The Effect of Press Variation on Color Stability on 7-color and 4-color Process Color Tint Builds

Matthew Furr
Application Engineer, Esko
Agenda

• Introduction

• Objective / Scope

• Methodology

• Hypothesis

• Experimental Design

• Results & Interpretation
CMYK Gamut

Gamut - a subset of colors which can be accurately represented in a given circumstance, such as within a given color space or by a certain output device.
Improved inks, plates, anilox rolls, presses, prepress applications and separations have enabled converters to move from the traditional limitation of ‘spot’ colors, to a more expanded, advanced, computerized screen and process printing technique using process inks.
CMYKOGV Gamut
Objective / Research Question

The effect of press variation on color stability with 4-color and 7-color process color tint builds.
Inks act as levers on the color tint build.
Inks act as levers on the color tint build.
Differences in Hue

- Blue to Yellow: $140.3°$
- Green to Yellow: $86.4°$
Differences in Hue

- Blue ➔ Yellow = 140.3°
- Green ➔ Yellow = 86.4°

Differences in Chroma
Hypotheses

1. Maximum GCR results in the least color variation.
2. A color build logic using 7C and Maximum GCR results in the least color variation.
3. 7C build logic results in the lowest ink consumption.
Simulation
Press Test (Profile) & Verification
Ink Jet Proof & Test

Initial Literature Review
Press Test (Curves)
Sample Selection
Final Press Run
<table>
<thead>
<tr>
<th></th>
<th>K</th>
<th>O</th>
<th>V</th>
<th>C</th>
<th>G</th>
<th>M</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPI</td>
<td>175</td>
<td>175</td>
<td>175 / 180</td>
<td>175</td>
<td>175</td>
<td>175</td>
<td>175</td>
</tr>
<tr>
<td>Angle</td>
<td>82.5</td>
<td>22.5</td>
<td>82.5 / 7.5 52.5 / 22.5</td>
<td>22.5</td>
<td>52.5</td>
<td>52.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Anilox</td>
<td>1200 / 1.7</td>
<td>900 / 2.19</td>
<td>900 / 2.18</td>
<td>1200 / 1.7</td>
<td>900 / 2.2</td>
<td>1200 / 1.7</td>
<td>1200 / 1.7</td>
</tr>
<tr>
<td>L* a* b*</td>
<td>16.3, -.6, -.8</td>
<td>67.7, 52.8, 77.3</td>
<td>28.2, 47, -61.8</td>
<td>59.6, -42.2, -40</td>
<td>63.6, -70, .9</td>
<td>51.3, 66, -13.1</td>
<td>87.7, -9.4, 97.4</td>
</tr>
</tbody>
</table>
Benchmark (AM)  Benchmark (FM)  Selection
Sample Selection
600 Pantone colors were selected for comparisons.
Final Press Sheet

Pairs Target (1 of 3)
4C (Max GCR)
7C (Max GCR)

Triplets Target (1 of 2)
7C (Max GCR)
4C (No GCR)

4C (Max GCR)
- Randomized Targets
- Comparisons Grouped
Over Impression of Printing Plates
<table>
<thead>
<tr>
<th>Set 15</th>
<th>Set 16</th>
<th>Set 17</th>
<th>Set 18</th>
<th>Set 19</th>
<th>Set 20</th>
<th>Set 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>
Data Reporting

Color Difference:
1. $\Delta E$ CIE 1976
2. $\Delta E$ 2000

3 Types of Variation:
1. Common Component
2. Alternative Component
3. Gray Component
Managing Data
4C No GCR

PANTONE 1595
C M Y K
6 74 100 0

Common Component
Alternative Component
Grey Component

7C Max GCR

PANTONE 1595
C M Y K O
0 72 100 5.9 0

Common Component
Alternative Component
Grey Component
How much of the stability is related to the grey component?
4C No GCR

Common Component
Alternative Component
Grey Component

PANTONE 1595
C M Y K O
5 74 100 0 0

4C Max GCR

Common Component
Alternative Component
Grey Component

PANTONE 1595
C M Y K O
0 72 100 5.9 0
**ΔE 2000 in Grey Component Variation**

<table>
<thead>
<tr>
<th></th>
<th>4C No GCR</th>
<th>4C Max GCR</th>
<th>7C Max GCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y-O</td>
<td>3.10</td>
<td>0.72</td>
<td>0.87</td>
</tr>
<tr>
<td>M-O</td>
<td>2.81</td>
<td>0.60</td>
<td>0.72</td>
</tr>
<tr>
<td>M-V</td>
<td>1.49</td>
<td>0.62</td>
<td>0.61</td>
</tr>
<tr>
<td>C-V</td>
<td>1.36</td>
<td>0.80</td>
<td>0.58</td>
</tr>
<tr>
<td>C-G</td>
<td>3.04</td>
<td>1.59</td>
<td>1.94</td>
</tr>
<tr>
<td>Y-G</td>
<td>3.24</td>
<td>1.76</td>
<td>2.13</td>
</tr>
</tbody>
</table>
Variation is reduced by 36%
2 Component Builds

<table>
<thead>
<tr>
<th></th>
<th>4C Max GCR</th>
<th>7C Max GCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y-O</td>
<td>2.03</td>
<td>1.83</td>
</tr>
<tr>
<td>O-M</td>
<td>4.03</td>
<td>3.53</td>
</tr>
<tr>
<td>M-V</td>
<td>4.00</td>
<td>3.24</td>
</tr>
<tr>
<td>V-C</td>
<td>3.12</td>
<td>2.40</td>
</tr>
<tr>
<td>C-G</td>
<td>2.82</td>
<td>2.02</td>
</tr>
<tr>
<td>G-Y</td>
<td>2.59</td>
<td>2.00</td>
</tr>
</tbody>
</table>

ΔE 2000 — **Common Component Variation**
ΔE 2000 — Common Component Variation

3 Component Builds

<table>
<thead>
<tr>
<th></th>
<th>4C Max GCR</th>
<th>7C Max GCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y-O</td>
<td>1.88</td>
<td>1.63</td>
</tr>
<tr>
<td>O-M</td>
<td>3.42</td>
<td>2.60</td>
</tr>
<tr>
<td>M-V</td>
<td>3.76</td>
<td>2.88</td>
</tr>
<tr>
<td>V-C</td>
<td>3.54</td>
<td>1.84</td>
</tr>
<tr>
<td>C-G</td>
<td>2.35</td>
<td>1.53</td>
</tr>
<tr>
<td>G-Y</td>
<td>2.04</td>
<td>1.67</td>
</tr>
</tbody>
</table>
Common Component
Alternative Component
Grey Component

Common Component
Alternative Component
Grey Component

4C Max GCR

7C Max GCR

PANTONE 305
C  M  Y  K
76  20  0  0

PANTONE 305
C  M  Y  K  V
67  0  0  0  14
4C Max GCR

Common Component
Alternative Component
Grey Component

7C Max GCR

Common Component
Alternative Component
Grey Component
ΔE 2000 — Alternative Component Variation

2 Component Builds

<table>
<thead>
<tr>
<th></th>
<th>4C Max</th>
<th>7C Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y-O</td>
<td>2.03</td>
<td>1.83</td>
</tr>
<tr>
<td>O-M</td>
<td>4.03</td>
<td>3.53</td>
</tr>
<tr>
<td>M-V</td>
<td>4.00</td>
<td>3.24</td>
</tr>
<tr>
<td>V-C</td>
<td>3.12</td>
<td>2.40</td>
</tr>
<tr>
<td>C-G</td>
<td>2.82</td>
<td>2.02</td>
</tr>
<tr>
<td>G-Y</td>
<td>2.59</td>
<td>2.00</td>
</tr>
</tbody>
</table>
ΔE 2000 — Alternative Component Variation

3 Component Builds

<table>
<thead>
<tr>
<th></th>
<th>4C Max GCR</th>
<th>7C Max GCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y-O</td>
<td>4.60</td>
<td>2.27</td>
</tr>
<tr>
<td>O-M</td>
<td>1.95</td>
<td>0.75</td>
</tr>
<tr>
<td>M-V</td>
<td>2.09</td>
<td>0.53</td>
</tr>
<tr>
<td>V-C</td>
<td>4.04</td>
<td>1.12</td>
</tr>
<tr>
<td>C-G</td>
<td>1.68</td>
<td>1.07</td>
</tr>
<tr>
<td>G-Y</td>
<td>2.12</td>
<td>0.88</td>
</tr>
</tbody>
</table>
Variation is reduced by 28%
Total Area Coverage

- 18.8% difference in the 2 Component builds
- 12.2% difference in the 3 Component builds
Summary of Findings:

1. Print Maximum GCR
2. 7C Max GCR resulted in lower Common Component variation when compared to 4C Max GCR
3. 7C Max GCR resulted in significantly lower Alternative Component Variation when compared to 4C Max GCR
4. 18.8% difference in TAC in builds with 2 components
5. 12.2% difference in TAC in builds with 3 components
Thanks to my committee and advisors!

Dr. Duncan Darby
Associate Professor

Dr. Sam Ingram
Graphic Comm.
Department Chair

Dr. Chip Tonkin
Director of
Sonoco Institute

Mark Samworth
Color Solutions
Architect - Esko

Bobby Congdon
Research Associate at
Sonoco Institute

Bradley Gasque
Research Associate at
Sonoco Institute