How to measure "color and feeling" for a unique car interior – state of the art digital color management solutions

automotive interiors EXPO 2012

12, 13, 14 JUNE 2012 MESSE STUTTGART, GERMANY

Stephanie Picht,
*Datacolor GmbH Germany*
Project Manager

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Content

Datacolor Color Management solutions for Automotive Industry (Interior)

- **Color in Design/Standards (Color Development)**

- **Color Communication with supply chain**

- **Color Quality control**

Industrial Color Solutions

- **Managing suppliers, materials and processes across complex supply chains and workflows**

- **Ever more sophisticated algorithms and color science**

- **Continuous advancements in color measurement technology to improve precision and range of use**

Specify → Measure → Formulate → Control
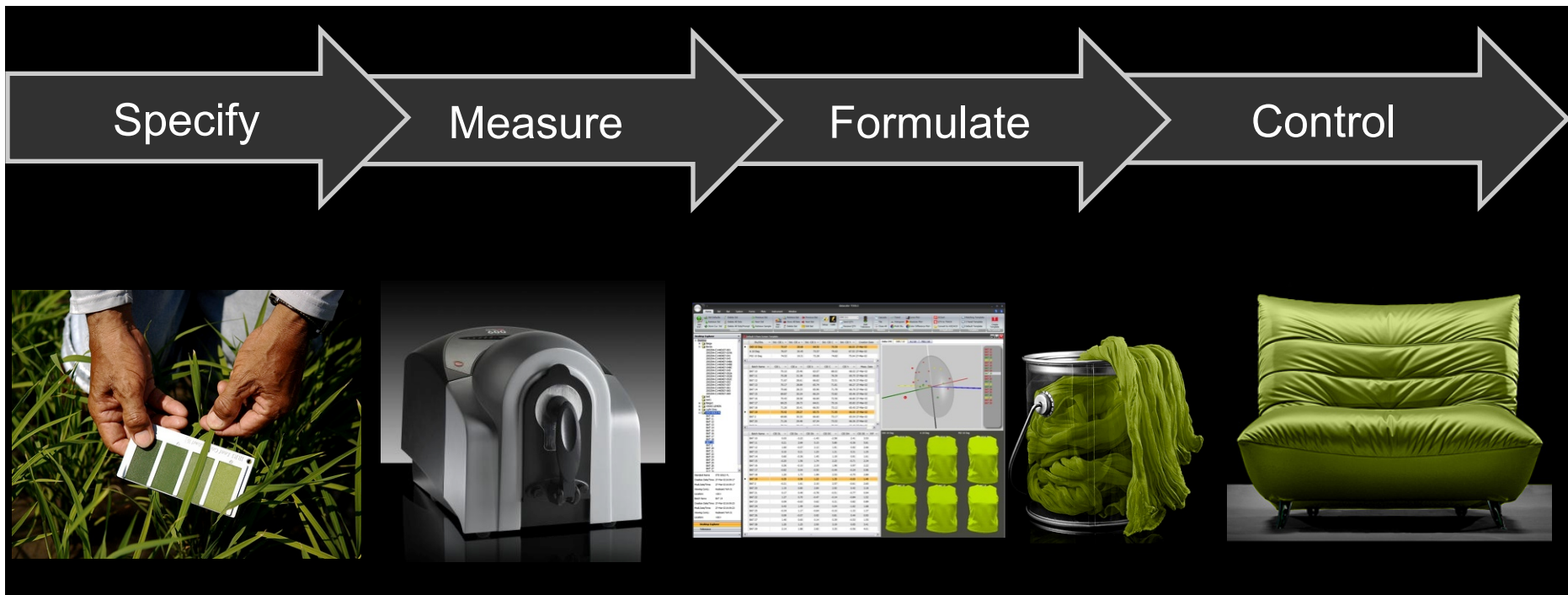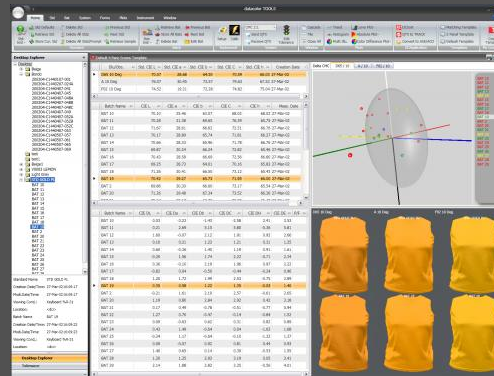
Industrial Color Solutions

HARDWARE

- High-precision
- Close-tolerance
- Desktop & Portable models

SOFTWARE

- State-of-the-art algorithms
- Unrivaled ease of Use
- Configurable

SERVICES

- Training
- Consulting
- Maintenance

Models 1995 and 2006 in comparison

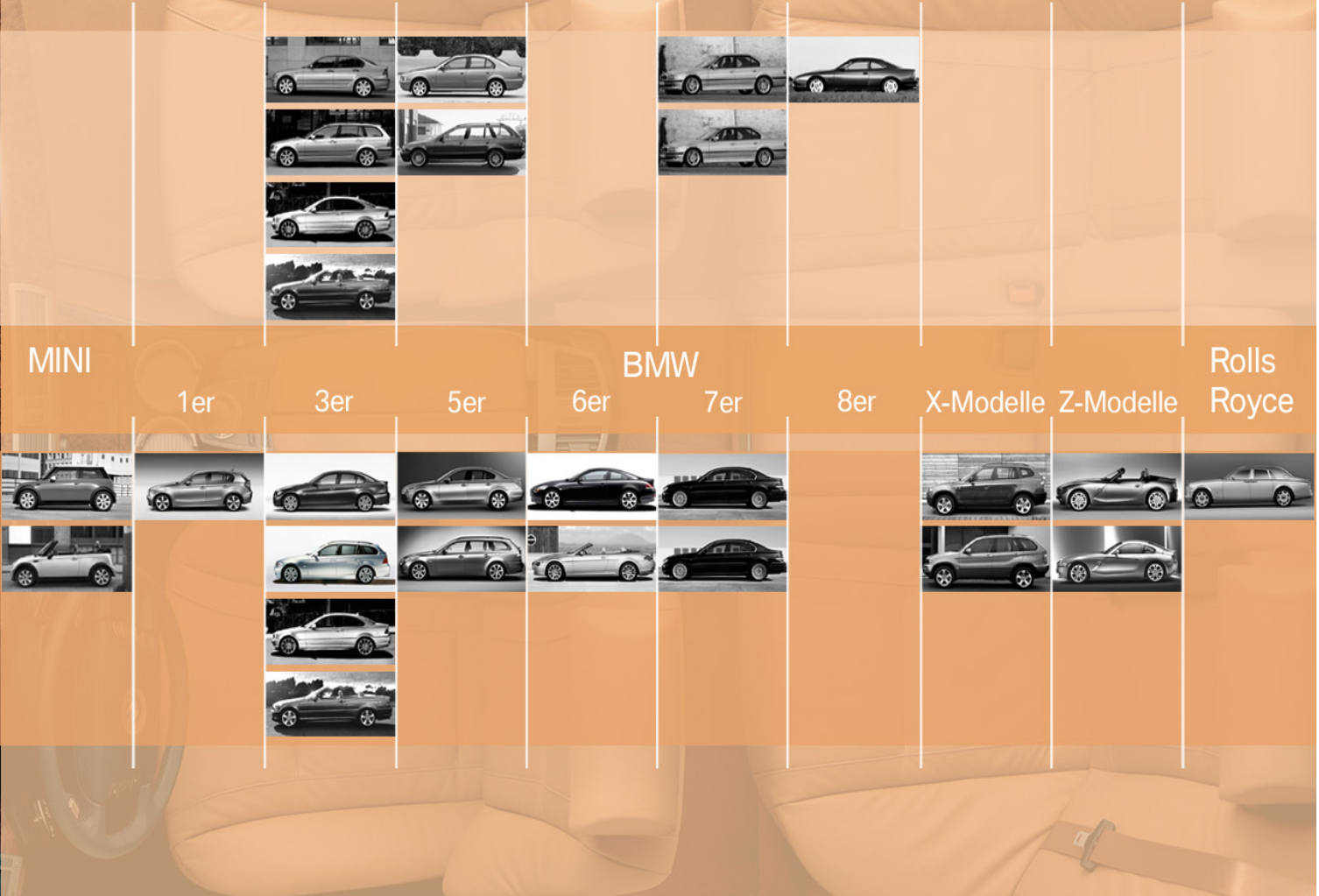| | MINI | | BMW | | | | | | | | Rolls |
| | | 1er | 3er | 5er | 6er | 7er | 8er | X-Modelle | Z-Modelle | Royce |

1995

2006

Today…

Fahrzeugtyp	Preiskategorie	CO_2 Emissionen
Kompakt, Limousine, Touring (Kombi), Coupé/Sportwagen, Cabrio/Roadster, SAV (Geländewagen)	ab 21.900,00 EUR bis 131.000,00 EUR	ab 99 g/km bis 325 g/km

BMW 1er (3-Türer)	BMW 1er (5-Türer)	BMW 1er Coupé	BMW 1er Cabrio	BMW 1er M Coupé	BMW 3er Limousine
BMW 3er Coupé	BMW 3er Cabrio	BMW 3er Touring	BMW 3er Touring (2012)	BMW M3 Coupé	BMW M3 Cabrio
BMW 5er Limousine	BMW 5er Touring	BMW 5er Gran Turismo	BMW M5 Limousine	BMW ActiveHybrid 5	BMW 6er Coupé
BMW 6er Cabrio	BMW 6er Gran Coupé	BMW M6 Coupé	BMW M6 Cabrio	BMW 7er Limousine	BMW 7er Limousine (2012)
BMW Active Hybrid 7	BMW Active Hybrid 7 (2012)	BMW X1	BMW X1 (2012)	BMW X3	BMW X5
BMW X6	BMW X5 M	BMW X6 M	BMW Z4 Roadster		

Trend more models, more variants….

Die Modellvielfalt bei den Autoherstellern treibt einer Studie zufolge immer neue Blüten. Derzeit sind 3281 unterschiedliche Fahrzeugvarianten nach Modellen, Karosserieformen und Motorenarten im deutschen Autohandel erhältlich, ergab eine Untersuchung des Center Automotive Research (CAR) an der Universität Duisburg-Essen. Bei den reinen Modellreihen wie Ford Fiesta oder Opel Astra seien es 376 - bis 2015 soll diese Zahl gemäß den Plänen der Hersteller sogar auf 415 wachsen. 1995 waren es erst 227.

«Eine Wende des Trends ist nicht absehbar. Das Gegenteil ist der Fall, der Trend beschleunigt sich«, stellt CAR-Direktor Ferdinand Dudenhöffer fest. Allerdings könnte sich dies für Hersteller, die gemessen an ihrem Anspruch nur wenige Modelle einer Reihe verkaufen, zum Problem bei den Vertriebskosten entwickeln. «Volumenmarken wie Citroen, Jeep, Chevrolet, Alfa Romeo, Daihatsu und Chrysler werden es schwer haben mit zusätzlichen Varianten im Markt zu agieren.» Stattdessen hätten überraschenderweise Marken wie Skoda, Dacia und Smart sogar noch Potenzial, resümiert Dudenhöffer.

Pkw-Modellvielfalt in Deutschland

● Anzahl der angebotenen Modelle   □ Anzahl der Modelle pro Marke

Quelle: Marketing Systems GmbH
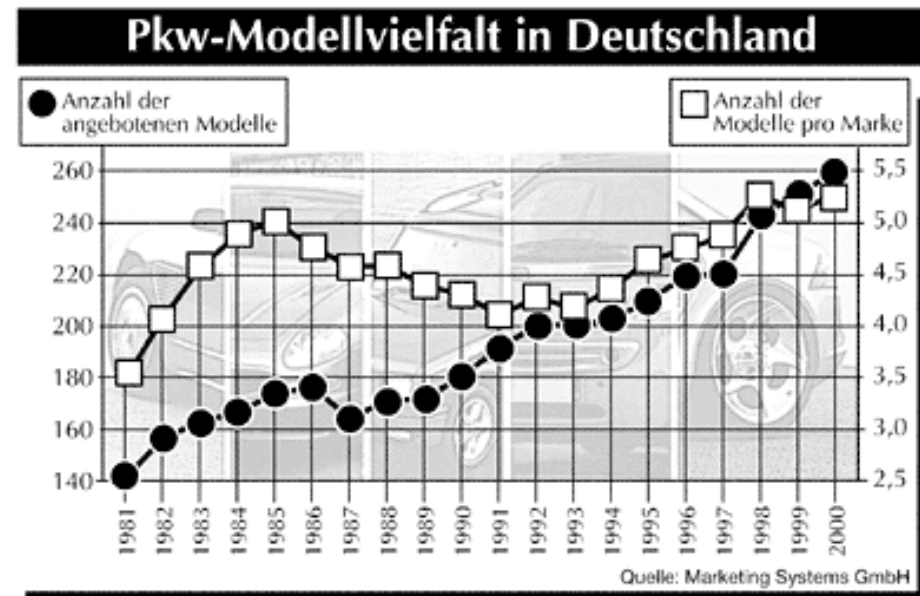
Differentiator Interior Quality

Differentiator Interior Quality

- The appearance of the vehicle interior has become a dominant criterion in the decision making process

- Buyer wants to feel comfortable in his car

- Aesthetic claims are increasing

- Design is crucial for the differentiation from competition

- Future trend: Customized Color Design

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Challenges

- Extremely time consuming process of developing a new model

- Complex network of suppliers

- Communication intensive and time consuming course of events

- Combination of different materials with various surface textures

- Interior harmony = visible mark of quality

Claim for striking development acceleration in the immediate future

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General Workflow
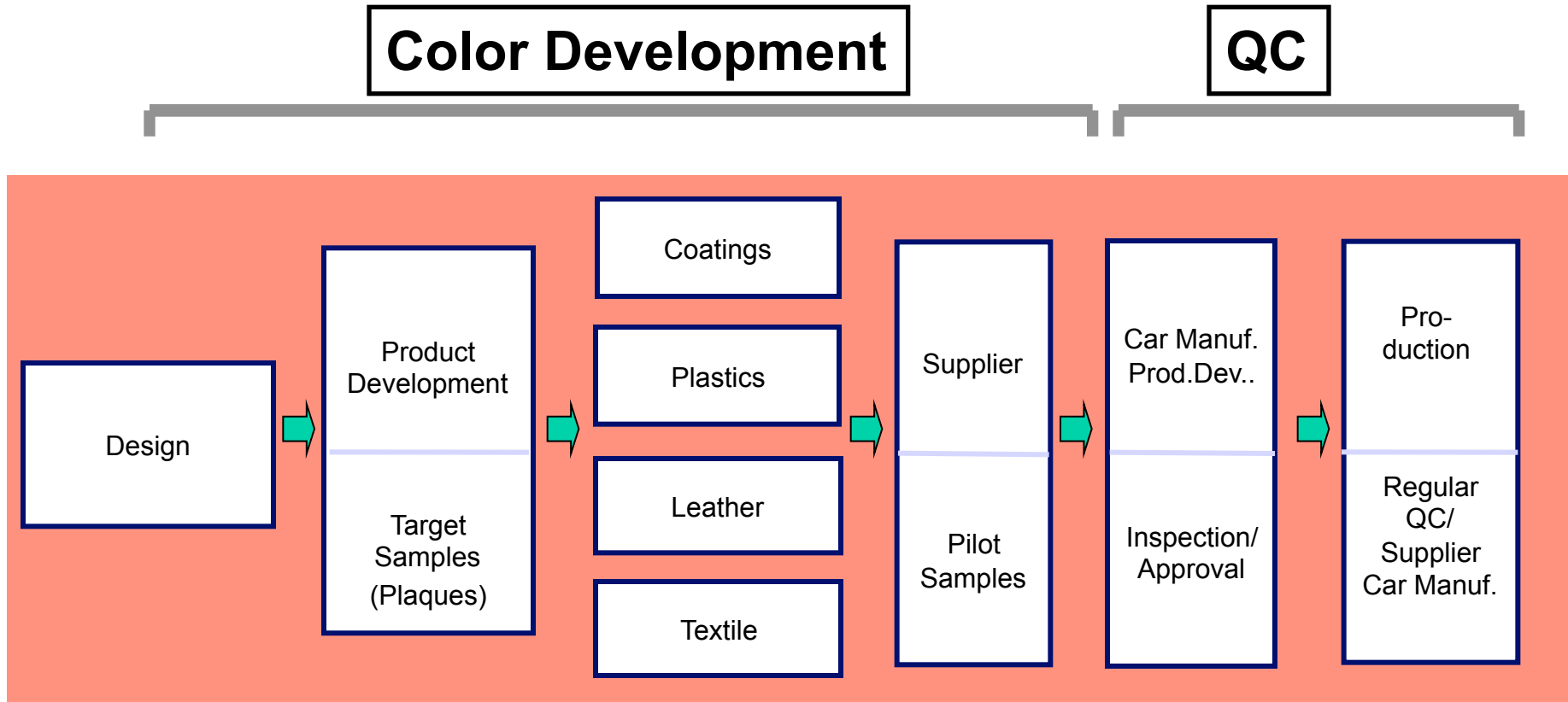
Current process: details

Production of one or more physical samples as close as possible to the standard

Comparison of samples with the standards / Cross-check of the various materials

Examination in different lighting conditions

Design

Product Development

Plastics

Leather

Textile

Supplier

Pilot Samples

Car Manuf.
Prod.Dev.

Inspection/
Approval

Pro-duction

Regular QC/
Supplier
Car Manuf.

Iterative color communication due to subjective, not clear instructions

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Digital color communication: 2 options

1

| Digital color communication |

OEM

- defines color based on reflectance values

- .qtx to supplier

Supplier

- supplier is producing phys. sample based on .qtx

- phys. sample is send to OEM

- .qtx (phys. sample is sent to OEM)
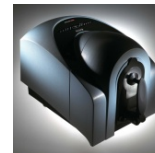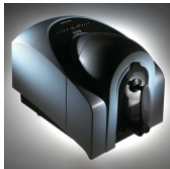
comp. spectro
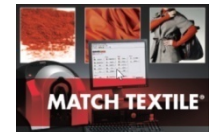
Digital Color Communication

■ **The process starts by measurement of a color standard to produce reflectance data – the digital "fingerprint" of a color…**
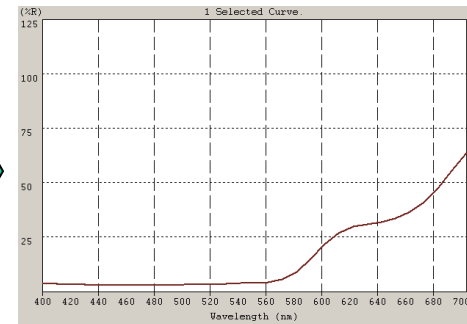
■ **…which is sent electronically to the supplier.**

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Digital Color Communication

- **Digital samples are submitted by the supplier for initial evaluation…**
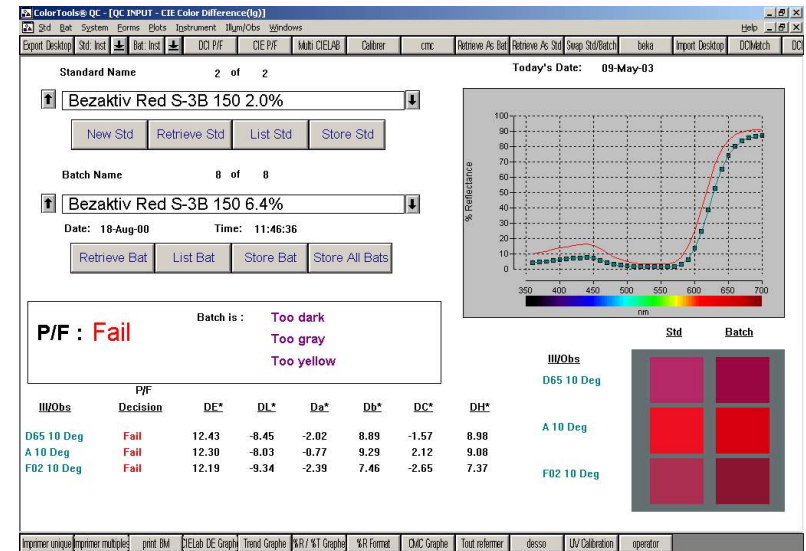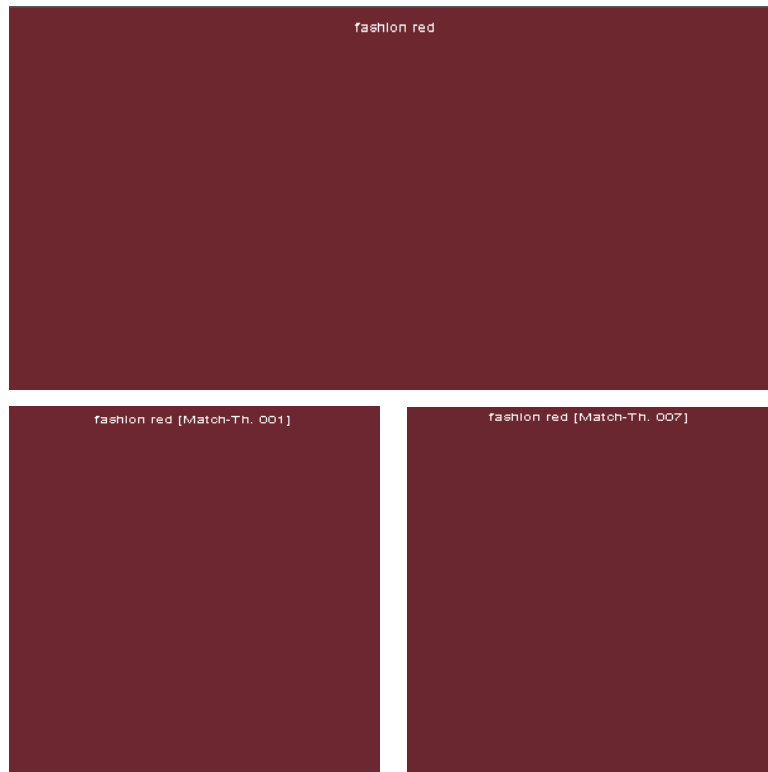
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Digital Color Communication

■ **…comments are sent to the supplier…**
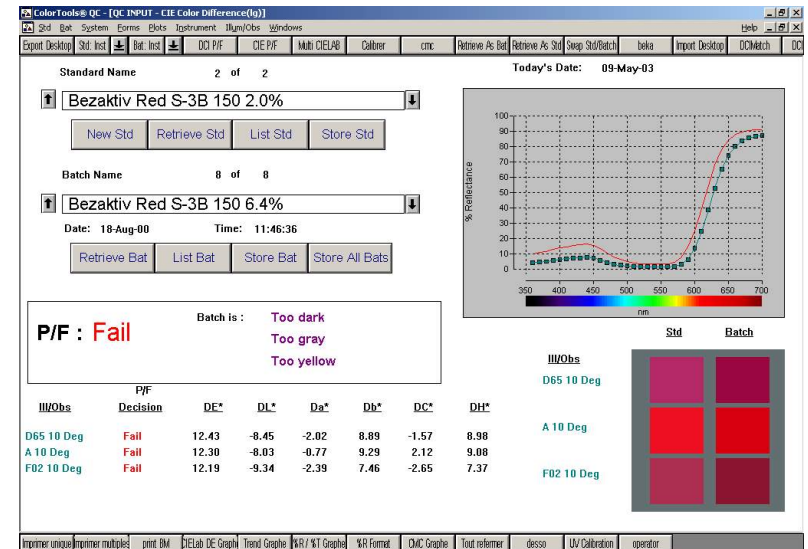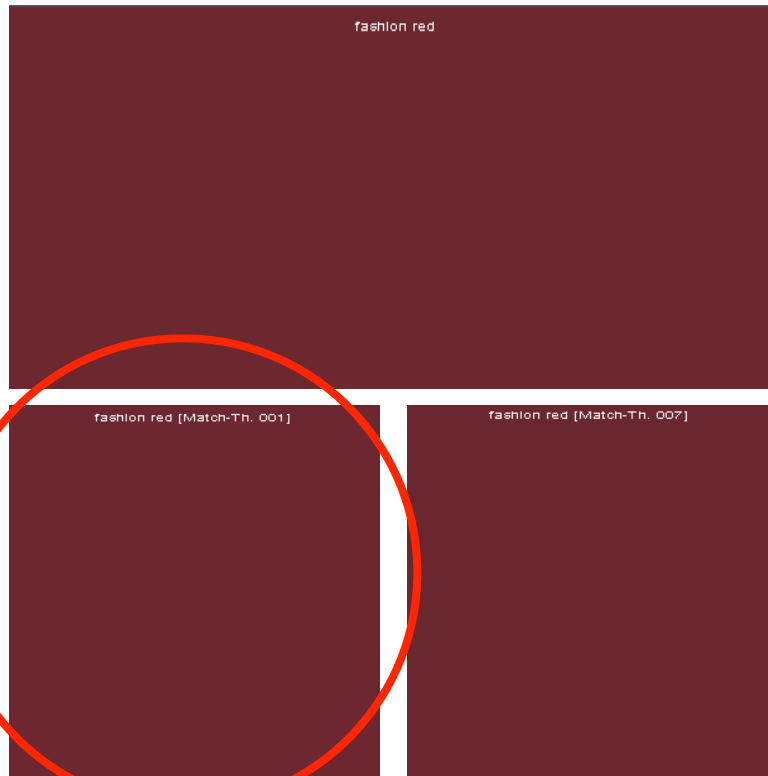
■ **…or a physical sample is requested for visual approval.**

Color Quality Control (Datacolor TOOLS® 2.0)

- **MS-Office 2007 style user interface**

Color Quality Control (Datacolor TOOLS® 2.0)
Monitor calibration DC Spyder 4
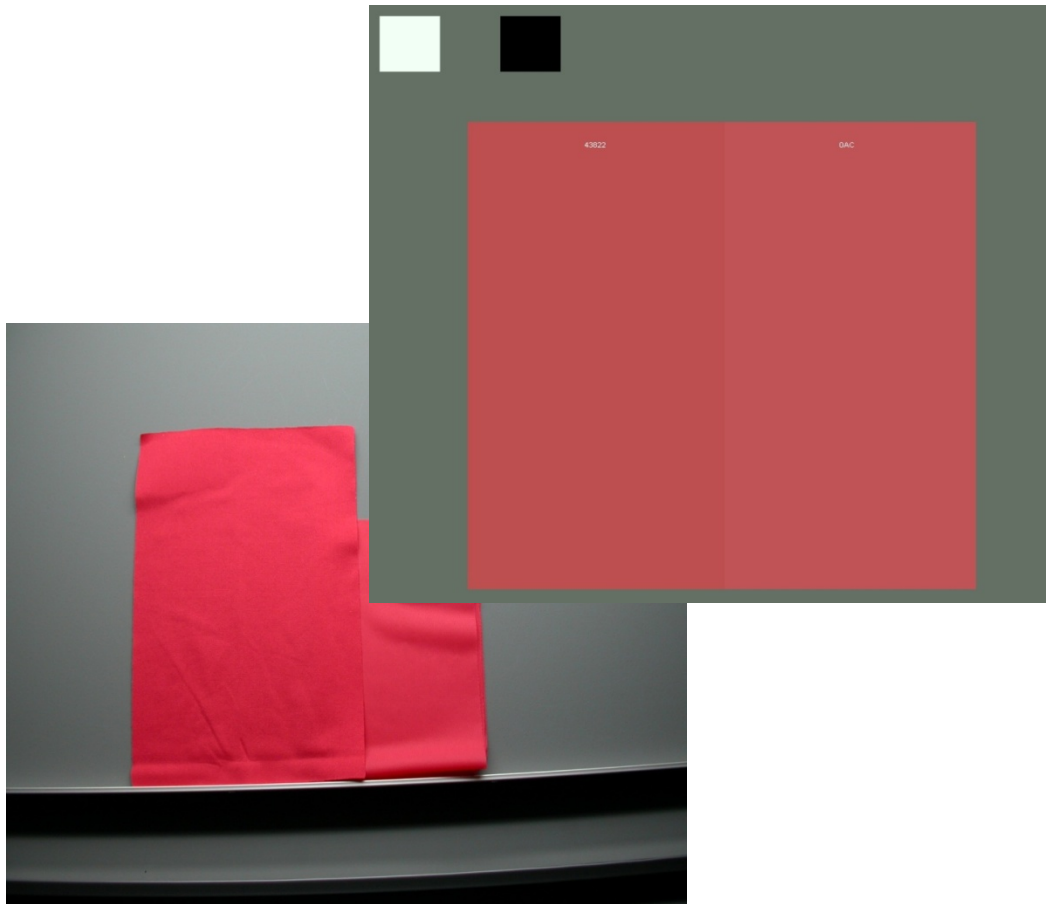
Color Quality Control (Datacolor TOOLS® 2.0)
TRENDPLOT visualized

11221	10295	11222	12019	12020/1	12346
12524	12773	12903	12904	13204	13205
13623	13623/1	13623/2	13624	13706	13870
13871	13871/1	13993	14006	14227	14228
14493	14494	14510	14511	14699	026/6

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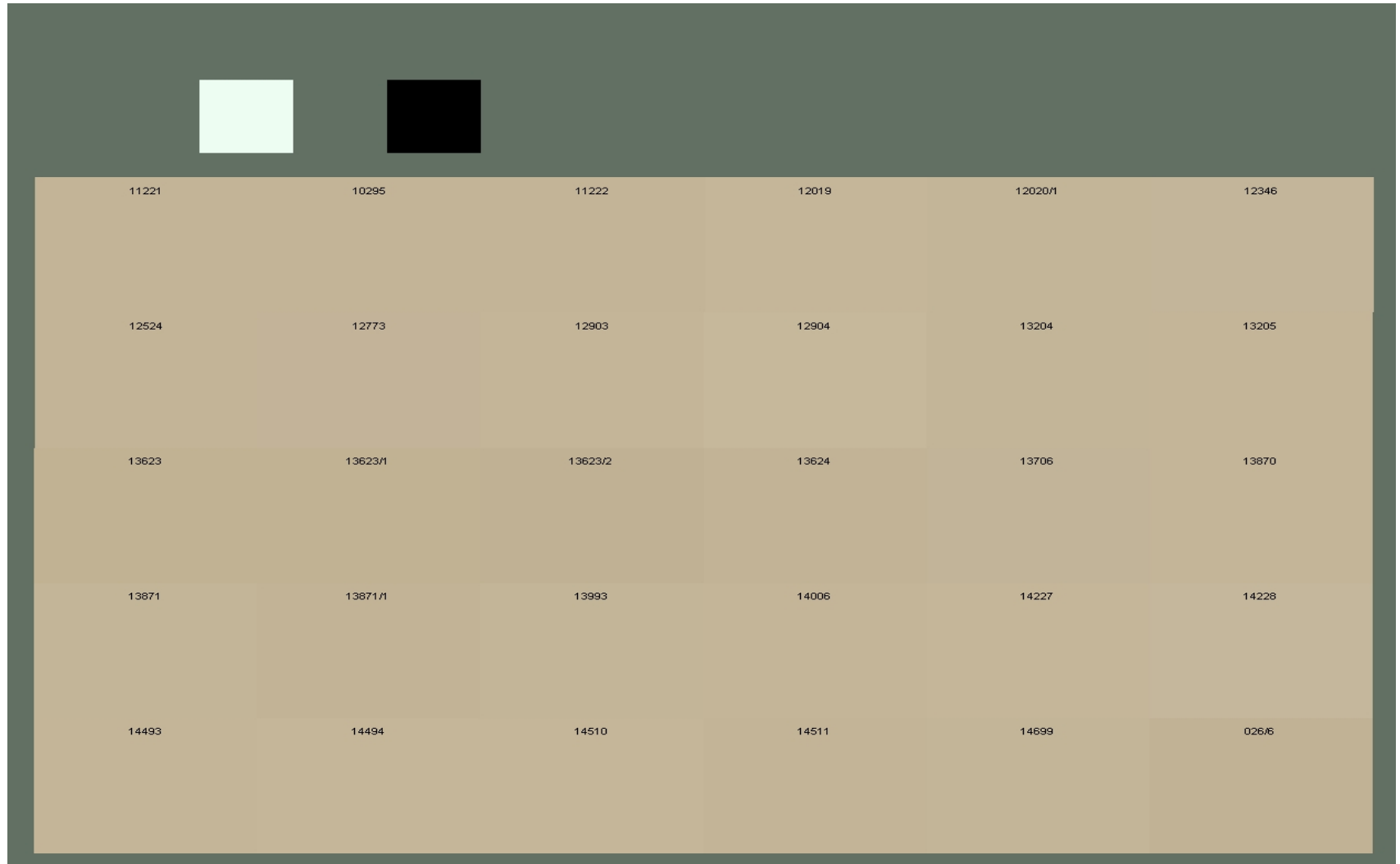
Digital color communication: 2 options

2

Digital sampling

OEM

- defines color based on reflectance values

- color adjustment with color slider related to different surfaces

- .qtx to supplier
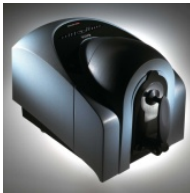
Supplier

- supplier is producing theoretical match based on .qtx

- theoret. match (.qtx) is sent to OEM

- phys. sample will be produced when OEM approves theoretical match

TOOLS²2.0

ENVISION®

comp. spectro

TOOLS²2.0

MATCH PIGMENT®

MATCH TEXTILE®

Datacolor Envision

..with Datacolor Envision colors and structures/surfaces can be Visualized on a calibrated screen

Separate visualization of color and texture
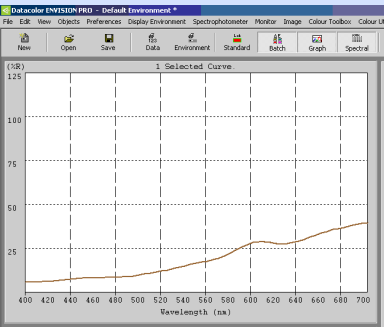
Color

+

Texture

Color and Texture = Appearance

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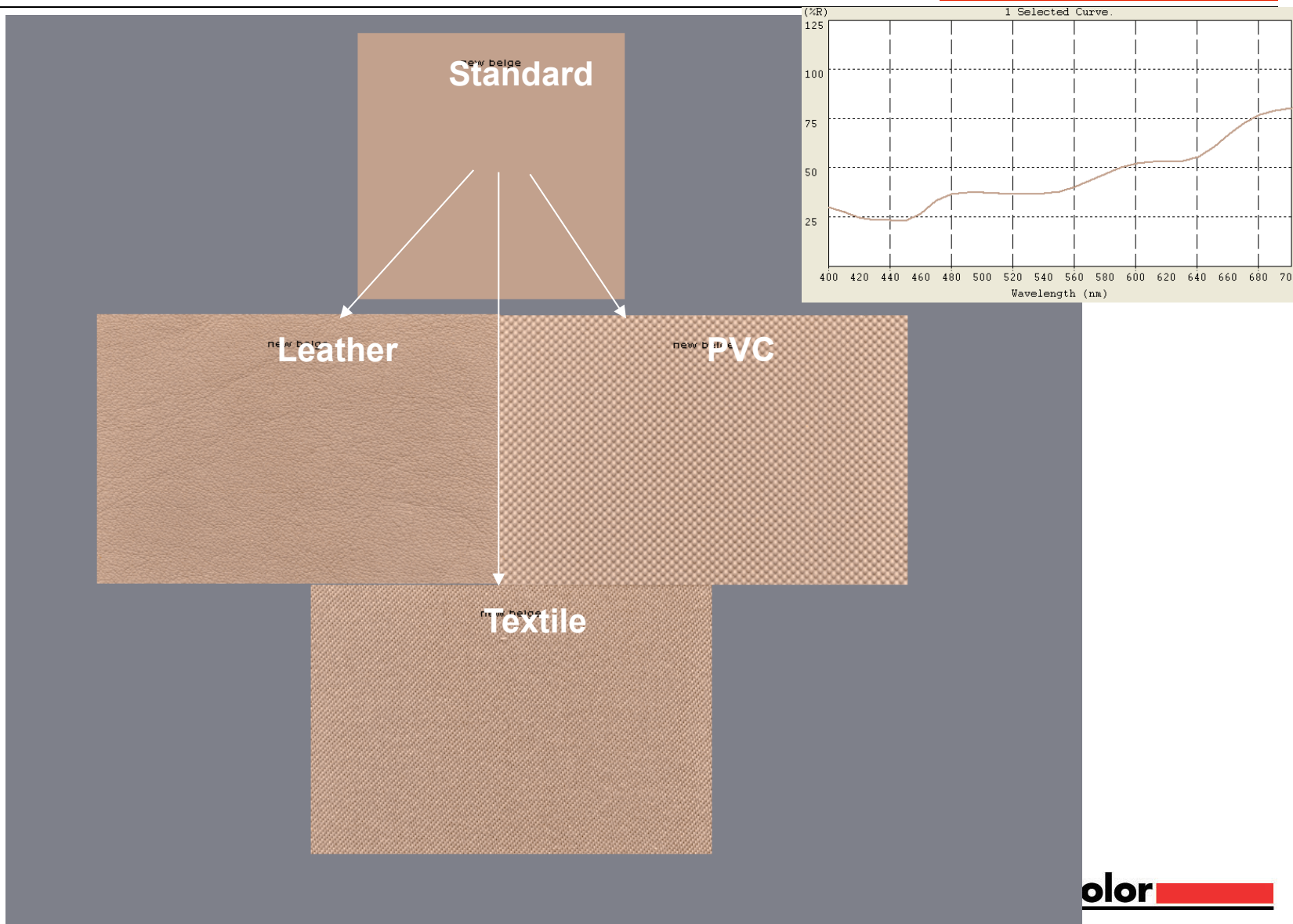
Datacolor ENVISION Technology: Digital sampling, communication with suppliers

Datacolor ENVISION Technology:
Digital sampling, communication with suppliers

2

Standard

modif. Standard

Leather

PVC

color information by email to supplier

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Match prediction Software

CIELAB ▾		L*	a*	b*	C*	h	CR	CF
Vorlage		65,96	7,45	20,27	21,60	69,82	0,00	
Rezept		65,95	7,42	20,25	21,57	69,88	100,00	0,22
Träger		93,30	-0,67	5,18	5,22	97,36		
Rezept	DE*	DL*	Da*	Db*	DC*	DH*	CDE	MI
D65/10	0,04	-0,01	-0,03	-0,02	-0,03	0,02	0,00	0,96
A/10	0,10	-0,03	-0,09	0,02	-0,03	0,09	0,00	
F11/10	0,93	0,52	0,08	0,76	0,73	0,24	0,00	
D65/10								
A/10								
F11/10								

Vorlage: new beige 1
Ansatz:
Träger: W/S
Rezept: Prediction 1 new beige 1

	1	PS 143 E	98,0000 KG
	1	Titandioxid R-FK-3	1,7534 KG
	1	Bayferrox 140M	0,1722 KG
	1	Marcrolex Blau 3R	0,0042 KG
	1	Gelb 3G	0,0703 KG
Σ		Gesamtmenge Ansatz	100,0000 KG

Color information by email to customer

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2

Standard

Visualization of theoretical reflectance data (Prediction 1 and 2)

Prediction 1

Prediction 2

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Datacolor ENVISION Technology:
Digital sampling, communication with suppliers

Standard

Prediction 1

new beige 1 Synthese1

```
Standard:   new beige 1
            Synthesised by Adjusting Standard
            24 May 2005, 09:39:55
            35 pt, 360..700nm, d=10, d/8°, LAV , SCI, UV Inc
            LCh  : [ 66.071  22.362  67.462], CabVV_D65, 10 deg
            Gloss: <Unset>

Batch:      new beige 1 Synthese1
            Keyboard input []
            24 May 2005, 10:10:18
            31 pt, 400..700nm, d=10
            LCh  : [ 66.048  22.739  68.046], CabVV_D65, 10 deg
            Gloss: <Unset>

Observer:   10 degree

Equation:   CIE Lab

Illuminant    DE*      DH*      DC*      DL*      Da*      Db*
────────────────────────────────────────────────────────────
CabVV_D65    0.44     0.23     0.38    -0.02    -0.07     0.44
────────────────────────────────────────────────────────────
D65          0.04     0.02    -0.03    -0.01    -0.03    -0.02
F11_TL84     0.92     0.23     0.72     0.52     0.08     0.75
A            0.10     0.09    -0.03    -0.03    -0.09     0.02
────────────────────────────────────────────────────────────
```


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Datacolor ENVISION Technology:
Digital sampling, communication with suppliers

Datacolor ENVISION Technology:
Digital sampling, communication with suppliers

Standard

Prediction 2

```
Standard:    new beige 1
             Synthesised by Adjusting Standard
             24 May 2005, 09:39:55
             35 pt, 360..700nm, d=10, d/8°, LAV , SCI, UV Inc
             LCh  : [ 66.071  22.362  67.462], CabVV_D65, 10 deg
             Gloss: <Unset>

Batch:       new beige1 Synthese 2
             Keyboard input []
             24 May 2005, 10:11:44
             31 pt, 400..700nm, d=10
             LCh  : [ 65.855  22.325  66.727], CabVV_D65, 10 deg
             Gloss: <Unset>

Observer:    10 degree

Equation:    CIE Lab

Illuminant   DE*      DH*      DC*      DL*      Da*      Db*
-----------------------------------------------------------------
CabVV_D65    0.36    -0.29    -0.04    -0.22     0.25    -0.15

D65          0.01     0.00     0.00    -0.01    -0.01     0.00
F11_TL84     4.38     4.21    -0.74     0.92    -4.22     0.68
A            3.34     3.33     0.26     0.02    -2.85     1.75
-----------------------------------------------------------------
```
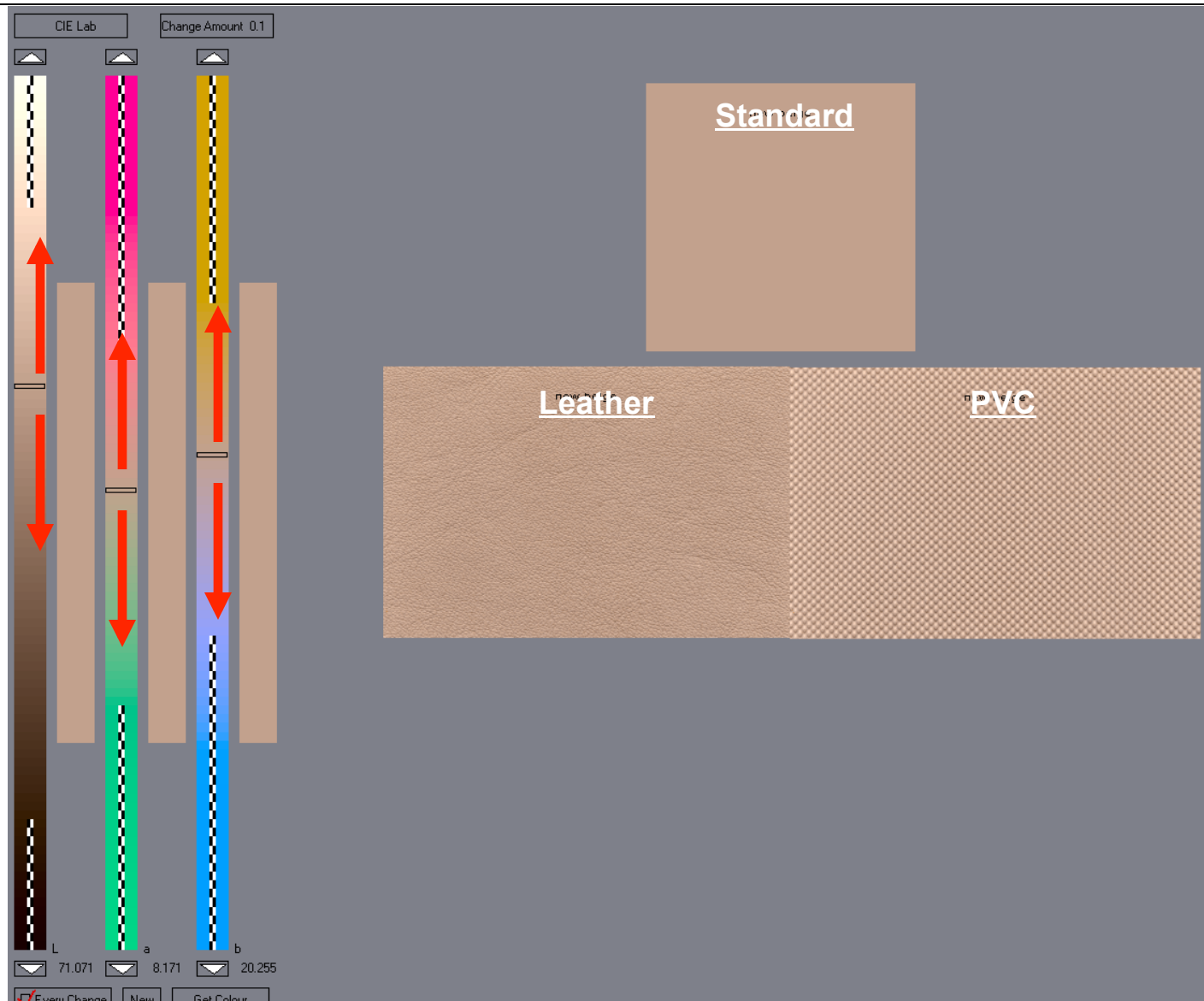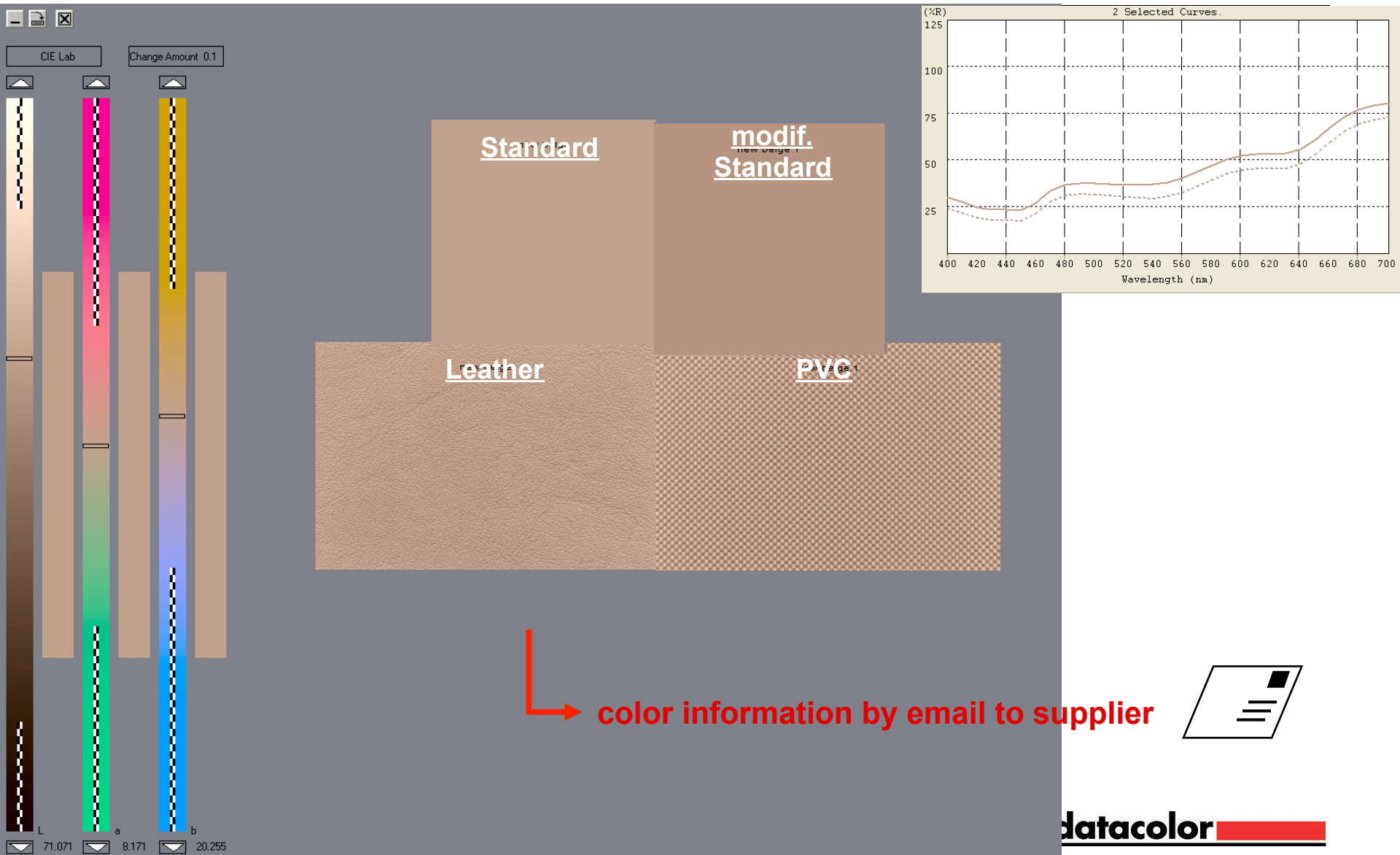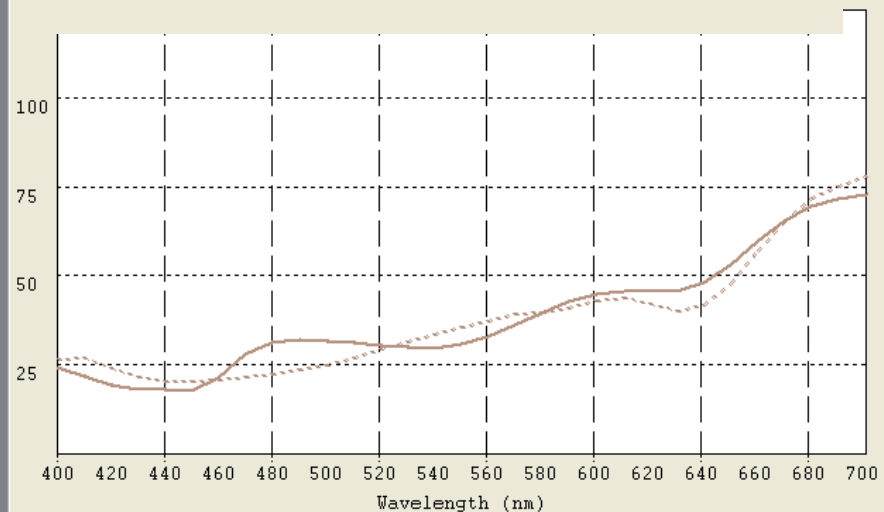
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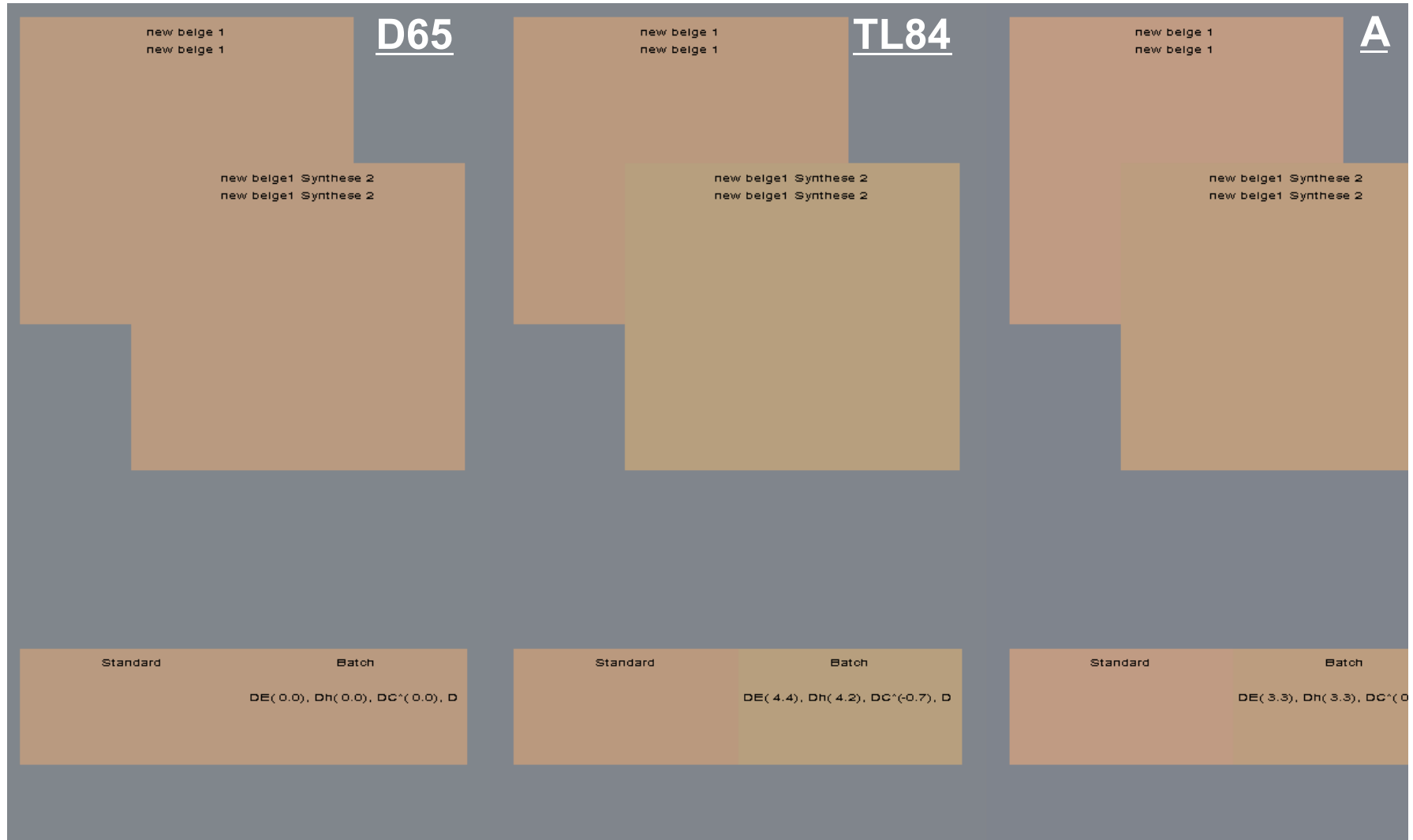
D65

new belge 1
new belge 1

new belge1 Synthese 2
new belge1 Synthese 2

Standard   Batch

DE(0.0), Dh(0.0), DC^(0.0), D

TL84

new belge 1
new belge 1

new belge1 Synthese 2
new belge1 Synthese 2

Standard   Batch

DE(4.4), Dh(4.2), DC^(-0.7), D

A

new belge 1
new belge 1

new belge1 Synthese 2
new belge1 Synthese 2

Standard   Batch

DE(3.3), Dh(3.3), DC^(0

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Datacolor ENVISION Technology:
Digital sampling, communication with suppliers

Standard	**Standard**
Prediction 1	**Prediction 1**
Prediction 2	**Prediction 2**

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Color in Context

Leather

Standard

PVC
new beige Synthese1

Prediction 1
new beige 1 Synthese1

Textile

Prediction 2
new beige 2

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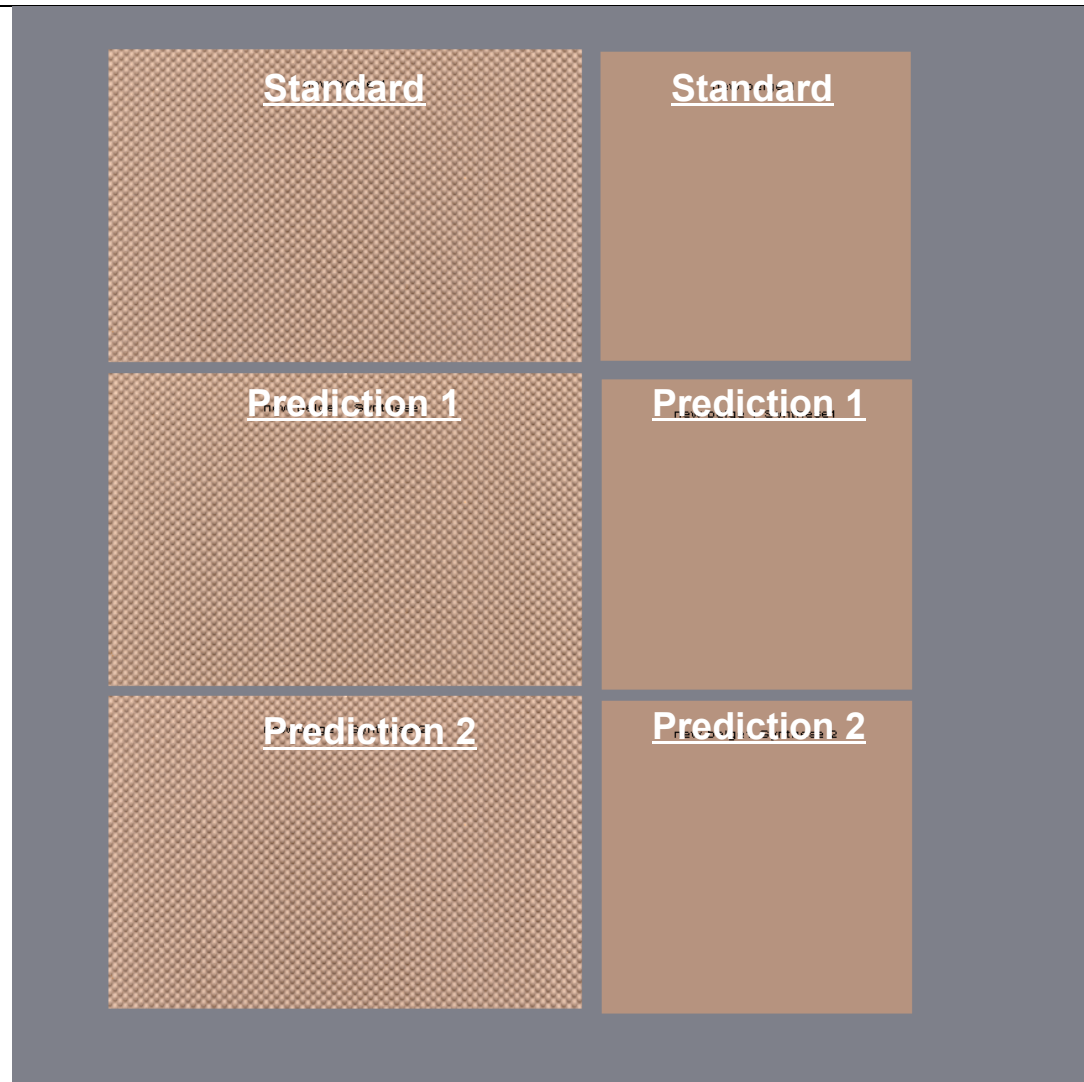
Optimization of the Color Development Process

2 points with high potential for optimization

Design → Product Development / Target Samples (Plaques) → Coatings, Plastics, Leather, Textile → Supplier / Pilot Samples → Car Manuf. Prod.Dev.. / Inspection/ Approval → Pro-duction / Regular QC/ Supplier Car Manuf.

1 Interactive process of development of color standards

2 Interactive process of development of samples for definite color approval

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Optimal Cooperation within the Value Added Chain

Car Producer:

- clear definition of color

- well defined color communication

- pre-feasibility check

Supplier:

- well defined color communication

- less iterations (sampling process)

- less phys. samples
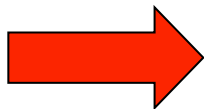
Costs / Time savings
Enhancement of efficiency
Controlled process (avoid risks)

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Digital Color Development
Summary/Conclusion

Advantages:

- 50 % time savings

- corrections possible in very early development phase/stadium

- Digital, theorectical formulations

- Digital color communication

- improvement of quality due to color harmony

Digital Color Development
From hardware to digital sampling

Thomas Lask
Walter Franz

VDI-K Mannheim
28th- 29th of March 2006

BMW Group

Color Quality Control
for automotive interior

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General Workflow

Color Quality Control (final inspection)

QC = SCE

OEM Product Development

Inspection/ Approval

Pro-duction

Regular QC Supplier OEM

d/8°

45°/0°

TOOLS 2.0

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Color QC for Car Interior (d/8°)

1. **General QC:**
   Select a valid standard with the defined texture
   Benchmarking:
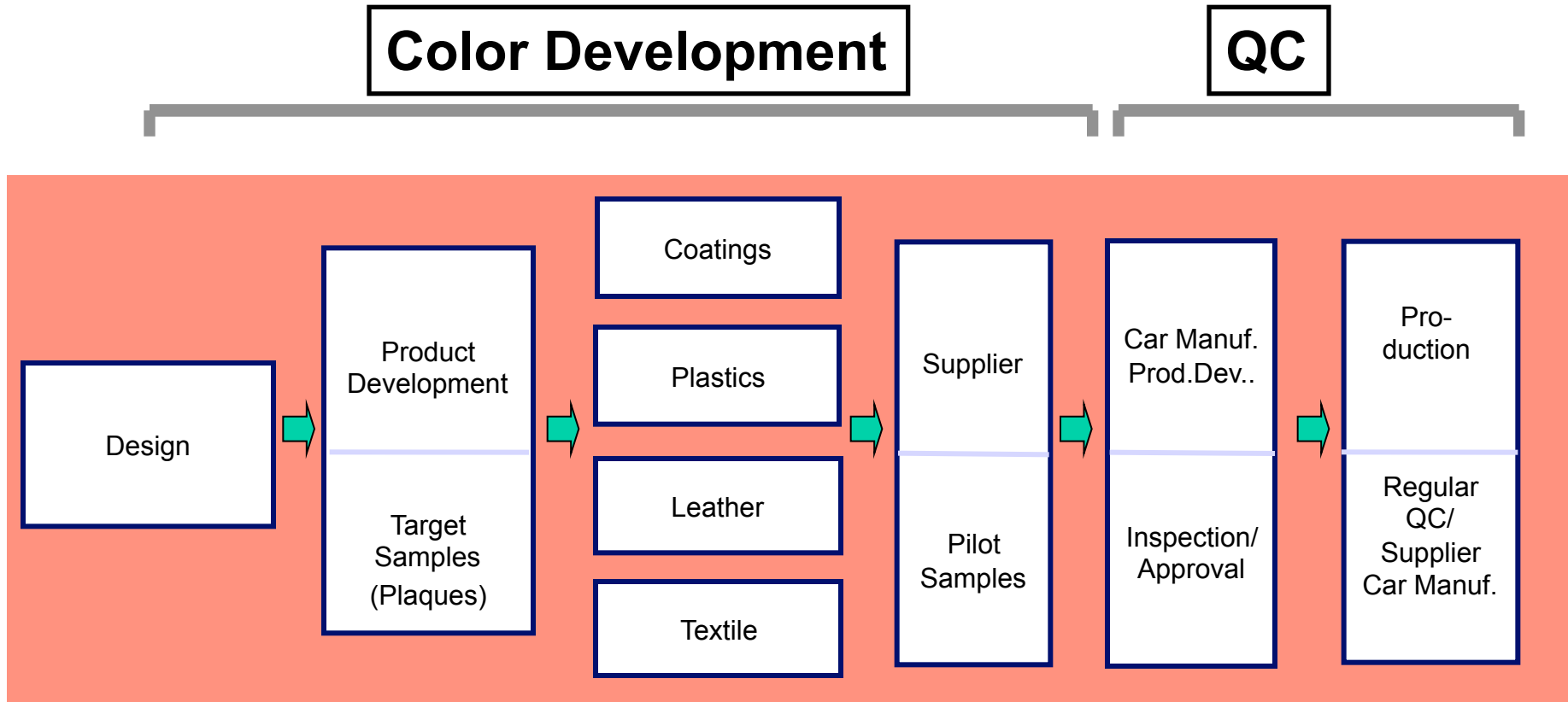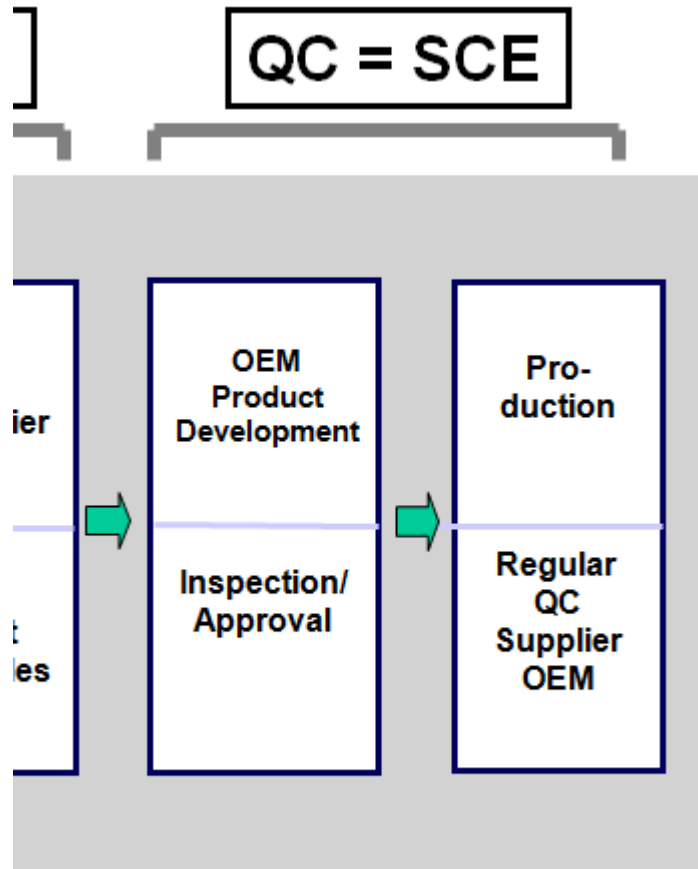   **Select a „leading" part/substrate and define it as the standard (e.g. dashboard or seat).**

2. **Chose parts/samples to be compared.**
   - Measurement areas must be free of scratches, dust and grease
   - Radius of curved parts min. 10 x the diameter of the aperture plate of the instrument used
   - Make 4 averaged measurements taken on different places

3. **Instrument settings**
   - Use d/8° geometry SCE, better GLOSS to include gloss measurements
   - Use SAV aperture plate to minimize the influence of curved samples; for very small parts use USAV.
   - If no specific tolerances available use CMC 1:1
   - Tolerance factor depending on the requirements may vary between 0.5 (high-end interior) and 1.5.

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Color QC for Car Interior (d/8°)

4. **<u>Documentation</u>**

Test report must contain the following information:

- Sample/part name and date of measurement
- Spectro used
- Used settings (e.g. SCE, SAV etc.)
- Used Color Difference Equation and/or Tolerance Formula
- Used illuminants (D65, A, F02 or F11) and standard observer (10°)

5. **<u>Sample reproducibility</u>**

It is helpful to check the reproducibility of a sample. Take 20 individual readings at different measuring points. Calculate the standard deviation of the color coordinates used.

<u>Tolerances used for QC must be min. three times greater than the standard deviation!</u>

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Datacolor 45G

High precision measurement of visual appearance
and gloss across materials

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Datacolor 45G Features and Benefits

Best Accuracy in Class

Best Inter-Instrument Agreement in Class

Measure Gloss and Color simultaneously

45/0 to correlate with visual appearance

Desktop software included

Standard Bluetooth Communication

Pass/Fail Warnings on up to three tolerances

Sleek Lightweight design

Measurability on a wider range of parts

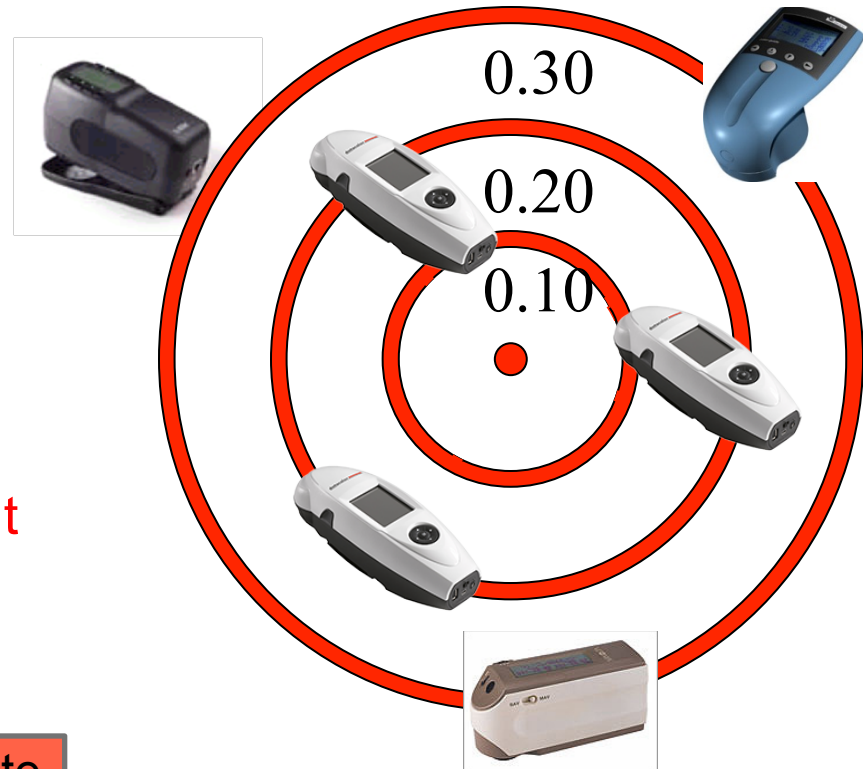Large Backlit Color Touch Screen display

USB On-the-Go

Versatile side-action targeting foot

Most illuminants of any portable unit

Inter Instrument Agreement

0.30

0.20

0.10

Best inter-instrument agreement

Average DE < 0.15

Max DE < 0.25

Datacolor 45G can be used to create digital standards for supply chain

Multi-level factory calibration of 45G produces very tight correlation across units

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Measure gloss and color simultaneously with 45G

See if appearance difference is due to gloss variation

Quality control for 60 degree gloss and color in one step

Ergonomic side-action targeting foot

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Ergonomic design

Left and right handed use with two measurement switches.

Flexible sample presentation

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Tools is an integral part of the Datacolor 45G System

All standards and tolerances are set in Tools, then transferred to the 45G

The 45G interface is simple and uncluttered

Results are clearly displayed on the screen

Batches are uploaded to Tools for archiving and in-depth analysis

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Summary: color management automotive interior

- **Color development: hardware/software existing**

- **Color quality control: hardware/software existing**

➡️ Go digital

to optimize your process
to have a consistent quality
to save time and costs

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Finally…..

More time for creativity!!!

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Future Outlook: digital color assessment
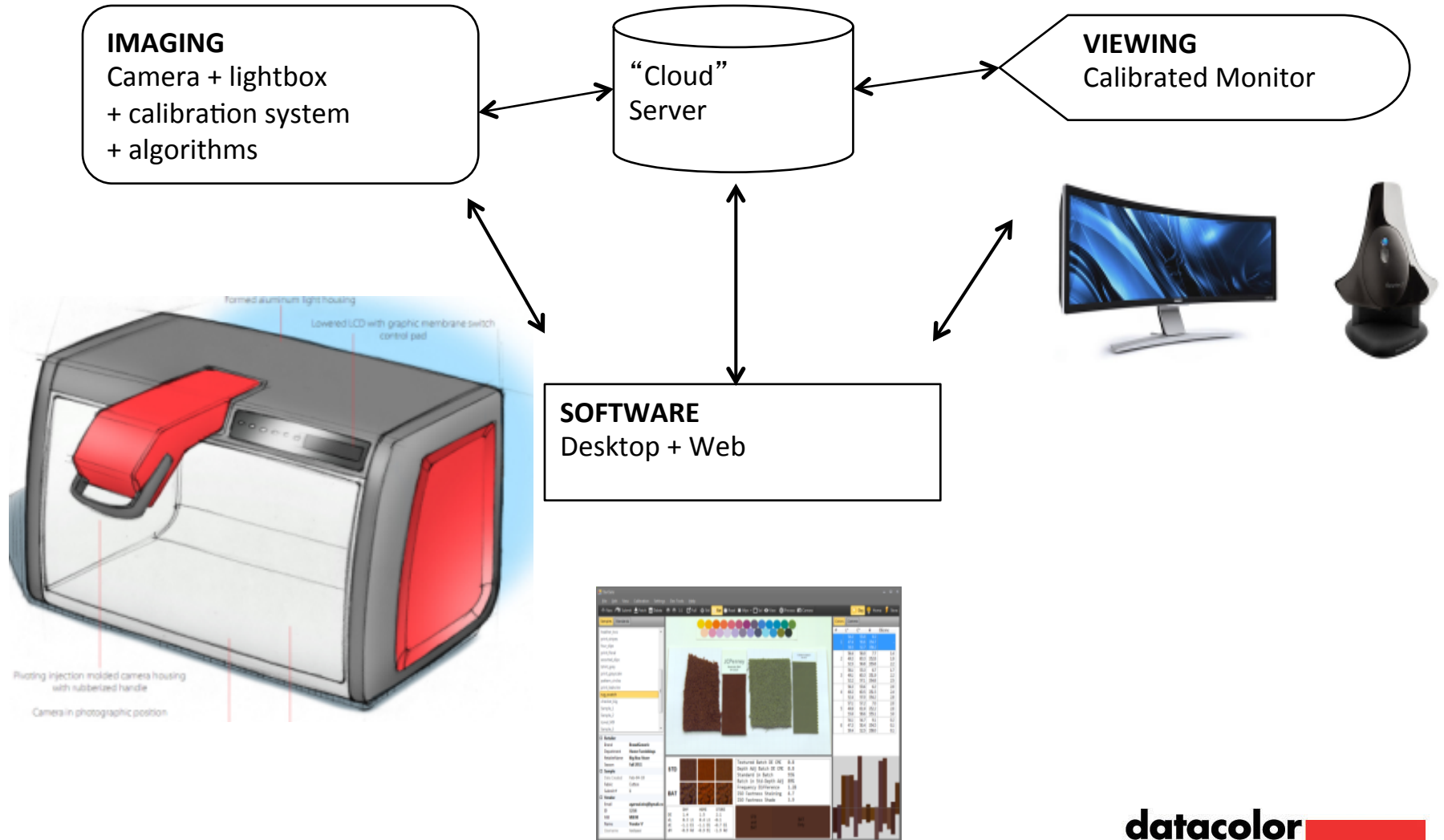
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New Datacolor Technology
Datacolor VIEWPORT – Available in 2012

- **Calibrated Camera Technology (Multiple Light Sources)**
- **Designed for communicating and evaluating prints, laces, multi-colored fabrics, carptes**
- **Ability to assess color accurately across continents simultaneously**
- **Provides Objectiveness, Consistency and Speed**

ViewPort – Imaging Components

IMAGING
Camera + lightbox
+ calibration system
+ algorithms

"Cloud"
Server

VIEWING
Calibrated Monitor

SOFTWARE
Desktop + Web

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DC Viewport

STD

BAT

auto1

Home | Sample | Standard | Viewer | System

Fetch | View | Print | Clear Report | Email | Standard | Batch | 606px | Approve | Reject | New | Day | Home | Store

Submit | Report | Select Area | Process | Image

22439 0P7 LD C
CHANTY 25470 0VA 94069.0
CHANTY 25597 0GY 93486.0
22439 004 LD A
CHANTY 26373 0FL 93975.0
31485 004 103322
Modell Part A & B
Modell Part C&D
Kaschierung 94215
31485 004 103310
31485 004 103100 B
BSP
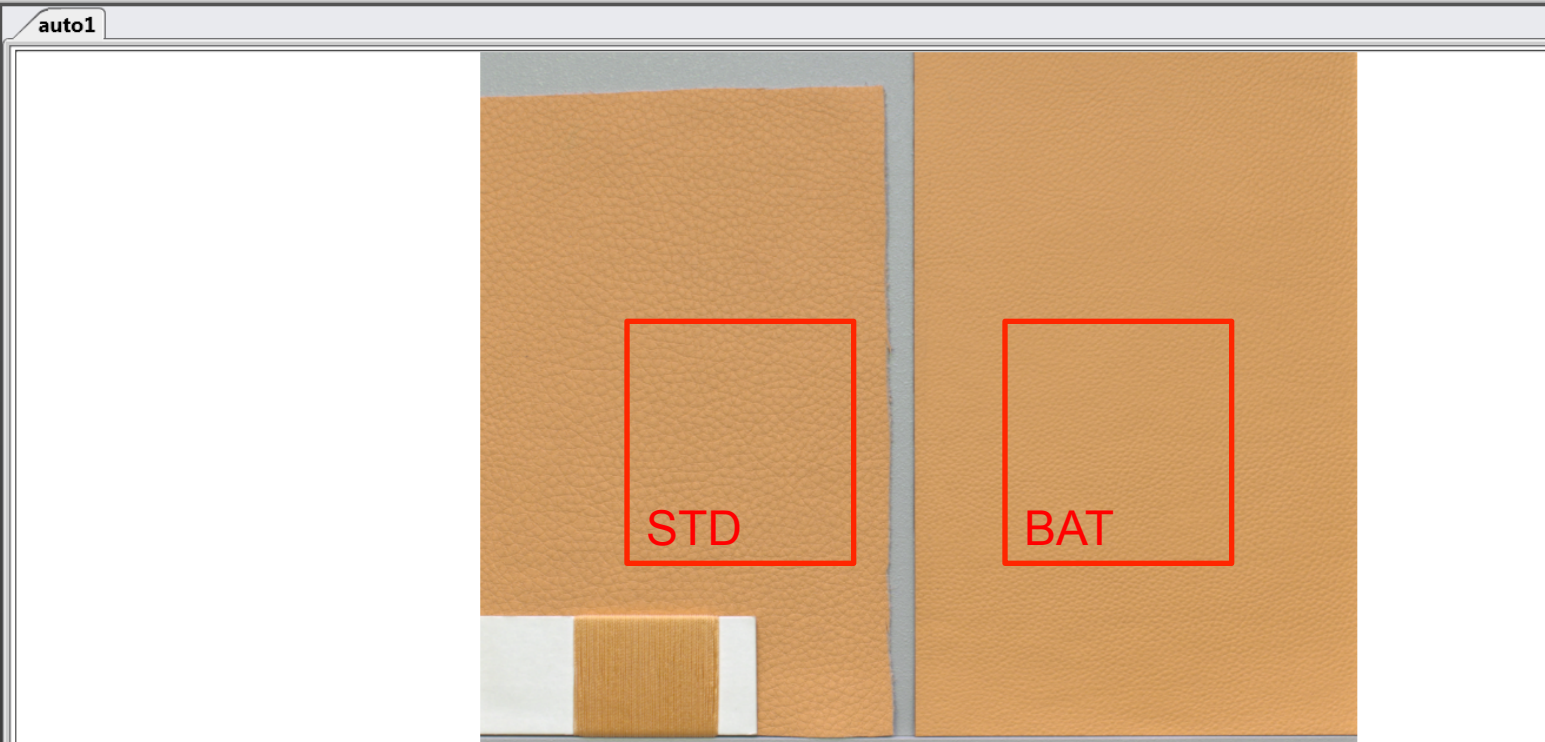
Result Grid

Std Name	Bat Name	Standard	Batch	Illuminant	dE		dL		dC		da		db		%Std	%Bat	Con
auto1	auto1			Day / D65	1,1	Pass	1,0	Lt	1,7	Br	-0,2	Gr	1,9	Yw	100,0%	100,0%	
					1,1	Pass	1,2	Lt	1,9	Br	0,0		2,1	Yw			
				Home / A	0,9	Pass	1,0	Lt	1,6	Br	0,1	Rd	1,7	Yw	95,0%	100,0%	

More questions ?

Please visit us:

Hall 3, A5530

www.datacolor.com

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