BALANCING 'AUTOMATIC COLOR' AND ARTISTIC INTENT: A ROLE FOR COLOR STANDARDS

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"A PICTURE IS WORTH A THOUSAND WORDS"

How much is it worth if you have no idea what it will look like?

STANDARDIZATION TODAY FOR COLOR MANAGEMENT:

Calibration

- Handled within each device, not typically a topic of standardization.
- Trade-offs are well understood.
- Practice is in place where feasible.
- Currently we have a significant implementation gap in the area of projectors and displays.

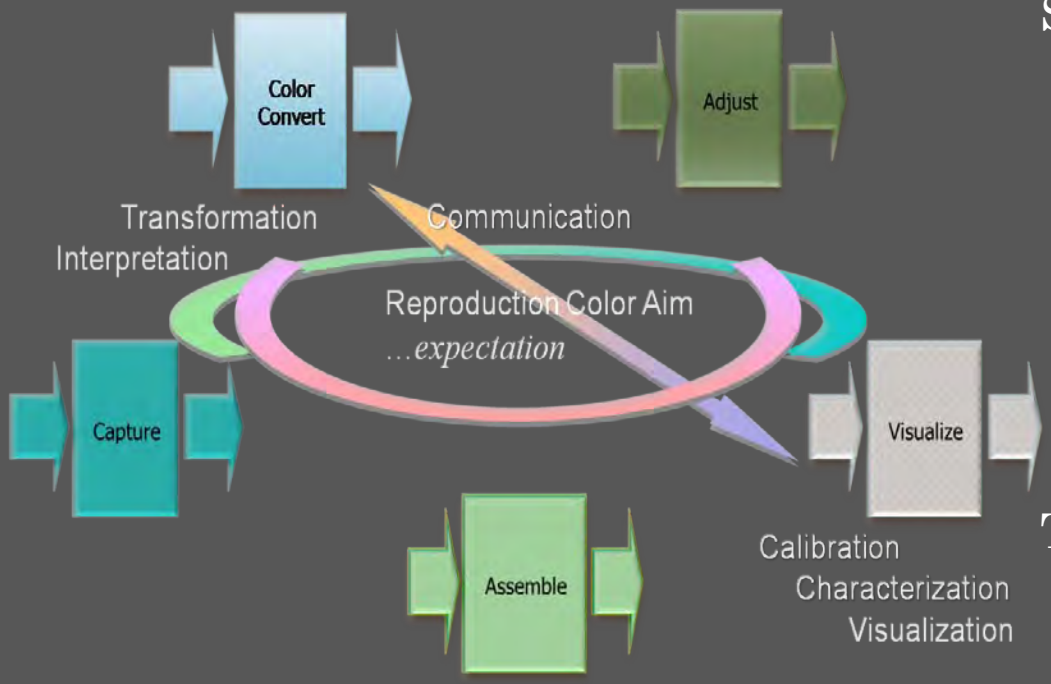
Characterization

- ISO standards are in place for graphic arts print conditions.
- Segments of the industry are grappling with characterizations for digital devices.

STANDARDIZATION TODAY FOR COLOR MANAGEMENT:

Communication

ICC profiles are carried in standardized digital content exchange formats.
Digital formats include color management controls, e.g., rendering intent.
Standardization is underway for workflow metadata for ICC profile selection.



Source Interpretation

Well established standardized exchange color encodings: sRGB, Adobe RGB, ROMM RGB, ISO 22028-1, graphic arts data exchange standards.
Ongoing standardization work is underway for named colors.

Transformation

Not standardized, remains with proprietary color engines, including some open source color management offerings.
Security issues blocking web CM.

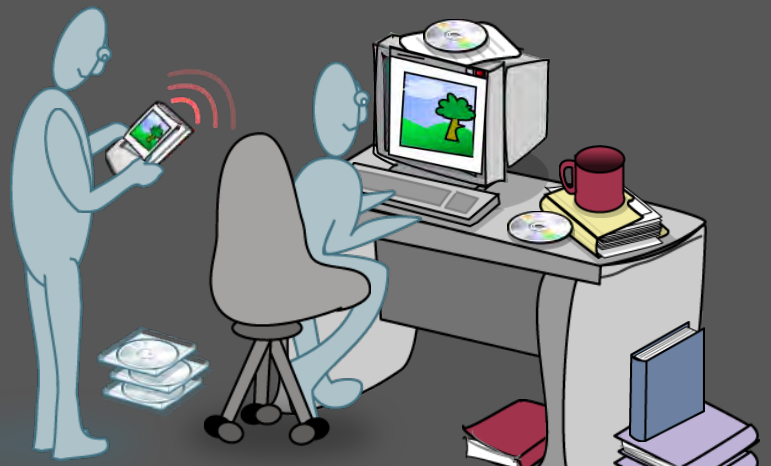
STANDARDIZATION TODAY FOR COLOR MANAGEMENT:

Reproduction Color Aim

ICC is considering to standardize a transform aim naming convention. Aims implementations remain in the purview of proprietary systems, with the exception of standard graphic arts print conditions.

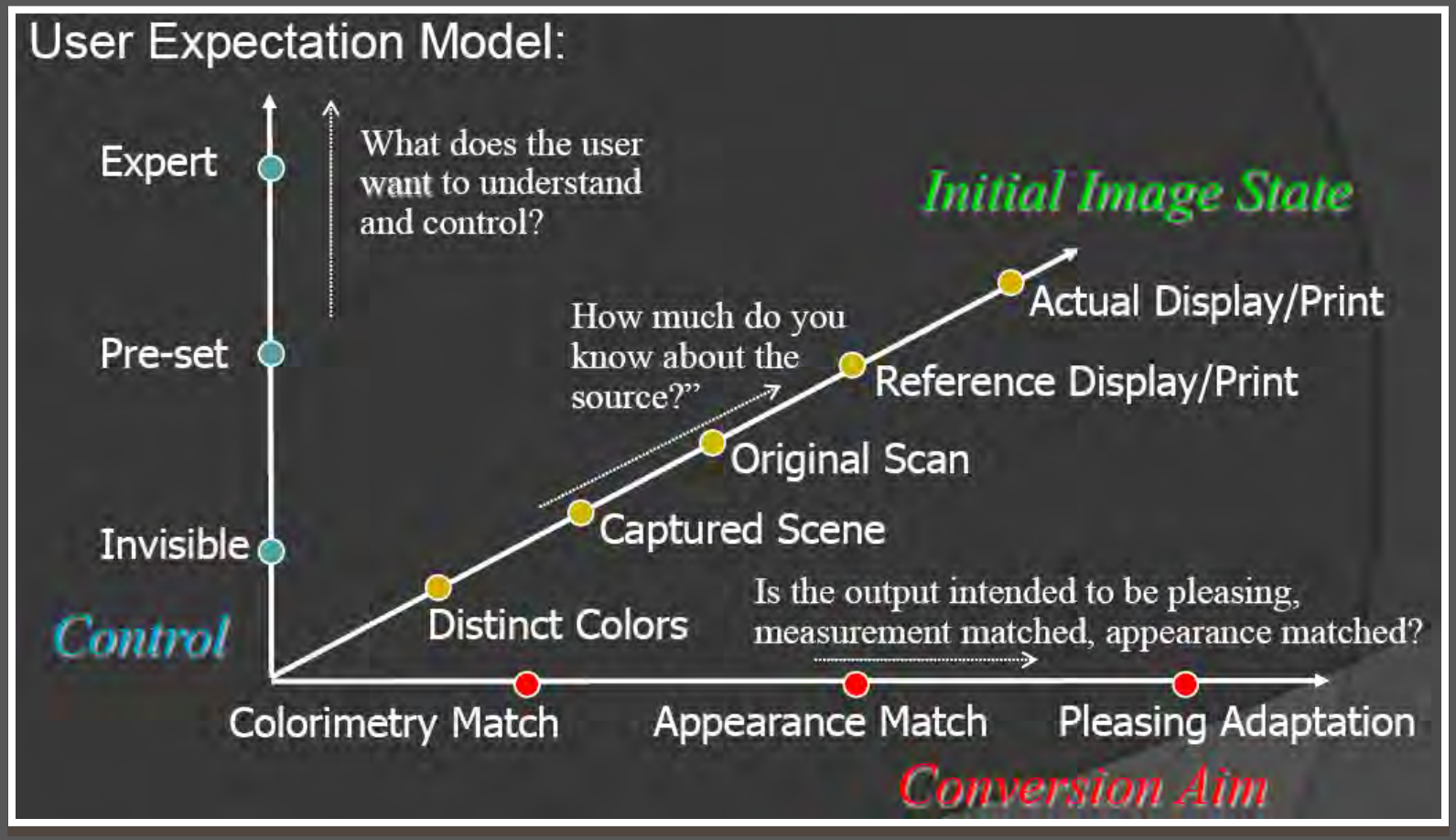
Visualization – the human element

Continuing rich area for research and reporting. 3D viewing is an ongoing standardization area for viewing conditions.



STATUS TODAY FOR COLOR SYSTEMS STANDARDIZATION

WHAT IS MISSING? UNDERSTANDING THE USERS' WISHES…



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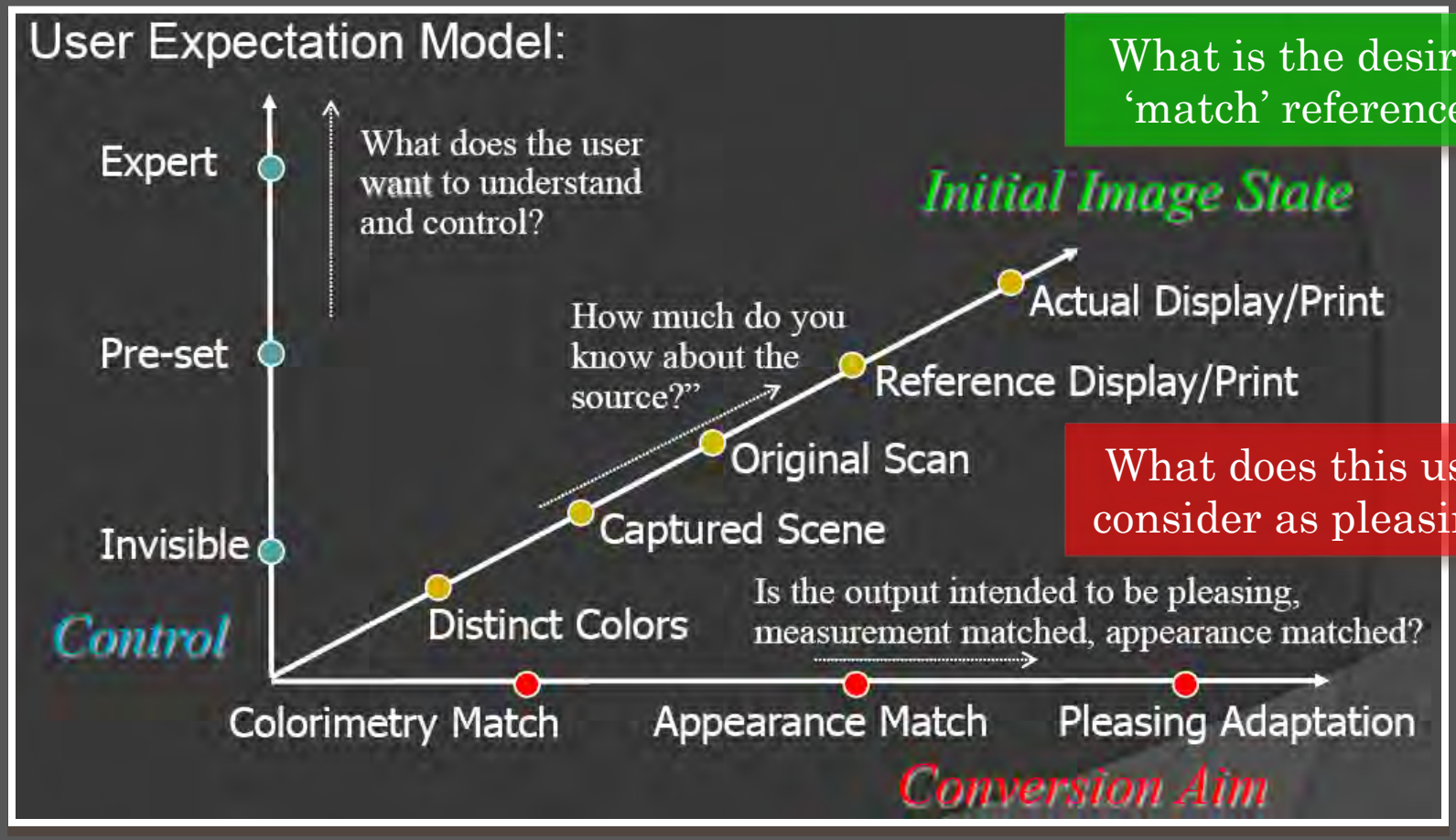


QUESTION

Are modern digital color users well served by "you press the button we do the rest?"

If not, can color interoperability standardization enable a capability to balance the 'automatic color' desired by many

- with honoring the *deliberate* creative user's reproduction intent
- with enabling the *deliberate* playback user's preferences
- with adapting to evolving display and print technologies?

Why this question now?

Digital capture, edit, and playback provide additional degrees of freedom for *deliberate* users – when enabled in common across systems.

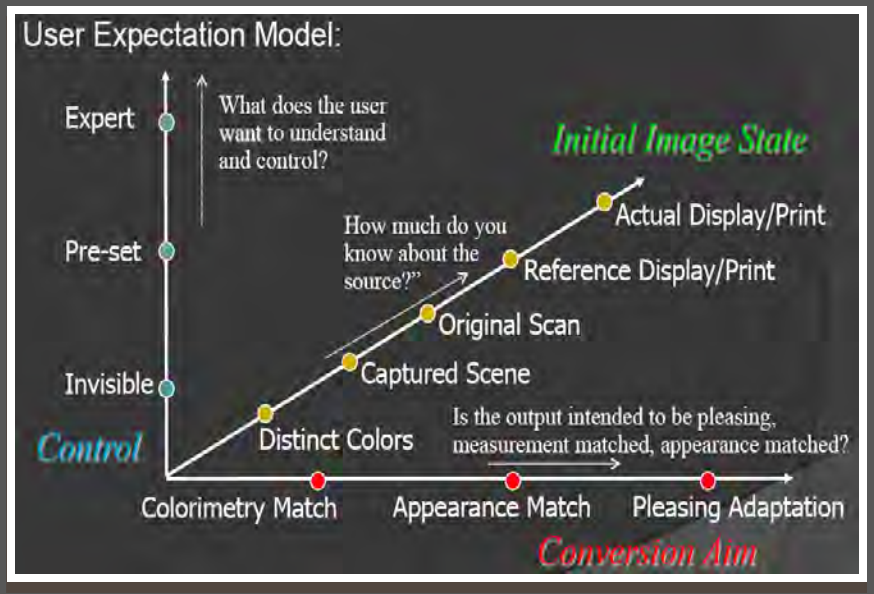
…and because avenues for visualization are continuing to expand.

STARTING POINT

Current cross vendor color workflows, having grown out of the days of film and analog print color, lack overt standardized digital mechanisms for:

- users who want control
- cases outside of the norm
- dealing with new variables in end-to-end color management.

Answering these unmet needs lies in the areas of Communication and Reproduction Color Aim:



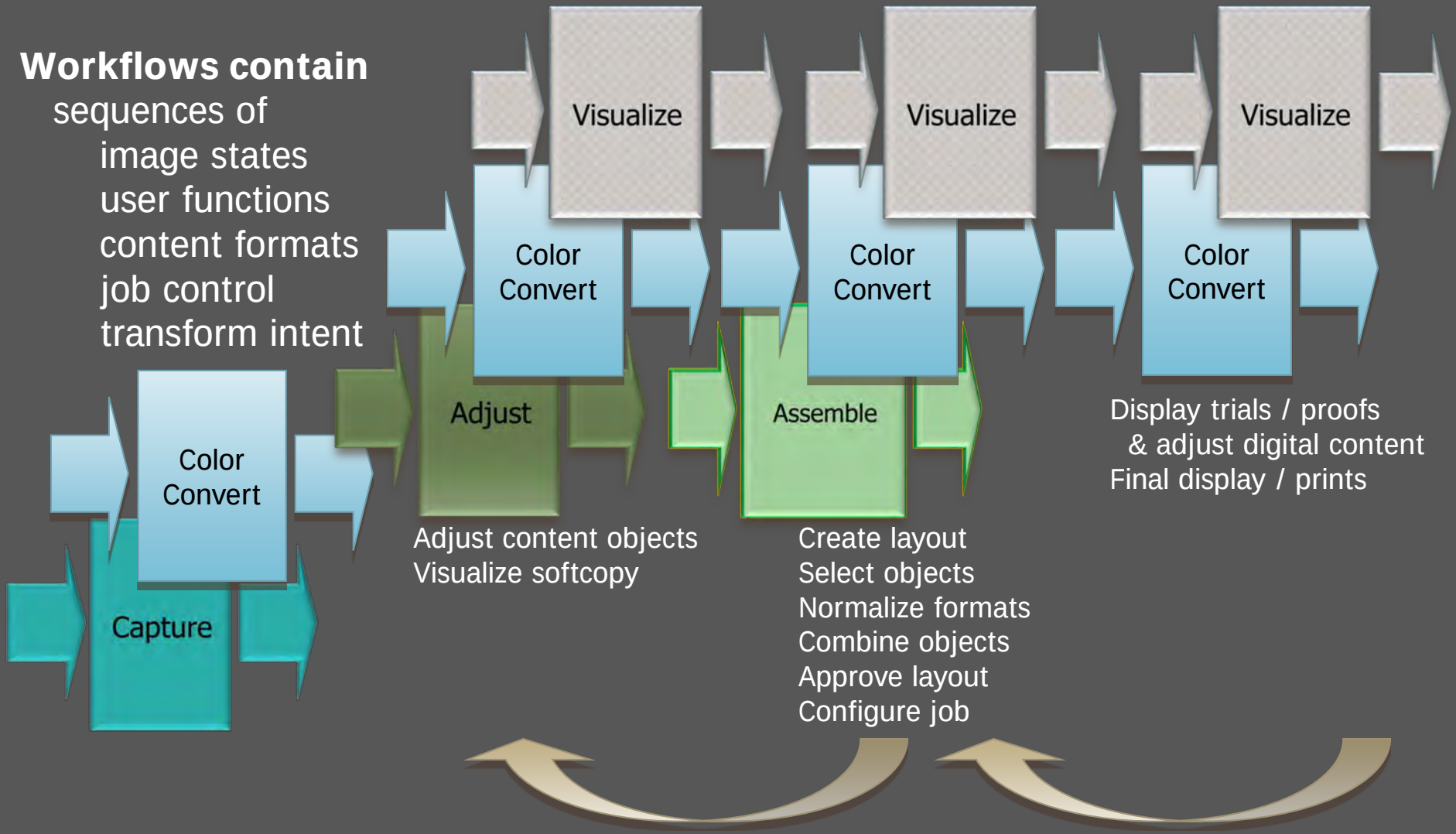
Communication

The capability to convey from one stage of a digital content workflow to another that which is needed to conduct operations according to the wishes of *deliberate* creative and playback users.

Reproduction Color Aim

The collected trade-off rules to govern device color rendition (e.g., gamut and tone mapping – including extrapolation) when rendering content between color space encodings or device conditions.

Workflows contain
sequences of
- image states
- user functions
- content formats
- job control
- transform intent



Keep in mind, when we think of the smarts for the "you press the button we do the rest" desired in perhaps the majority of non-expert situations, … combined with the capability to exercise the control desired by deliberate users, we have to think across multi-stage multi-display and multi-print workflows.

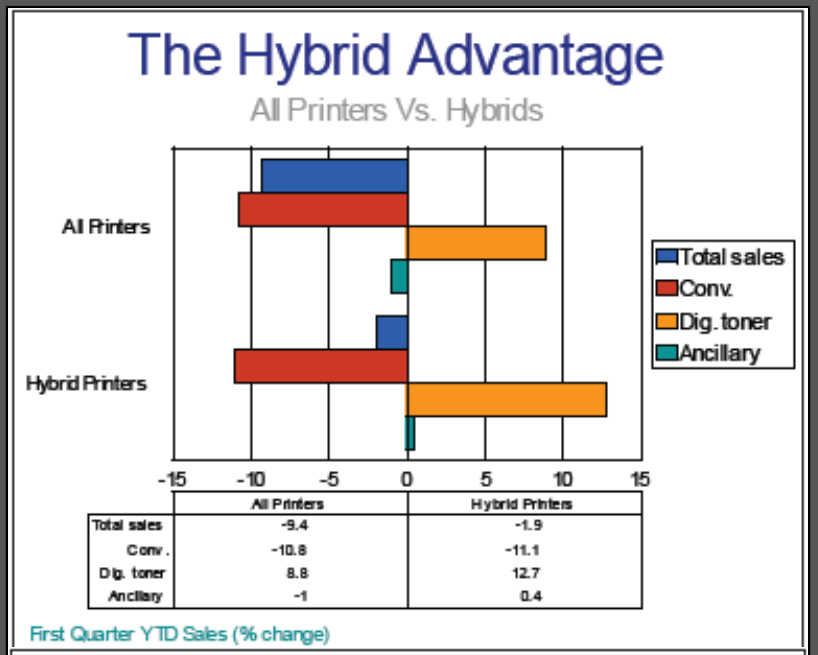
PRINT INDUSTRY

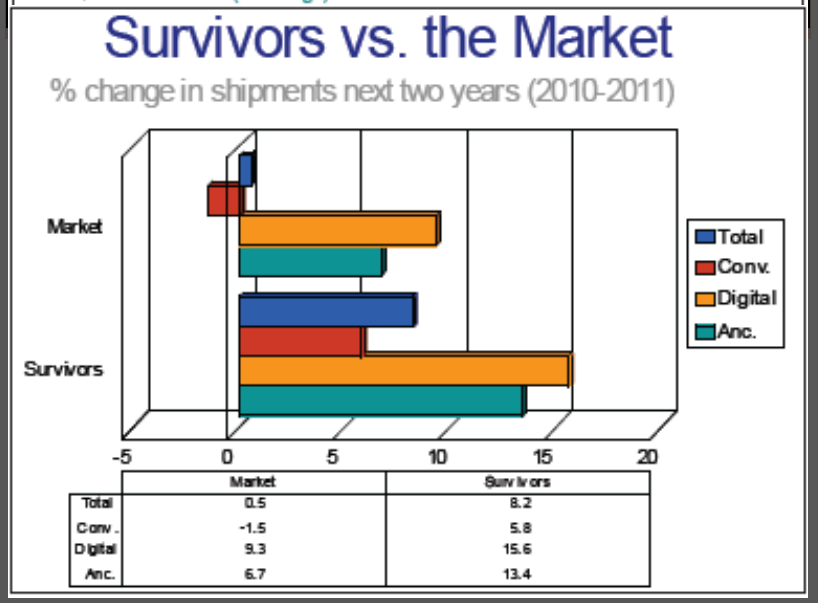
"…ink-on-paper print sales declined by 14.8 percent, pulling down the total. On the plus side, digital toner-based print, inkjet print, and printers' ancillary services all exhibited sales gains." *

"The overall decline in printing and consistent historical print industry lag relative to the economy makes it more impressive that digital (toner-based and inkjet) print has been increasing in real sales volume over the past few years through the current recession."

"Increasingly, both digital and conventional processes are used in the same job. Our survey results indicate that almost 12 percent of current jobs combine digital and conventional print."

"Looking deeper, we see that almost **one in four jobs performed by sales leaders (top 25% sales growth) are combination digital-conventional print**. In contrast, the comparable proportion for sales laggards (bottom 25% sales growth) is less than 5 percent."





* "Printing Industries of America Economic & Print Market Flash Report," Dr. Ronnie H. Davis, Vice President & Chief Economist, Volume 3, March 2010 (pertains to 2009)
"Mapping the Economy and Print Markets Post-Recession 2010–2011," Printing Industries of America Economics and Market Research Department, Dr. Ronnie H. Davis, Vice President & Chief Economist , Ed Gleeson, Manager

ONE SOLUTION: PROPOSED FOR PDF ISO 32000-2

Proposed to change "14.11.5 Output Intents" to:

Output intents (PDF 1.4) provide a means for matching the colour characteristics of page content in a PDF document with those of a target output device or production environment in which the document will be output.

The optional OutputIntents entry … holds **an array of output intent dictionaries, each describing the colour reproduction characteristics of a possible output device or production condition.** The contents of these dictionaries may vary for different devices and conditions. ...

With the explanatory NOTE 1: This use of multiple output intents allows the production process to be customized to the **expected workflow** and the specific tools available. For example, one production facility might process files conforming to a recognized standard such as PDF/X-1, while another might use the PDF/A standard to produce RGB output for document distribution on the Web. Each of these workflows would require different sets of output intent information. Multiple output intents allow the same PDF file to be distributed unmodified to multiple production facilities. ...

"Suggestions for extending the PDF syntax (as of ISO 32000-1) in the upcoming ISO 32000-2 standard,"
Olaf Drümmer, callas software GmbH, Berlin, Germany

E.G., RENDERING & PRESS DECISIONS TO ACHIEVE A REPRODUCTION COLOR AIM

Color production

- Grey balance
- Primary colorant colors
- Saturation density
- Substrate color and surface
- Spot color simulation
- Gradients & Sweeps
- Layered object color blending

Separations

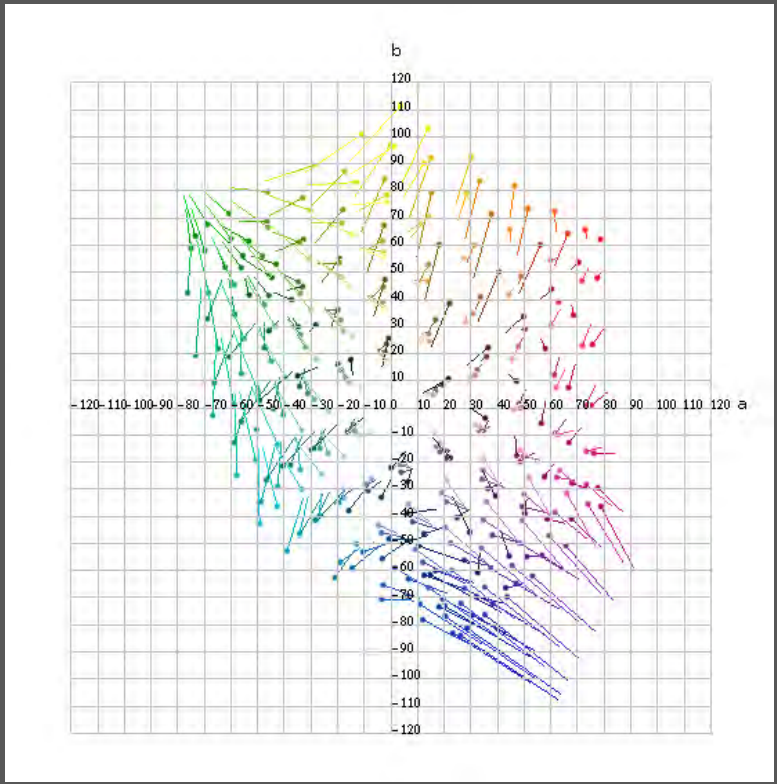
- Separation solid ink density
- GCR / UCR / UCA
- Knockout/overprint
- Highlight dot consistency
- Total halftone dot area coverage
- Separation registration
- Trapping
- Per separation print contrast
- Colorant laydown order
- Colorant interactions

Screening

- Dot gain - TVI
- Linescreen resolution
- Line width control
- Digital halftone
- Screen rulings
- Screen angles
- Dot placement accuracy

V4 GENERATION ICC WORKFLOW

- E.G., RENDER FROM THE SOURCE TO PCS



V4 sRGB gamut plot from "ICC v4 Perceptual Rendering Intent: Applicability & Construction," Jack Holm & Ingeborg Tastl, ICC DevCon'06

The ICC V4 Preference sRGB profile uses a LUT in the preference transform [perceptual A2B] to provide a 'print-referred' look in PCS.

When printed through a compatible V4 print system, experiments show that this approach can decrease differences seen between prints from different print systems.

On the other hand, the prints may not match the typical sRGB calibrated monitor as closely as may V2 sRGB prints.

This is a partial solution, limited by the fact that the wide range of visualization devices are not equally capable to portray the print-referred PCS rendition.

V4 ICC RENDERING VARIANTS

Adobe RGB original

Re-encoded in V2 sRGB for display

Re-rendered to ‘print look’ V4 sRGB

From the candidate image set of “ISO 12640-4 Graphic technology — Prepress digital data exchange — Part 4: Wide gamut display-referred standard colour image data [Adobe RGB (1998)/SCID]“

V4 ICC WORKFLOW VARIATIONS

source image states*

output transform options

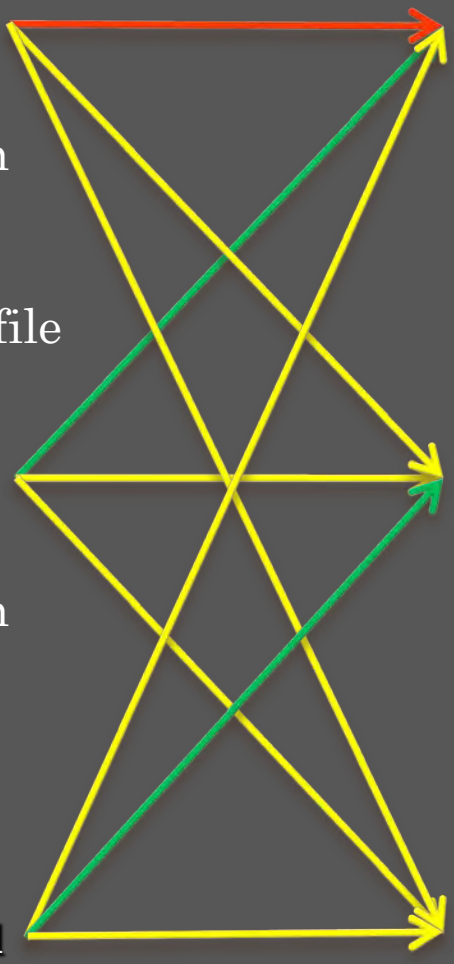
scene-referred

dependent on perceptual rendering of source profile

display-referred
(sRGB)

dependent on the chroma and tone of the content

print-referred



Output Profile – perceptual V2 rendering (assumed display sRGB input)

Output Profile – perceptual V4 rendering (assumed 'PCS print look' input)

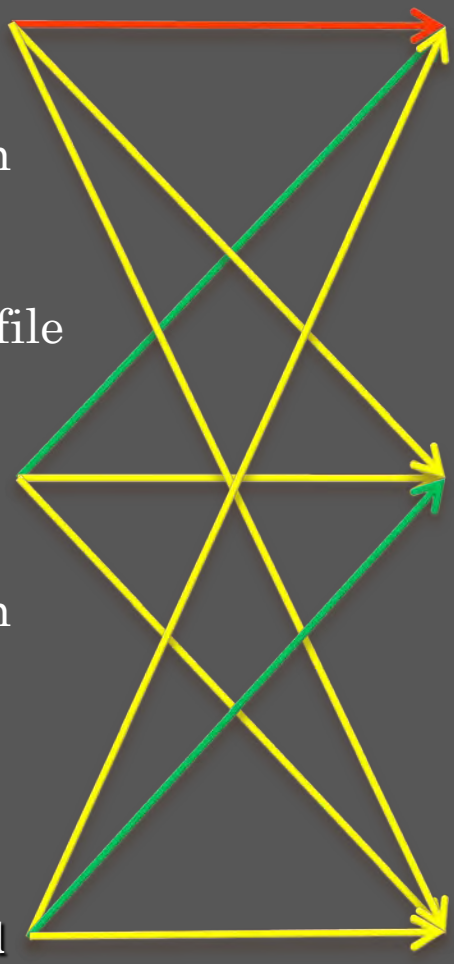
Output Profile – colorimetric re-encoding (assumed constrained 'PCS print look' input)

* ISO TC42, ISO 22028-1 Photography and graphic technology — Extended colour encodings for digital image storage, manipulation and interchange — Part 1: Architecture and requirements, 2007

V4 ICC WORKFLOW VARIATIONS

source image states*

output transform options



scene-referred

dependent on perceptual rendering of source profile

display-referred
(sRGB)

dependent on the chroma and tone of the content

print-referred

Output Profile – perceptual V2 rendering (assumed display sRGB input)

In fact, the number of rendering result variations is much greater than shown here – due to the available range of perceptual and saturation intent transforms.

Output Profile – colorimetric re-encoding (assumed constrained 'PCS print look' input)

* ISO TC42, ISO 22028-1 Photography and graphic technology — Extended colour encodings for digital image storage, manipulation and interchange — Part 1: Architecture and requirements, 2007

UNDERLYING DISCONNECT:

Device-specific control for each output may be specified from the source and then forwarded to each point of visualization, as in the PDF ISO 32000-2 example.

This method does not address certain needs:

- the content is later to be displayed on an unexpected medium
- the content is converted to another digital format
- the creative user is not capable to make all of the device-specific control decisions for the desired display or print media.

Implicit embedded 'creative user reproduction intent' + unexpected display medium characteristics = dissatisfaction under some valid conditions

Fundamentally, the tactic of estimating each specific display medium situation and specifying device-medium trade-offs for each of those situations cannot extend sufficiently to handle the unexpected and diverse display media we will see in the future.

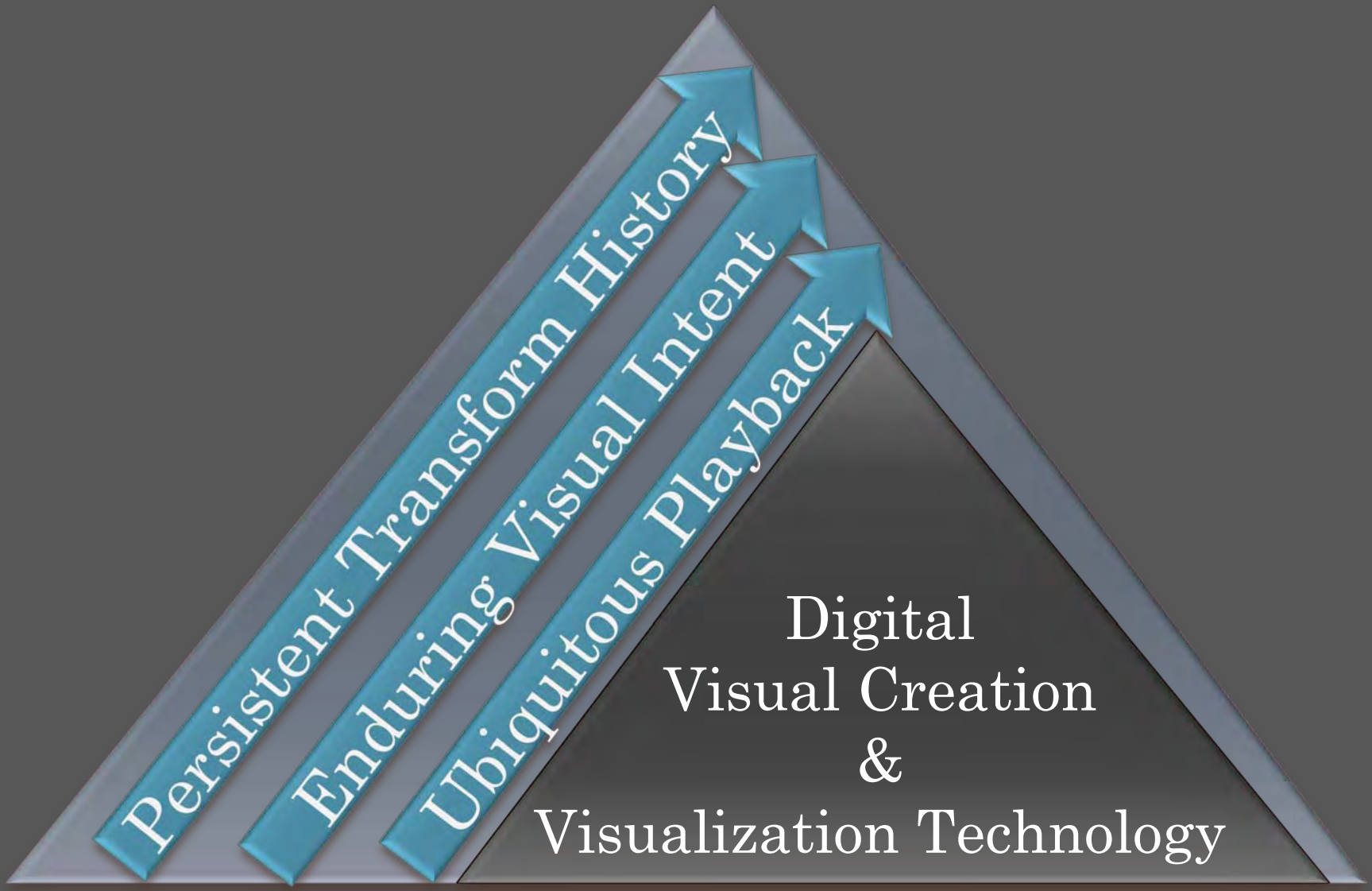
E.g., as we see the increasing importance of selected special colors and colorants, increasing use of special effect pigments (with such as angle dependent color effects), shifting emphasis to multiple distributed stationary digital displays, 3D digital displays, transitory proximate mobile displays, …

THE AUDIO METAPHOR

creation stage expert controls

Made possible by:
- **Robust distribution encoding**
- **Adaptation in each 'playback'**
- **Commonly defined parameters for local instance rendition tuning**

playback stage – commonly available playback parameters apply the intent of the creator within the capability of the device and enable influence by the playback user



ENABLED BY STANDARDS

ICC METADATA TAG

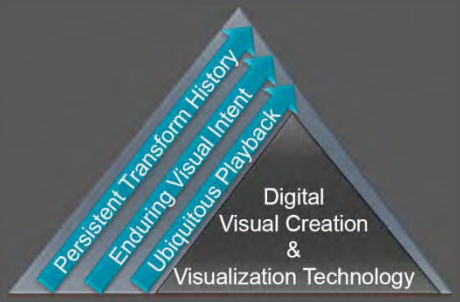
The ICC has standardized the dictionaryType and metadataTag structure that can perhaps be useful in addressing this need.

2. The acceptance of this proposal will result in:
A tag type and tag to be added to the next minor revisions of the ICC.1 specifications, both ICC.1:2001-04 (version 2) and ICC.1:2010 (version 4). The establishment of an ICC metadata registry on the ICC web site.

3. Nature of the proposal
This proposal defines a new tag type for use in optional tags. This proposal includes establishing an ICC metadata registry. This proposal defines an optional new tag using this new tag type.

The new type and tag are defined for use in providing information for automating profile selection and/or color transform selection.

Provided with source content, in a source ICC profile, the metadataTag is an available content-format-agnostic mechanism that can be considered for more general use to convey the visual intent of associated source content.



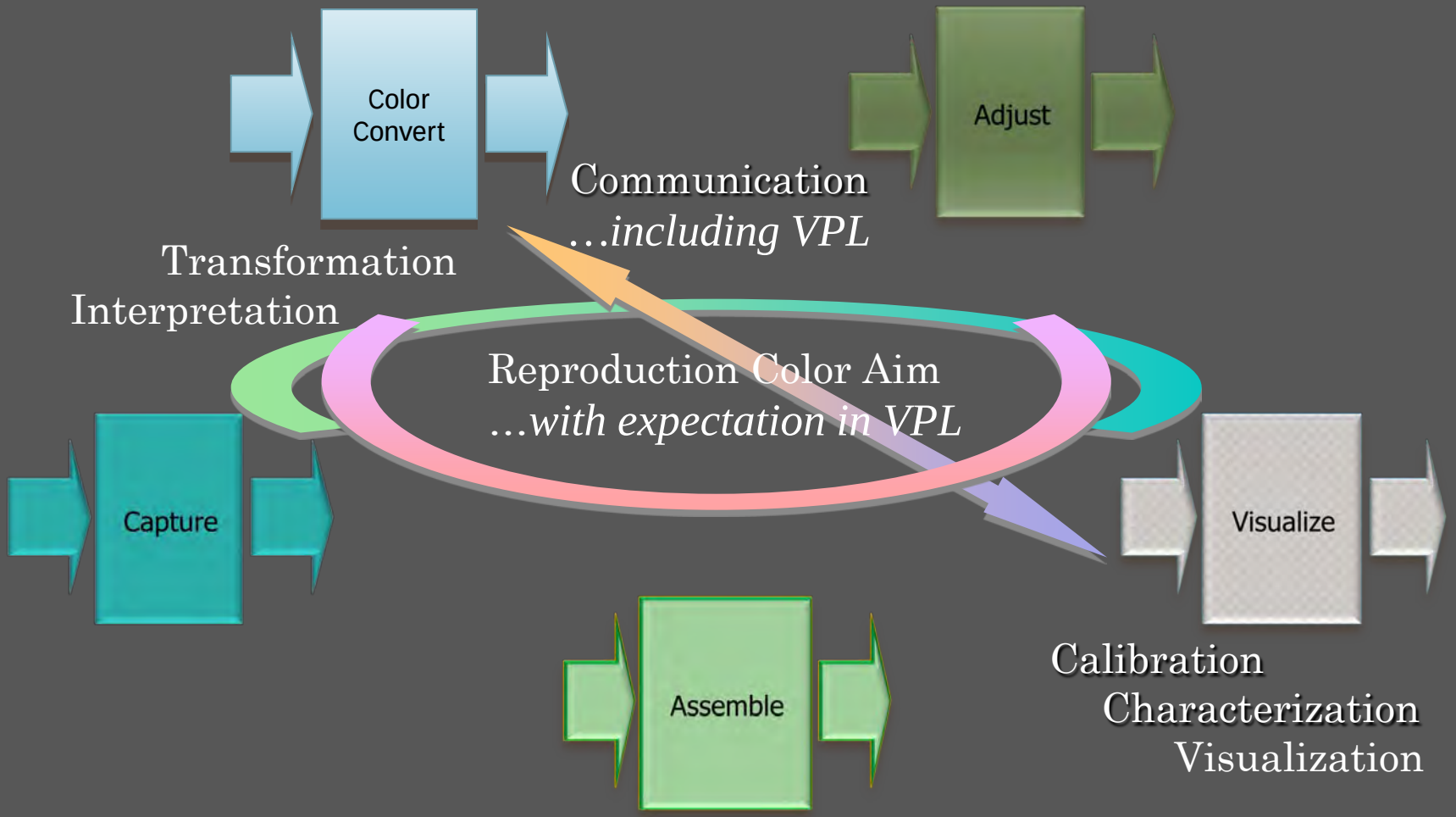
STANDARDIZATION OPPORTUNITY: PARAMETERS AND PARAMETER VALUES FOR

- PERSISTENT TRANSFORM HISTORY
- ENDURING VISUAL INTENT
- UBIQUITOUS PLAYBACK CONTROL

Communication of visual intent and meaningful playback controls will require establishing a standard **visual preference language (VPL)**:

- including parameters and parameter values to influence digital color rendition
- interactions between the VPL parameters and the appropriate models of human color perception
- interactions between the VPL parameters and the color transform processes used to accomplish color management through sequences of edit and playback.

VPL parameters will be intended to influence color management mechanisms for digital color content visualization.


Color
Convert
Adjust
Communication
…including VPL
Transformation
Interpretation
Reproduction Color Aim
…with expectation in VPL
Capture
Visualize
Assemble
Calibration
Characterization
Visualization

THANK YOU