

WhatTheyTh!nk

Presented By :

Don Carli



TECH OUTLOOK: APPEARANCE MANAGEMENT

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“It’s difficult to make predictions... especially about the future.” ~Niels Bohr.

Figure 4.1:

Market factors likely to impact demand for solutions based on iccMAX by 2022

Market Factor	Significantly Decrease	Slightly Decrease	Neither Decrease nor Increase	Slightly Increase	Significantly Increase
Metallic, pearlescent, fluorescent and other special effects requirements	0%	0%	4%	26%	70%
Expanded gamut printing applications	0%	0%	7%	44%	48%
Industrial hyperspectral imaging for agriculture, security, food and drug processing, etc.	0%	0%	14%	48%	39%
Adobe Creative Suite Support for iccMAX	0%	11%	21%	39%	29%
Consumer spectral imaging applications	0%	0%	24%	48%	28%
Track and trace requirements	0%	5%	52%	24%	19%
Cross-media marketing	0%	0%	46%	43%	11%
Variable data publishing	0%	11%	75%	4%	11%
Consumer safety regulations	0%	0%	64%	32%	4%
Changing workforce demographics	0%	0%	69%	27%	4%

Q. To what extent do you believe the following market factors will decrease or increase demand for new color management solutions based on iccMAX by 2022?

Source: Nima Hunter Inc. Delphi Poll of color experts n=37



Discovering a New World of Color and Appearance Management Solutions

A special thank you to the co-chairs and members of the task force for their support, time, and effort during the creation of this study...

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What's the value of solving retail returns due to appearance failure?

\$849.9B

Estimated Total Price of Retail Returns in 2025

15.8% of annual U.S. retail sales. Online returns are estimated at 19.3%.

Plus, each return costs retailers between \$10 and \$65 to process.

Retailers see returns. Brands see complaints. Converters see reprints. No single party sees the full cost structure.

9.5 billion pounds of returned goods end up in U.S. landfills annually.

How much of these return costs are appearance-related?

What is appearance management?

Not a contest with color management. An inheritance from it.

Approved
reference

COLOR MANAGEMENT — the workflow you already run

Characterize

Output

Measure

Tolerance

Did we reproduce the intended color within measurement tolerances?

APPEARANCE MANAGEMENT — the same workflow, extended

Characterize

Output

Measure

Tolerance

+ gloss, foil, raised clear,
texture, pearlescence, etc.

Did we reproduce the intended appearance under the conditions that matter for acceptance?

Appearance management does not replace or obsolete color management, it builds on it.

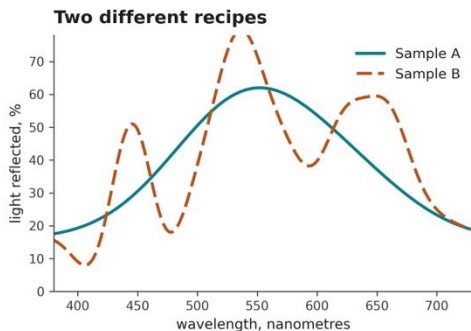
Different measurement methods answer different questions

None captures the whole appearance problem.

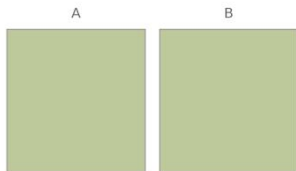
Method	What it answers
Spectrophotometry	How a material responds across a spectrum of wavelengths
Goniometry / multi-angle	How that response changes with lighting and viewing angle
Profilometry	Height and texture
Imaging	Where an attribute appears across the surface

The right question is not which instrument is most complete. It is which attribute is deciding acceptance.

The light changed. Nothing else did.

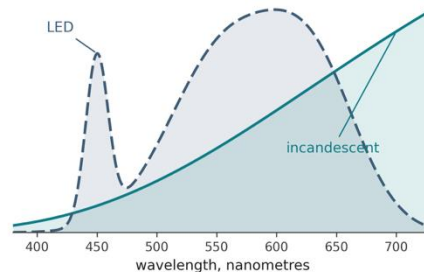


Under the approval light

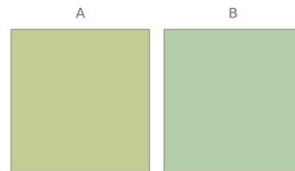


They match.

Two different lights



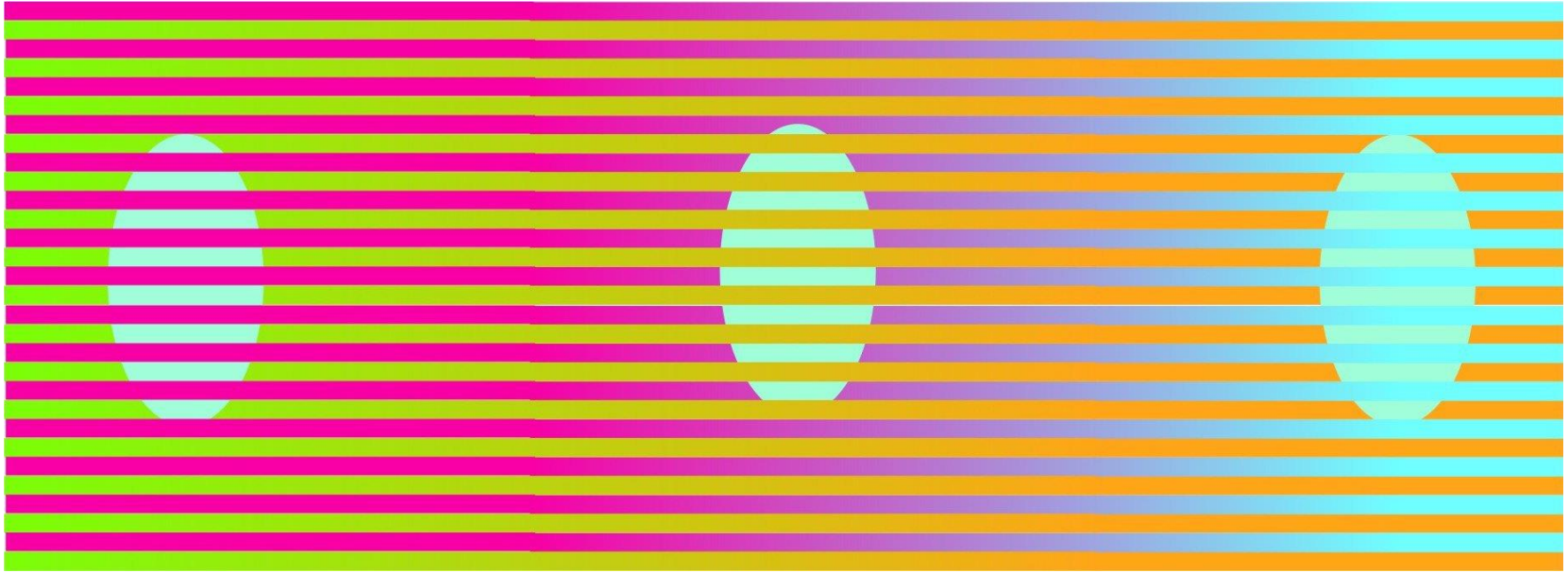
Under the light at home



They no longer match.

Measurement characterizes the stimulus. Models can estimate aspects of observer response. But acceptance tolerances still have to be defined.

Your eye is doing arithmetic you didn't ask for



Munker-type illusion by David Novick, University of Texas at El Paso. Source: Journal of Illusion.

Why digital embellishment makes the gap visible

Same carton. Same light. Two viewing angles.

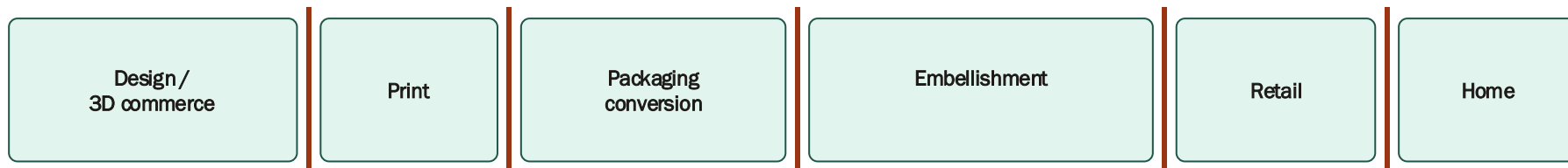


Straight-on — spot color reads true **Oblique** — foil and raised clear catch the light

Color management didn't fail. The product acquired attributes the color management record does not describe.

Why brands, retailers, designers, and converters should care

There are six or more governed domains to manage, but the seams between them are largely ungoverned.



- What reference is each domain working from?
- Who keeps the evidence after the handoff?
- What conditions define acceptance in each domain?
- Who sees the failure if it happens downstream?

Every seam is a handoff. What doesn't travel is critical measurement data, tolerances, metadata, and acceptance conditions.

The approval reference has moved beyond anyone in production's control

Color

Measured, specified, signed off

Digital file
colour specified

Ink and material
the physical recipe

Printed result
measured in a booth

Approval is signed here

Appearance

Outside anyone's production control

The room light
LED, and it varies

Viewing angle
surface and angle

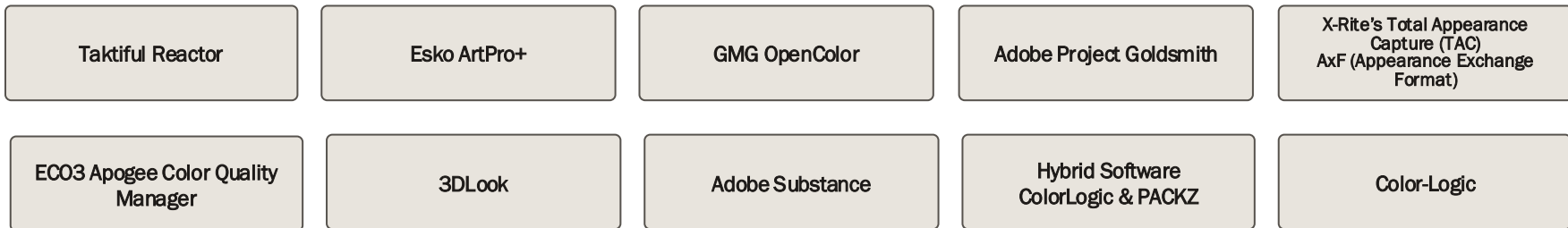
Their own eyes
no two people match

Looks right, or looks wrong
the only verdict that counts

Tools and standards now emerging*



Not every useful connection has to be open, vendor-neutral, end-to-end, or formally standardized to be worth having.



Where appearance matching fails

Four places a match can fail — even when the color workflow is doing its job.

1 Measurement gaps

If the scan misses fine texture or flake behavior, the digital record is thinner than the object itself.

2 Rendering shortcuts

Online viewers simplify light and reflection to move fast. Fine for most products — not for foil flash or gloss.

3 Screen vs. object

A display emits light. An object reflects it. The buyer also brings expectations a color number can't capture.

4 Production drift

A digital model represents one ideal target. Varnish, foil pressure, and curing all vary — production is not one target.

“It looks wrong” is the start of the investigation, not the root cause.

Measures that can close the gap

Match the evidence to the failure you're actually seeing.

1 Richer measurement, where needed

Not everywhere. Most jobs do not need per-pixel spectral, angular, or topographic data.

2 Compare screen to physical

Under declared lighting, against a real sample — not just an attractive on-screen preview.

3 Controlled proofing

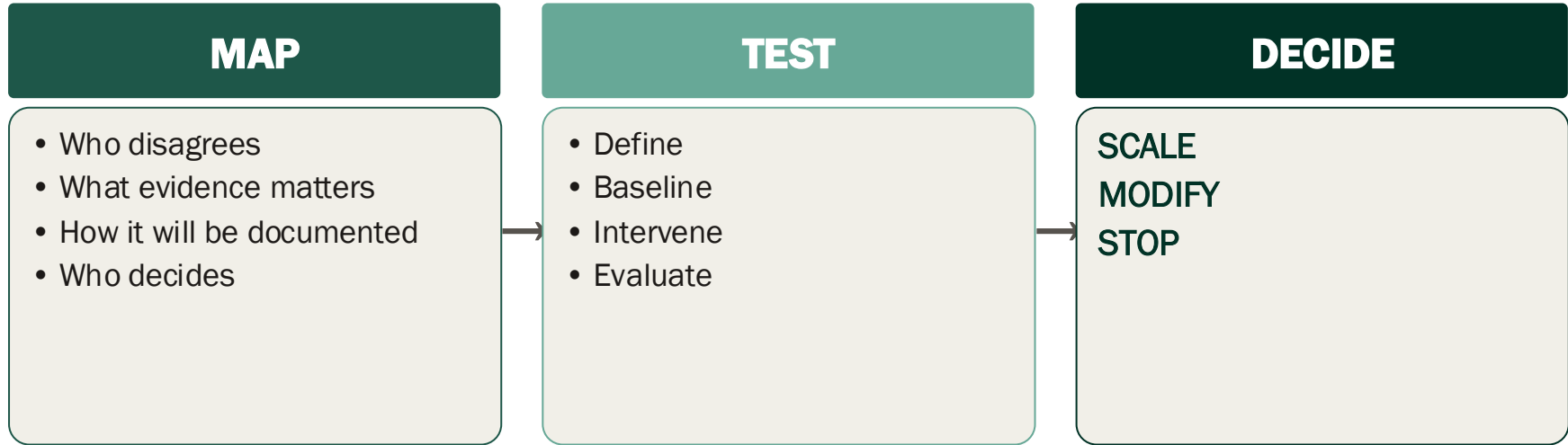
Under the conditions where people will actually judge the work, not the conditions that are convenient.

4 Tolerance models with real variance

Reflecting how the process actually behaves, with feedback loops where that's practical.

Stage 0 is research, not procurement. Test what twelve people told you against two hundred.

What a credible pilot should do



If your pilot cannot produce a stop decision, you have designed a purchase with extra steps.

Pilot A: an embellished carton

PILOT A — an embellished carton

Business question	Why does this account keep rejecting work that measures in spec?
Acceptance conditions	Booth + retail LED. Normal + oblique angle. Foil and raised clear only.
Observer named	The account's packaging QA lead — not an average observer.
Evidence	Rejection rate at that account, and whether rejections cluster by condition.
Decision date	Fixed before the pilot starts.



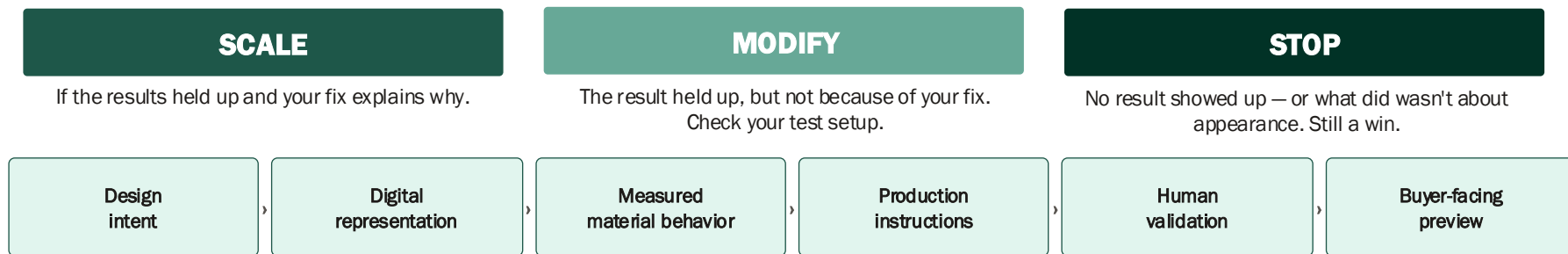
Pilot B: Two shops, one shade

PILOT B — two mills, one shade

Route A / B	Site A: direct-to-fabric pigment. Site B: dye-sublimation transfer.
Acceptance conditions	Retail LED + warm domestic lamp, normal view, side by side.
Baseline	Both paths measured under both illuminants before anything changes.
Evidence question	Do the two paths diverge under one light and agree under the other?



Where appearance management pilot projects can go



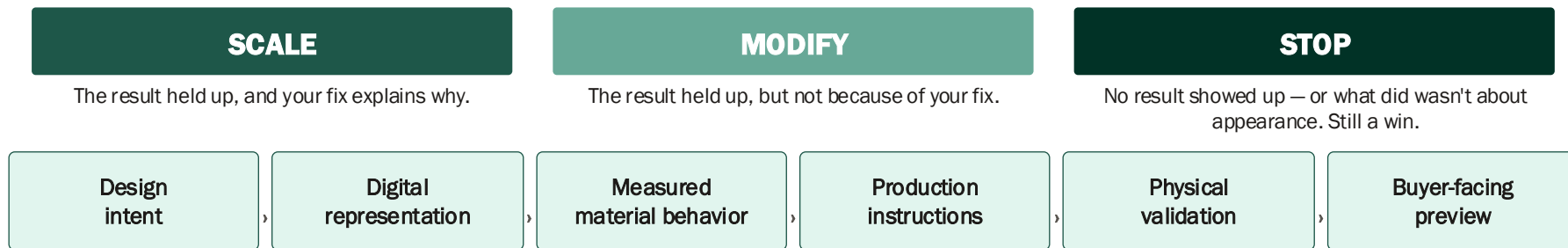
Nothing in this chain works start to finish today

Digital representation predicts. Physical measurement characterizes. Human validation connects the two.

If you remember one thing: The need for appearance management is not a claim that color management failed.
It's recognition that the object, the reference, and the customer's viewing conditions are more complicated than the data color management carries today.

Achieving an end-state vision for total appearance management

Collaborate on multiple pilots and decide in advance what each outcome should look like to gather evidence.
Then seek consensus on standards for measurement, tolerances, modeling, validation, and governance



Digital representation predicts. Measurement characterizes. Human observation and measured validation connects the two.

Remember this: The objects, the reference measurements, and the customer's approval conditions got more complicated than color management data alone carries, so new measurements, appearance models, and governance rules are required

If you ask me what happens next

Not a forecast. Not a recommendation. Just where I'd put my own money.

1 Narrow pilots scale first

One handoff, one SKU, a decision date set before you start. Not a consortium.

2 The formats stitch together

iccMAX, gTF, and MaterialX/OpenPBR end up side-by-side. Nobody is declared a winner.

3 Accountability lands by default

With whoever owns the customer relationship — not because a body assigns it.

4 Observer question outlasts measurement

Better sensors arrive before better answers about whose judgment counts.

Q&A



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Where to go next

MY WRITING ON THIS

The \$850 Billion Retail Return Problem Nobody Owns... Yet

She Never Saw Your Proof. And She's the Customer.

Most Digital Textile Printing Failures Start After Approval

Why Brands and OEMs Should Fund Appearance Management Pilots in 2026

Where the Appearance Chain Breaks

whattheythink.com

WHERE THE WORK IS HAPPENING

International Color Consortium

color.org · *iccMAX / ISO 20677*

Khronos 3D Commerce Working Group

khronos.org/gltf/3dcommerce · *glTF for e-commerce*

Academy Software Foundation

aswf.io · *MaterialX and OpenPBR*

ACM SIGGRAPH

siggraph.org · *annual conference*

All of these groups are open. You can read the specifications and take part.

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