

THE SECOND C: The Ninth Sphere of Paradise— Primum Mobile, Part 3

By Keith Hoover

“The measure of their vision lies in merit.”

—Dante Alighieri, *Divine Comedy, Paradiso, Canto XXVII*

The first two installments of Primum Mobile introduced the Color Accreditation Program (CAP), a two-pronged approach to manage product color at the mill [1]. The C2M2 (Color Capability Maturity Model) delivers a predictive component that assures color quality as an outcome of the dyeing process. Real-time access to the mills' colorimetric data verifies that every production lot is onshade. Super. But how and where does CAP fit in the product development process?

To answer that question, this article steps back from the brand lab dipping process (handled by a centralized color team or left as a part of design) and looks at all who have a stake in color execution. It is true that brands are the specifiers and sellers of the goods. But mills and garment vendors are the actual manufacturers, so any color management process that adds value must involve them. As it turns out, reviewing color inside the brand is the worst place to do it. Here is a better way.

DIGITAL COLOR MANAGEMENT (DCM)

Digital Color Management (DCM) is an overarching *program* that incorporates several *projects* that focus on the various types of color application for apparel products. Since the majority of garments are made of solid color fabric, it makes sense to start with a project to implement Digital Solid Color Management (DSCM). Subsequent projects will tackle Digital Washed Color (DWC), Digital Print Color (DPC), and Digital Complex Fabric Color (DCFC). The completion of each project delivers immediate efficiency and cost savings via expense reduction and supply chain integration. It

also builds the necessary capability maturity to launch the next project.

Project: Digital Solid Color Management (DSCM)

Conventional approaches to color management relying on visual assessment are notoriously unreliable, subjective, slow, and expensive. Adopting a digital color process improves color accuracy and process speed but implementing it *within* the brand is costly in terms of headcount, capital expenses, and software (or SaaS) acquisition. And the lab dip process does not adapt well to a work from home environment.

This leads to another problem. In the conventional process, the brand bears the cost and responsibility for color approval. However, color approval is a task that garment vendors are contractually obligated and better-suited to execute since all garment vendors are required to deliver “first quality” products. The definition of quality is “conformance with specification.” Color is a product specification. Therefore, garment vendors should solely own the responsibility for delivering onshade goods.

However, there is a third and more fundamental problem with conventional wisdom. Any color management approach based solely on lab dip assessment is flawed, whether visual or digital, because it focuses on the color accuracy of a *single lab dip* rather than the color precision of all production. In essence, it assumes that if a small swatch of fabric dyed in the lab matches the color standard, then every lot of production will match the color standard. Without continual production color assessment, we are left with only a pretty lab dip.

BRAND SOURCING VENDOR MILL



Color specification process



The color execution process

Figure 1: A simplification of the color development process shows that the 1) brand, 2) garment vendors, and 3) mills are all involved in color approval. Why do it once when you can do it three times?

Assessment Area	Criteria	KPI	Metric
Procedures	General Procedures	Sample preparation & measurement	Is the lab dip color difference evaluation based on DE CMC (2:1), AATCC Test Method 173?
Procedures	General Procedures	Sample preparation & measurement	Does sample preparation and measurement follow the protocol outlined in the specifier (retailer) Color Approval Process & Procedures Manual?
Procedures	General Procedures	Sample preparation & measurement	Is a visual inspection for streaks, blotches, and other irregularities conducted prior to measuring the sample?
Procedures	General Procedures	Sample preparation & measurement	Is the sample conditioned prior to measurement?
Procedures	General Procedures	Sample preparation & measurement	Are four (4) measurements, in four (4) different locations, taken for each sample?
Procedures	General Procedures	Sample preparation & measurement	Is the difference between the four measurements less than or equal to 0.5 DE CMC(2:1)?
Procedures	General Procedures	Sample preparation & measurement	Is photochromism considered when measuring samples?
Procedures	General Procedures	Sample preparation & measurement	Does the vendor have the capability to provide the specifier with a color sample that is large enough to be folded until opaque and to cover the Large Area View on an approved spectrophotometer?

Table 1

Stop Doing, Start Doing

Conventional color approval processes 1) are unnecessarily expensive, 2) involve too many people, 3) are too narrow in scope, and 4) add no value. Process improvement offers the opportunity to start doing things differently, but also implies that some things should be stopped. Here are four elements of improving color management.

1: Eliminate solid color lab dip review at the brand
That's right. I said it. This is the ninth installment of "The Second C." It should be clear by now that the "brand lab dipping process" is broken.

Consider the poor brand colorists huddled over stacks of lab dips inside hot lightboxes. You would think that their chief responsibility is color quality. But you would be wrong. Their chief responsibility is to track the timing of color work in process (WIP) tracking.

There are deadlines within the product calendar that dictate when development approvals must be completed in order to place purchase orders. As deadlines approach, process exceptions come into play. For color, they are called "Best Can Do's" (BCDs) and are issued when unacceptable matches are approved to meet the PO deadlines. BCDs are business decisions, not color decisions.

This textile series will share technical insights and wisdom of AATCC members. The "Second C" series will focus on color. If you wish to contribute your own technical insights on topics of interest to AATCC members, contact Communications Director, Maria Thiry; thiry@aatcc.org.



Timing trumps accuracy every time. Every Product Lifecycle Management (PLM) or Product Data Management (PDM) system in existence can track timing. Few (if any) have built-in color QC functionality. In fact, acquiring the right color management tools like spectrophotometers and color QC software continues to be a challenge in business environments driven by EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization). So, color accuracy is only important until it's not.

2: Involve and empower the garment vendor

Apparel brands rely on garment vendors to oversee raw material acquisition and garment production. Garment vendors have a direct interest in assuring the color quality of the fabric they procure from mills. Color must be accurate overall, but, more importantly, it must be consistent from lot to lot to prevent shading within a garment (for instance, from body to sleeve). If there are delays in fabric delivery or problems with color consistency, the garment vendors take the financial hit, either through air freight upcharges, chargebacks, cancellations, or getting run out of town on a rail.

All garment vendors have some type of internal color management process in place to review both lab dips and the quality of incoming dyed fabric lots used for garment production. Many garment vendors have invested in spectrophotometers and color QC software. However, since most of their brand customers have no true color standards, specifications, and legitimate color difference tolerances in place, the garment vendors' color process contributes little value. If the brands were to butt out and instead provide legitimate color standards, specifications, and tolerances, then garment vendors could leverage their current capabilities and take on the role of color approval for the brand. The only thing missing is assessing and accrediting each garment vendor's color process.

This can be accomplished by adopting a **Garment Vendor Color Certification (GVCC)** [2] process to 1) specify what is needed for a digital color management process and 2) verify that all garment vendors are using digital color technology to evaluate lab dips according to these specifications.

Implementing GVCC delivers the advantages of objective digital color management without the brand taking on the burden of headcount and capital expenses. However, it does not provide a true picture of the quality of color in production.

3: Involve and empower the mill

Dyers at the mills have the most technical knowledge and access to sophisticated software and hardware to match color. They have a direct interest in color accuracy, precision, and process efficiency because their companies' sales volume and profitability depend on the dyers' performance.

The **Color Accreditation Program (CAP)** allows mills to leverage this competency and eliminate the conventional lab dip approval process altogether. Rather than reviewing lab dip sample colors prior to production, the CAP process involves the following:

- Examination and evaluation of a mill's color capability maturity through an analysis of the manufacturing variables that contribute to shade inconsistency in the dyeing process
- The ongoing collection of digital color measurements of all production lots compared to the master color standards

Garment vendors with CAP mills in their matrix can incorporate the CAP process into their approach to managing color.

4: Do better in the meantime

Since the DSCM project is implemented over time, current internal color processes at the brand remain in force until the project is complete. It is necessary to create an SOP for proper color review that combines the best practices outlined in prior "Second C" articles and the business requirements (timing) for the brand. This SOP, the Interim Optimized Labdip Evaluation (IOLE) [3] provides the means to standardize and improve the performance of all brand team members involved in color approval. IOLE also forms the basis for standardizing color management requirements in GVCC.

GARMENT VENDOR COLOR CERTIFICATION (GVCC)

Like CAP, GVCC is part of a specification compliance/model. Brands provide garment vendors with clear specifications defining color and fixed tolerances for approval. Garment vendors provide colorimetric data verifying that the color of the fabric they use is onshade. But, unlike CAP, GVCC is more rigid and narrow in its approach. Its purpose is to assure consistent data acquisition (color measurement) and decision making, empowering those on the frontline to manage color without involving the brand.

Trusting Garment Vendors as Remote Color Offices

Garment vendor certification basically shifts the color approval function from the brand to the garment vendors. Data are exchanged with garment vendors either using the brand's existing PLM system or via an API (Application Programming Interface) to an external color management system.

In addition to continuing to manage the business side of WIP tracking, a GVCC vendor must be able to efficiently execute the technical side of color evaluation. So, everything about the brand's color approval process must be documented and reduced to an SOP. As such, the SOP must be repeatable, that is, lab dips must be processed consistently in the same office. The SOP must also be reproducible, that is, lab dip assessment results must be the same, regardless of the office processing them. GVCC defines what a brand color office is supposed to do and makes it portable. In essence, the IOLE provides the substance for this SOP.

Like the CAP, GVCC is based on a variation of the Color Capability Maturity Model (C2M2-V). The C2M2-V is prescriptive in nature, in that it defines and assesses the absolute requirements that must be in place at a garment vendor color office.

Conceptually, C2M2-V is based on root cause analysis and the premise that the requirements for color acceptability assessment can be defined, measured, and classified to determine a garment vendor's competence at shade assessment. It is illustrated as a fishbone diagram, based on a series of 87 questions in five Assessment Areas (Information Systems, Office & Equipment, On-site Testing, People, and Procedures). The spine or problem to be solved is Color Acceptability; the combination of knowledge and discipline necessary to consistently evaluate acceptable color matches. Major bones correspond to those Assessment Areas and minor bones make up ten Criteria. Twenty-four Key Performance Indicators (KPIs) are also defined for all Criteria along with their associated Metrics. It is these Metrics upon which the questions in C2M2-V are built.

For example, two Criteria fall within the "General Procedures" Assessment Area: "General Procedures" and "Maintenance." Within the "General Procedures" Criterion, there is a KPI for "Sample Preparation & Assessment." Associated with this KPI are several Metrics, one of which is: "Is the lab dip color difference evaluation based on DE_{CMC}(2:1), AATCC Test Method 173?" Table 1 shows the relationship between Metrics (specific questions), KPIs, Criteria, and an Assessment Area (a major bone of the fish).

The C2M2-V Audit

The C2M2-V audit is straightforward, consisting of only three elements: a garment vendor self-assessment, an independent assessment (on-site or virtual) in which answers are determined for each metric, and a series of on-site exercises. The Assessment Areas, Criteria, KPIs, and Metrics are the same for both the self- and independent on-site assessments and come directly from the C2M2-V. Self-assessments are conducted and reported by garment vendor personnel. On-site assessments are conducted by an experienced, independent firm with relevant subject matter expertise. The only difference is that the On-site team performs diagnostics on the spectrophotometer(s) and administers a series of tests to assess the competence of the garment vendor color team.

On-site Tests—Show and Tell

Process repeatability and reproducibility are largely dependent on consistent and accurate execution. So, the C2M2-V includes an Assessment Area for the On-site test in which the garment vendor colorists are questioned to assess their knowledge of the basics of five Criteria and nine KPIs with their 41 corresponding Metrics.

- **Assessment Area:** On-site
- **Criteria:** Data integrity (1 KPI), maintenance (3 KPIs), processing (3 KPIs), resources (2 KPIs)



- **KPIs:** Color measurement (11 metrics), color review decisions (2 metrics), color review exceptions (4 metrics), color sample review (11 metrics), color standards (2 metrics), conditioning (3 metrics), light booth (1 metric), processed lab dips (2 metrics), spectrophotometer (5 metrics)

For example, here are the specific Metrics for the “Color Measurement” KPI. Team members responsible for color measurement must demonstrate their knowledge and ability to do the following:

- Does the color technician know the proper instrument set-up conditions (aperture size, SCI/SCE, UV set-up)? *(Action required)*
- Can the color technician change the instrument set-up conditions? *(Action required)*
- Does the color technician know the specifier’s illuminants? *(Action required)*
- Does the color technician know how to change the illuminants? *(Action required)*
- Does the color technician know how to inspect the color sample for minimum size, streaks, blotches, and other irregularities prior to measurement? *(Action required)*
- Does the color technician know how to check for UV content in a color sample? *(Action required)*
- Does the color technician know how to properly fold and present the color sample to the instrument? *(Action required)*
- Does the color technician know how to check the standard deviation of color sample measurements to be averaged? *(Action required)*

- How long does it take the color technician to measure the ten test submits? *(Action required)*
- Does the color technician know the required data fields for each submit? *(Action required)*
- Does the color technician know how to enter the required data fields in the software? *(Action required)*

On-site Tests—Now Do It

There are three roles on a GVCC color team:

- Color technician
- Color analyst
- Brand coordinator

Every person in each position is observed doing their job associated with a number of test submits. Color technicians must measure swatches, color analysts must make pass/fail decisions, and brand coordinators must manage exceptions.

Report Card

Once the C2M2-V On-site audit has been completed, the on-site team finishes its documentation and evaluates the results, comparing them to the absolute performance requirements. This is a pass/fail test. A digital process is only as good as the data. So, the GVCC color team must show mastery of their tasks. Coaching is provided during the process, but this really is a test. The On-site team prepares a summary of their findings along with a “Get-Well-Soon” plan to address any deficiencies.

THE RIGHT MIX

There are different ways to apply this model. And it takes time to make a change to the sourcing matrix. The goal is to have all mills CAP-certified, since visibility about color quality down to the dyelot level provides the best risk mitigation.

Inheriting a Burden

GVCC shifts the color approval function from the brand to the garment vendor. Just as the old-fashioned lab dipping process represents a cost burden to the brand, so too it represents one for the garment vendor. However, CAP offers garment vendors a way to reduce or eliminate that burden. Since there is a direct relationship between their color approval workload and the number of CAP mills in their matrix. As mills in a garment vendor's matrix are CAP-certified, the garment vendor's workload is reduced, since there are fewer lab dips to be reviewed. The more CAP, the better. Garment vendors soon see the financial advantage of getting mills in their own matrix CAP-certified, improving their operational excellence and distinguishing themselves from other competitors.

Getting There From Here

There are three ways to apply the model described in this article:

1. **CAP Mill Garment Vendors:**
Only fabric from CAP mills is used in garments (low risk)
2. **CAP/Analog Mill Garment Vendors:**
A mix of fabric from CAP mills and non-CAP mills is used in garments (medium risk)
3. **Analog Mill Garment Vendors:**
Only fabric from non-CAP mills is used in garments (high risk)

Brands should aim for option A (and some are already there). Some brands have dictated that all mills must be CAP-certified and others have given their garment vendors the discretion to adopt CAP. Of course, there are some garment vendors that prefer life in the 20th century and do not require their mills to be CAP-certified. But, beware. Sloth is not only a deadly sin, but it will get you in trouble with Big Brother.


Big Brother is watching

The apparel industry is in transition from a model in which Tier 1 garment vendors are solely responsible for execution, quality, and timely product delivery to a new era that places sustainability and environmental regulatory compliance on the brand. It has already started in the EU [4]. Brands will need transparency to Tier 2 (fabric suppliers) if not Tier 3 (fiber and finishing raw materials) in order to comply. Adopting the GVCC and CAP processes aligns with achieving these new sustainability and environmental goals.

So, brands should start the transition today. Not only will they see immediate savings and improvement in product

color, but they will actually be able to claim that they know what is going on in production.

FAITH WITHOUT WORKS

We have made the case for CAP and Digital Solid Color Management (DSCM). However, great ideas are a dime a dozen. Unless implemented, there is no benefit. The next installment will present a project management template for implementing DSCM, including Phase 1: Project Initiation & Planning, Phase 2: Project Execution, Phase 3: Project Monitoring & Control, and Phase 4: Project Close Out. 

Notes

1. Natic currently supports the CAP industry-wide. <https://natic.com/>, also Hoover, K; Merit, R. *AATCC Review* 2023, 23 (2), 22-28.
2. Also called CCP (Color Certification Program) at Natic, a rather unfortunate acronym.
3. In Greek mythology, Iole was the daughter of King Eurystus of Oechalia. Heracles claimed Iole as his bride, but she refused his courtship. Iole threw herself down from a high city wall to escape. The garment she was wearing opened up and acted like a parachute, ensuring her safe escape from tragedy. In this sense, the interim color approval process implemented in this project will provide a safe escape from the status quo until GVCC and CAP can be fully implemented.
4. www.europarl.europa.eu/news/en/press-room/20220620IPR33413/new-social-and-environmental-reporting-rules-for-large-companies

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.

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