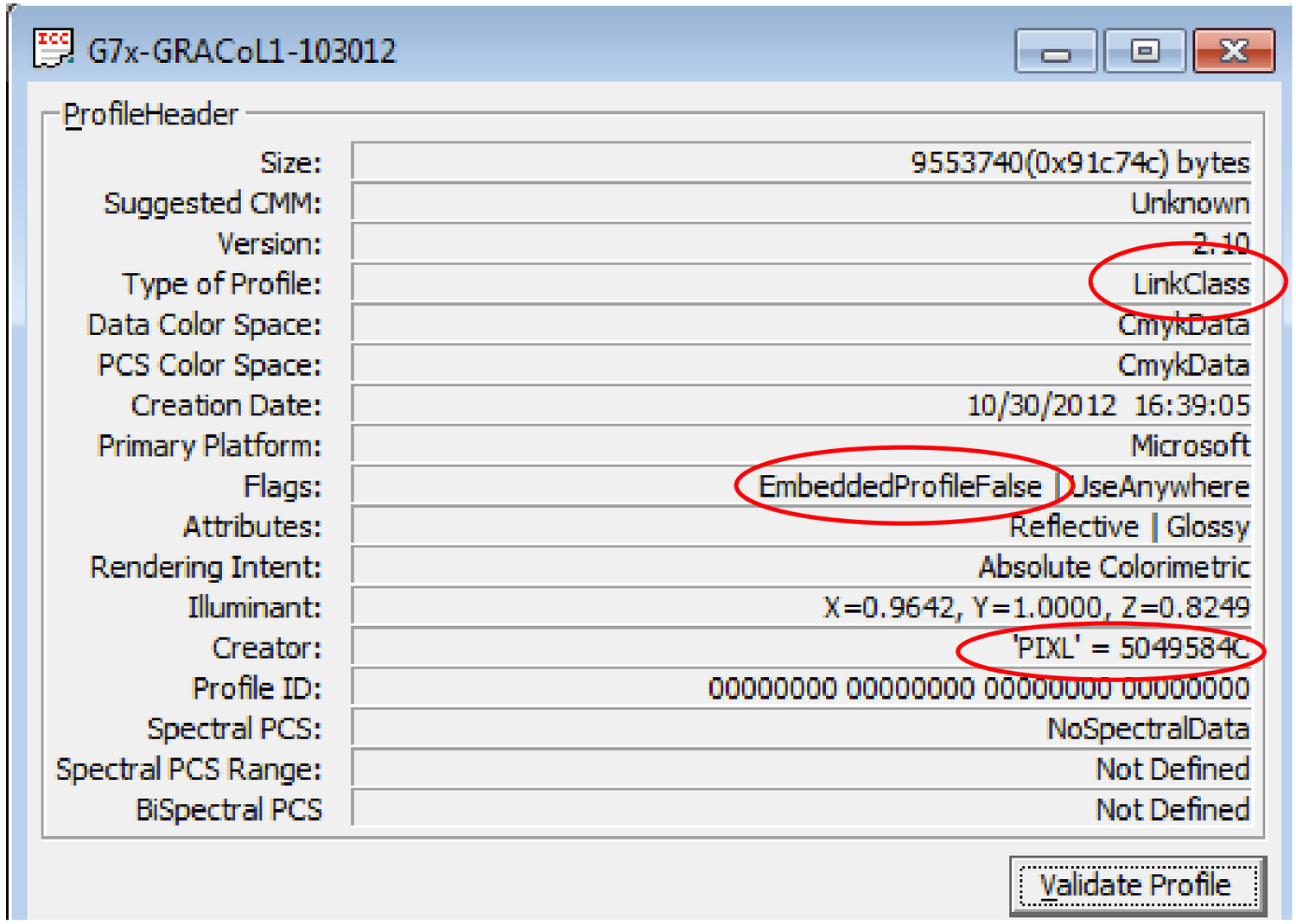
- **Device Link profiles, link a profile from a source device color space and a profile from a destination device color space using a mathematical look up table, to produce a profile that can be used to convert between these color spaces and produce a close match to the source color space in the destination space.**

- **Common uses for device Link profiles are a color correction profiles in printing, where the ink set and process produces different visual results than a standard proof, or in ink jet proofing where the color space of the device is different than the proofing aims.**

ICC Device Link's

- **Tag table review**

- **Simple profiles**
- **Header**
- **desc**
- **cprt**
- **pseq**
- **A2B0**



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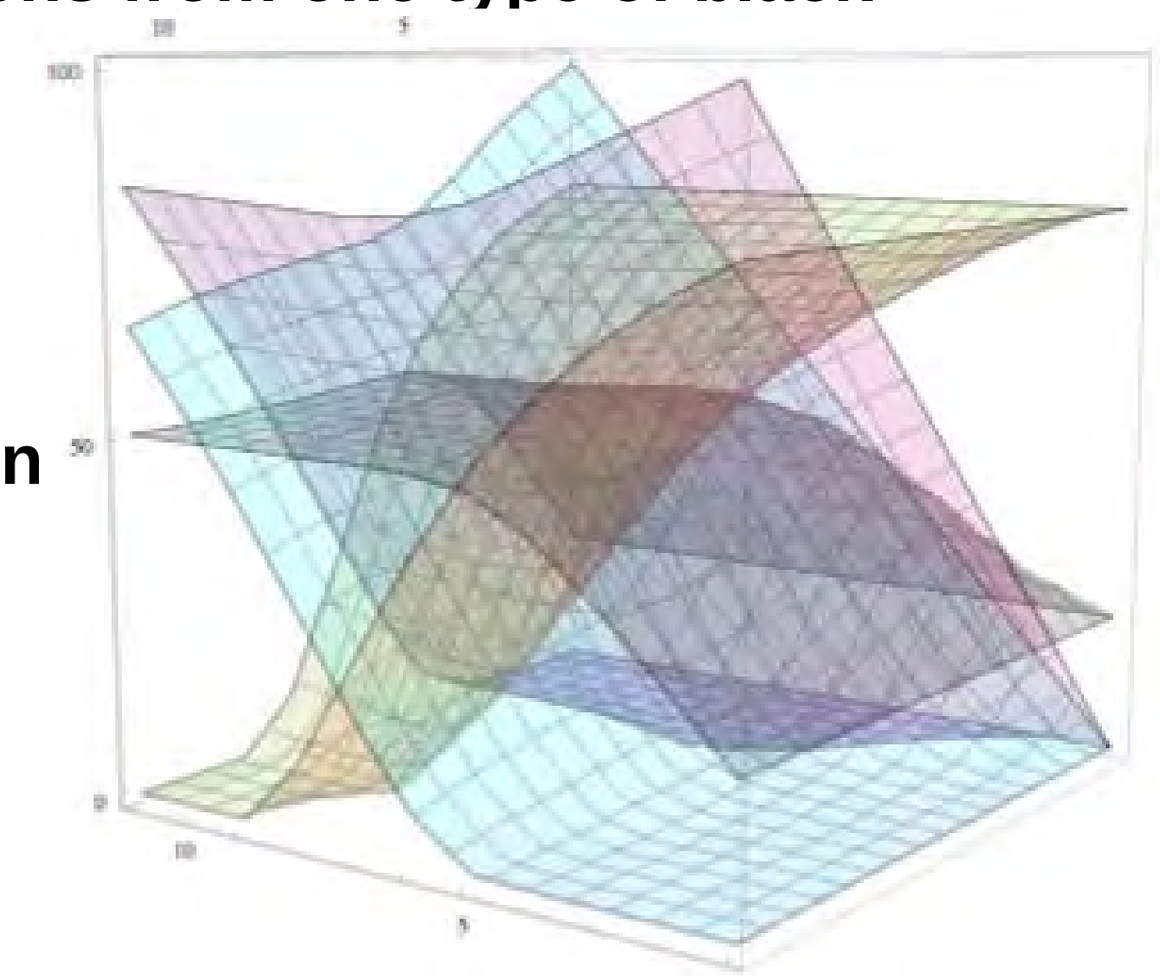
ICC Device Link Profiles - GCR

- **The safest way to convert files of one known CMYK Color Space to another, or change the separations from one type of black generation to another to allow for more color stability on press.**



- **The A2B0 tag tables must be created with the same CMM used in the rip to process page files so as not to increase transform errors.**

Thank you!

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