

THE SECOND C: A Higher Class of Problem, Part 2

By Keith Hoover

Ptolemy was a second century mathematician, astronomer, and geographer. For over 1,200 years, his book, *Almagest*, provided Classical and Medieval Europe with the foundation for a scientific understanding of the universe. It was exhaustive and meticulous in its scope, covering Aristotle's cosmology, spherical trigonometry, the motion of heavenly bodies, the determination of global latitudes, the predicted length of days and years, the motion of the sun and moon along with their relative distances to the earth, and a catalog of 1,022 stars.

Popular culture would have us believe that the conventional wisdom of those who lived 2,000 years ago were limited to primitive concepts such as a flat earth. However, Ptolemy stated one of his core arguments thusly: "The Earth, in relation to the distance of the fixed stars, has no appreciable size and must be treated as a mathematical point."¹ He clearly had a sophisticated grasp of the immensity of the universe.

Relative to our understanding of the universe, Ptolemy got a lot of things right. A lot, except the main thing. Ptolemy thought that everything revolved around the Earth.

About 1,300 years later, Nicolaus Copernicus proposed that the sun was the fixed point in heaven around which the Earth and planets revolved. This new idea did not necessarily invalidate Ptolemy's other theories, but it did place things in a different perspective.

The same can be said for color today. Color management in our industry has traditionally been narrowly focused on product color accuracy. However, color is a part of many product design and development processes and sub-processes—not just lab dips—all of which should be tied to an immovable digital specification but are not. Textile color management is mature, but not the center of the apparel universe.

Heretofore, I have focused on the journey from visual lab dip driven processes to a digital one. And we have seen that commercially scalable digital color management that eliminates the need to send lab dips on trips around the world is not only feasible, but optimal. As with all journeys, we have arrived at the destination, which (contrary to what some believe) is in fact the point of a journey. So, let's reconsider our model of the color universe and expand our reach.

PRODUCT DESIGN AND DEVELOPMENT

Photoshop, Illustrator, 3D garment design software. To someone entering the design team today, these are the tools of the trade. AI-assisted tools like **NewArc.ai** are the next cool thing. But these digital tools, as a class, have entered the market over the past few decades on a steep change curve. Features have increased exponentially, and SaaS-based models have enabled never-ending updates and add-ons. As such, "acquired knowledge" about using these tools quickly becomes obsolete.

IT is now an integral partner in design departments (much to their chagrin) because of these design tools' reliance on networks, hardware, and techy stuff. IT's main focus has been on evaluating new tech, assuring network security, and getting it to work. How the tools are used is up to each designer. Making sure the tools work is up to IT.

Color Relativism

Irrespective of the technology in use, design still depends on composition and color. The ability to simply define and render shapes is a key feature of digital design tools. And color-pickers simplify color selection. Or do they?

If I draw a square in Software A and send the file to designers at other workstations, they will see the same square. Likewise, sending the file to a printer will generate a printed square. However, adding color to the square changes everything. Maybe the same color will show up when the file is viewed on another monitor or sent to a printer. Or not. We now move from absolute color to the world of device-dependent color—as well as competing and often proprietary color models.

Long gone are the days when the color accuracy of a design depended on an artist's ability to mix paints. An artist with a good eye and understanding of color theory could consistently produce "the right color." And the color of the paint on the brush was the same after it was applied to paper.

But color is now digitally defined by various software and hardware settings that are hidden—both literally and figuratively—from the designer. And these settings are complicated and technical. Managing them requires the same level of expertise that is necessary for a dyer to understand Kubelka-Munk. And there are few people in Design or IT with that detailed knowledge. So, even though these new design tools have allowed designers to work faster, they have degraded the ability of a designer to define color consistently.

Doing stupid faster pops up in another process.

Yes, It's A Problem

Even though color accuracy is crucial for CAD designers, a fast, reliable process to achieve and document accurate color matches is missing at many companies. Many CAD designers in the fashion industry use an RGB workflow (monitor color) in the design process instead of CMYK (printer color). CAD designers spend a great deal of time manually matching colors by printing out charts or ranges of color and picking the best visual match in the specific room where they create and review designs. The results are not necessarily shared across the organization. Matching colors in design software for onscreen and print accuracy is largely an unsupported process.

In a recent project, I consulted with several key digital designers at an apparel brand to gather their input on the importance of color accuracy and the ability of current processes to deliver it. All designers agreed that



color accuracy was important, and none saw the status quo as acceptable. Each followed different practices for matching colors. Even though color is a major design attribute, some had given up trying to achieve color accuracy, conceding that "people in design review meetings are used to the idea that my CADs are 'not for color.'" Those who attempted to match colors accurately spent between two minutes and an hour per color match. About 25% of their time was spent trying to match colors. All agree that if the burden of color matching were removed, they could spend more time designing.

A NEW FOCUS FOR COLOR MANAGEMENT

There are three distinct phases in any color management process: color exploration, color specification, and color production. In the world of lab dipping, the color team maintains a color library and sets up seasonal palettes (color exploration), sends lab

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dip requests to mills (specification), and monitors bulk (production). In this model, they can capture objective definitions of each color, monitor who is matching each color, and document the quality of the final product. When executed using the best processes, a small team can see the color quality of every production lot around the world.

So, could technology be implemented to apply that same model inside a brand to manage color in product design and development? In this model, seasonal color palettes are built and pre-matched, and optimized digital palettes are distributed for use in CAD software, the results of which are consistent, accurate printed colors across the organization.

Vivid CLM

Vivid CLM (Color Library Management) is an online software that supports accurate color rendering across a group of calibrated printers typically seen in a product design office.² It supports color exploration, specification, and production, focusing on a company's internal CAD design process (and can be extended externally, as well). It uses built-in technology to solve and manage color upfront instead of requiring expert technical users to constantly oversee and fix the process. In today's economic environment, set-and-forget focused solutions like this make sense.

The Color Library

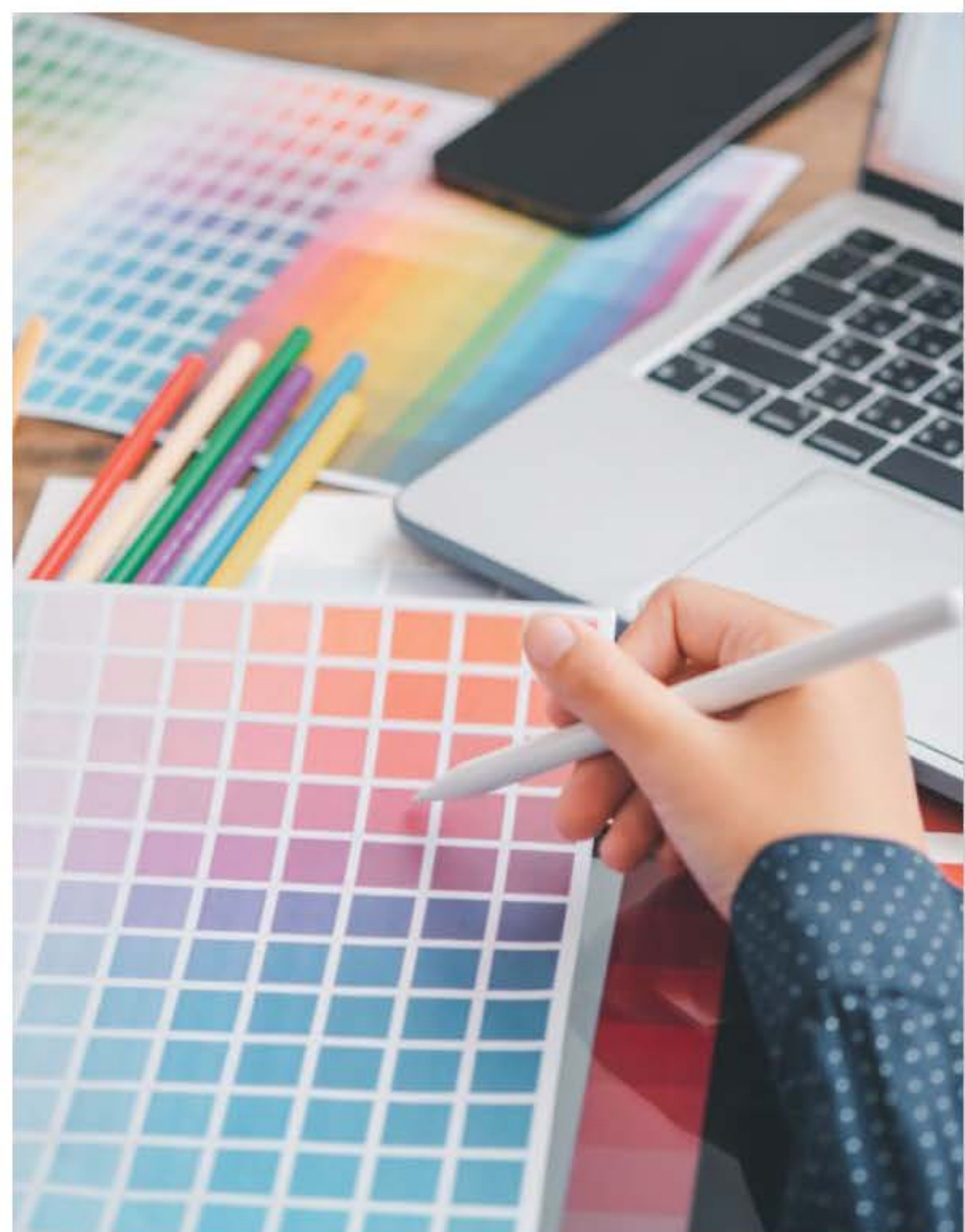
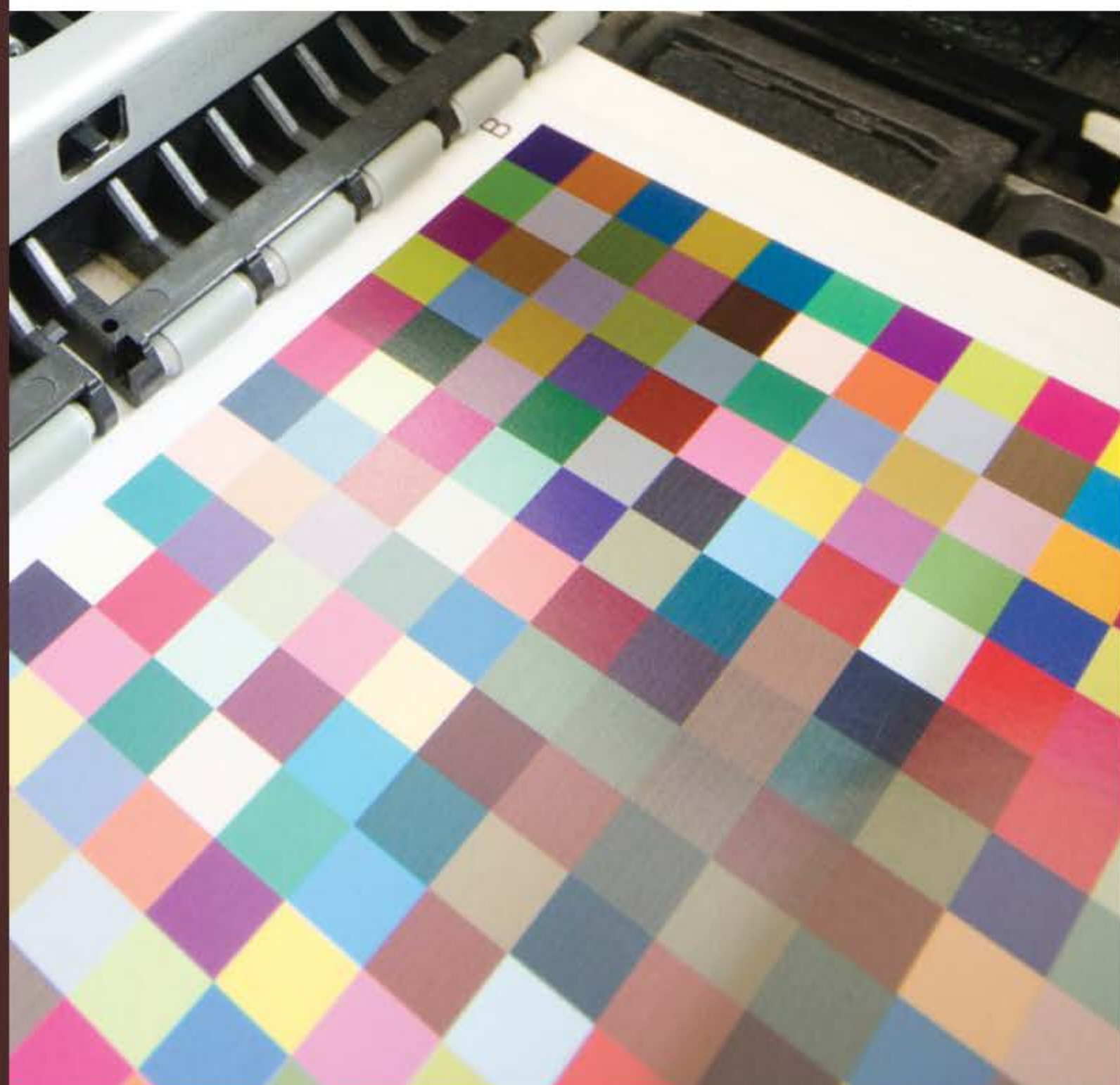
Brands that own spectral data (QTX, CxF) from companies like Archroma, CSI, Pantone, and Coloro can store them as "Books" in the Color Library. They can also create custom Books by digitizing legacy physical swatches with one of an assortment of available devices.³

Seasonal color palettes can be set up by retrieving the master colors from the Books and dropping them into palettes. This mirrors the color palette documentation process already in place using Excel, PLM, or any other system.

Printer Calibration

Printers that use Vivid CLM should first undergo conventional calibration as a best practice, which can be managed by local printer service providers. The calibration technician checks the RIP (Routing Information Protocol), driver, paper in use, inksets in use, print volume history, and other settings. If everything is in order, then a calibration routine is done to optimize print quality consistency.

Calibration, in and of itself, does not ensure that colors within an RGB workflow will print color accurately. Matching RGB colors to a printer is a much different process than using a CMYK spot color workflow. If you print "Ammeye Blue" on a calibrated Epson Model X printer,



it might appear too green. But it will appear too green every time you print it on any calibrated Epson X printer. So, the purpose of printer calibration is to assure that colors are printed predictably and consistently within this specific workflow.

Color Mapping Setup

With the data and printer calibration in place, the user launches a procedure to map color accuracy for each model of printers in use. Note, that if multiple units of one model are in place, then the color mapping process only needs to be done on one printer (assuming that all are calibrated). If different printer models are in use, then color mapping must be done on each model.

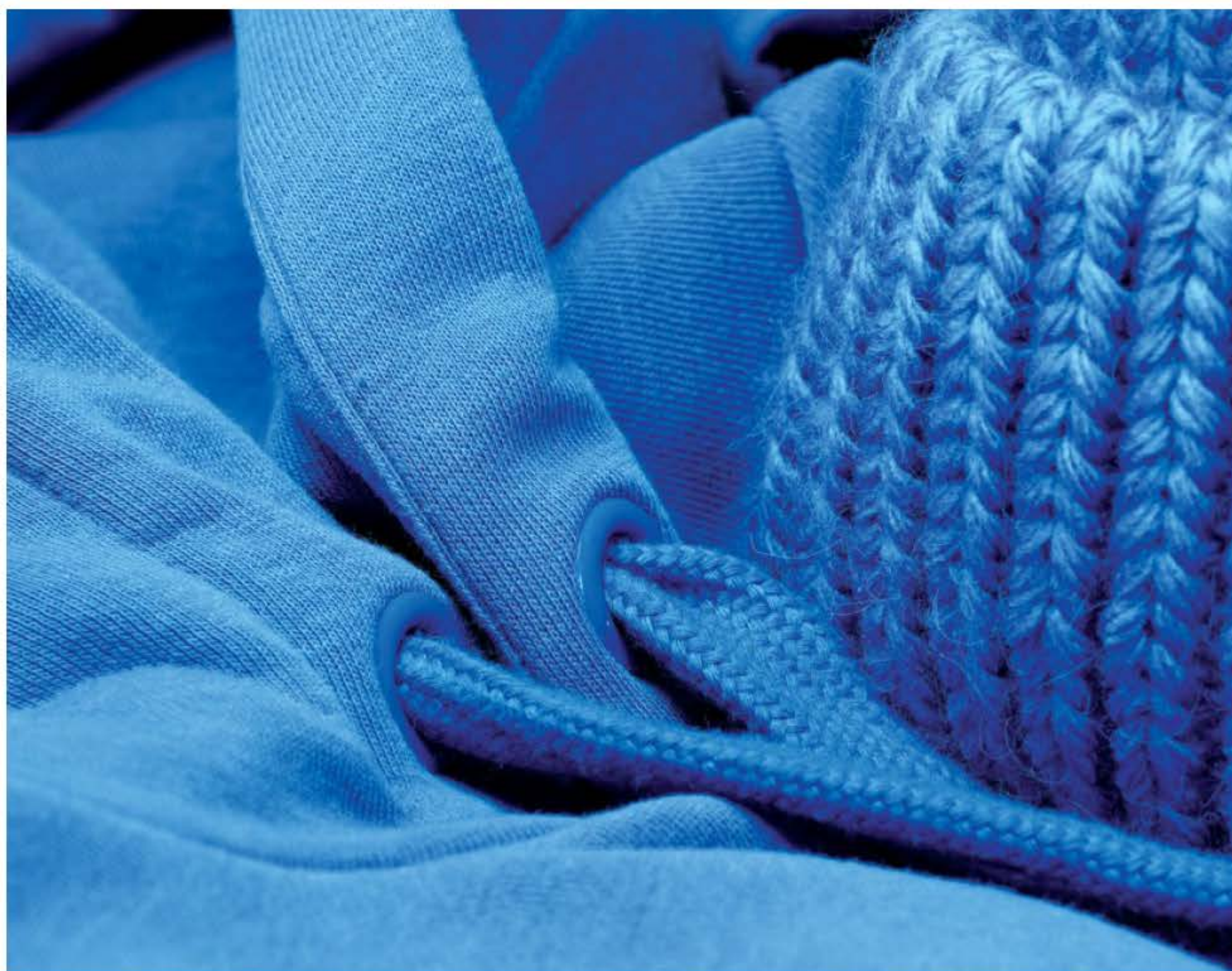
The color mapping process involves the use of algorithms that improve the match of each printed color to its original standard. First, the primary illuminant is selected in the software. This selection should represent the lighting in place in the office setting. Design in general does not take place in a lightbox, so Vivid CLM optimizes the accuracy of printed colors seen in the general office environment or presentation rooms. If your office environment includes windows, multiple light sources, and a fleet of lava lamps, then, well, there is only so much that any technology can do (and color accuracy probably isn't that high of a concern).

Even with multiple variables in the office environment, Vivid CLM can, at minimum, provide a better starting point for color accuracy compared to just printing colors using legacy data. There are additional tools that enable colors to be tweaked as necessary to get better results in a quick timeframe.

Color Mapping Execution

Next, a series of colors are collected and printed to each printer model. The colors in each printout are measured into the desktop app. The software displays the color difference for each color and generates a correction (if needed). The corrected colors are then printed and measured again. With each iteration, the user determines whether to accept or reject each match based on DE_{CMC} or DE_{2000} color difference and a visual comparison on screen. The software also flags colors that are out of gamut and shows the best possible version. This feature prevents wasted time trying to match the unmatchable.

The results of each mapping (by specific color) are stored by printer type in the software. This provides a digital record of the "accuracy state" of each printer (similar to the production match capability of Color Accreditation Program (CAP) mills). This also provides the ability to maintain the original state of the color standard and provide multiple alternate versions of the color based on the printing output within the same palette.





Color Resources

Digital color cards including all of the colors in each seasonal palette are available for distribution and printing. These can be sent to anyone with an interest, from design and development to merchandising and sourcing. They can even be sent to suppliers, although the color accuracy will depend on the external printers in use. Additionally, ASE palette files are available for design so that colors used in CAD will be optimally pre-matched and paired with specific printer models.

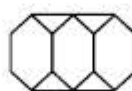
User Access

Brands with multiple categories and design groups can be managed in the Vivid CLM Admin Portal. Users are assigned to groups so that they automatically receive the palettes applicable for their roles. User and role assignments take place when Vivid CLM is initially installed and as roles change within each group.

A DIFFERENCE IN FOCUS

Quality management folks like to talk about the difference between QC and QA. Quality Control (QC) requires inspecting a widget after manufacturing to determine if it meets the spec. Quality Assurance (QA) considers specs and processes to optimize the chances for manufacturing success. QC requires lots of inspectors and continual work. QA requires planning and work up front.

Vivid CLM solves the problem of printer color mismatches in product design and development. It is a long overdue solution to assure the color quality of digital designs created in the ever-increasing collection of design tools. And it is technology that the Color Team can propose to increase their sphere of influence.



Notes

1. Ptolemy 1952, Book I, Chapter 5, p.9.
2. <https://vivid-clm.com>
3. Digital color data produced by colorimeters, 45/0 instruments, and a new generation of hybrid color capture devices are not interchangeable with colorimetric data generated from d8 sphere spectrophotometers. However, they can be used to improve the color accuracy of printers. When it comes to managing printer colors, instrument geometry is probably the least of your worries.

Keith Hoover, President of Black Swan Textiles, implements manufacturing-centric digital processes for color and fabric development. He has implemented digital color management programs for Ralph Lauren, Target, Lands' End, JCPenney, and Under Armour, ultimately leading to a process that eliminated lab dips altogether. At Under Armour, Hoover championed the UA Lighthouse, driving digitalization and advanced manufacturing processes to explore local-for-local sourcing. He has worked hands-on in mills worldwide and is a frequent AATCC presenter.

Articles from The Second C: Series

- Hoover, K. The Second C: Color with a Purpose. *AATCC Review*, 2022, 22 (1), 36-39.
- Hoover, K. The Second C: From Inspiration to Replication. *AATCC Review*, 2022, 22 (2), 28-32.
- Hoover, K. The Second C: Lab Dips—The First Circle of Hell (Part 1). *AATCC Review*, 2022, 22 (3), 26-30.
- Hoover, K. The Second C: Lab Dips—The First Circle of Hell (Part 2). *AATCC Review*, 2022, 22 (4), 32-36.
- Hoover, K. The Second C: Leaving Limbo. *AATCC Review*, 2022, 22 (5), 34-39.
- Hoover, K. The Second C: The Sixth Circle of Hell—Heresy, Part 1. *AATCC Review*, 2022, 22 (6), 34-39.
- Hoover, K. The Second C: The Sixth Circle of Hell—Heresy, Part 2. *AATCC Review*, 2023, 23 (1), 26-33.
- Hoover, K.; Merritt, R. The Second C: The Ninth Sphere of Paradise—Primum Mobile, Part 1. *AATCC Review*, 2023, 23 (2), 22-28.
- Hoover, K. The Second C: The Ninth Sphere of Paradise—Primum Mobile, Part 2. *AATCC Review*, 2023, 23 (3), 22-28.
- Hoover, K. The Second C: The Ninth Sphere of Paradise—Primum Mobile, Part 3. *AATCC Review*, 2023, 23 (4), 26-31.
- Hoover, K. The Second C: The Ninth Sphere of Paradise—Primum Mobile, Part 4. *AATCC Review*, 2023, 23 (5), 34-39.
- Hoover, K. The Second C: The Cost of Color. *AATCC Review*, 2023, 23 (6), 34-43.
- Hoover, K. The Second C: The Truth About Color Revisited. *AATCC Review*, 2024, 24 (1), 26-33.
- Hoover, K. The Second C: A Higher Class of Problem. *AATCC Review*, 2024, 24 (2), 24-28.

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