Digital Textile Printing

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CREATE = Colour Research for European Advanced Technology Employment, October 20th, 2008
Outlines

- History
- State of the Art of Textile Printing Industry
- Technology (after ITMA 2003)
- Reconsiderations – Rationales
- Case Studies (Europe and US)
- New design possibilities by digital printing technology
  - HD Imaging / New Design Styles
- Into the future
  - Materiality
  - Surface Imaging
  - Alternative Manufacturing
  - Research
History

- 1878  The principal mechanism (Lord Rayleigh)
- 1960s  First inkjet system (Continuous Inkjet System)
- 1972  Piezoelectric D.O.D. heads by Clevite Corp in Ohio
- 1979  Thermal D.O.D. inkjet heads. (HP and Canon -bubble jet)
- 1995/96  Seiren Viscotex System (Production inkjet printing on cloth)
- 1995/96  Encad TX 1500 series (Thermal D.O.D. heads)
- 1998/99  Large Format sampling Printer (Mimaki TX series)
- 2003-  Production Printers (Mimaki, Reggiani, Robustelli, Konica / Minolta, Osiris, Miyakoshi / Kyocera, Tencate)

Flat-Bed Garment Printers (Brother, Mimaki, Kornit,)
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State of the Art of Textile Printing Industry

- Worldwide Total Textile Printing $100+ B (analog and digital)

End User Expenditures

- Soft Signage: 33% (45+ % inkjet printing penetration)
- Industrial Textile: 67% (1+ % inkjet printing penetration)


- Worldwide Printing Growth (Industrial Textile Printing)

20+ Billion meters per year
At least 1% per year of increase

Reasons:
- Acceleration of fashion cycles
- Continuous world population growth

Technology after ITMA 2003

- Inkjet Technology becomes the main digital textile printing technology
  Piezo electric DOD / Multi-deflection Continuous Flow Inkjet
- Established Production Printing: Mid to High Speed Production Printers
- Increasing Printing Speed and Reliability
- More developments in high production
  Miyakoshi / Kyocera, Tencate Advanced Technology

Shifts towards Mid-High Speed Production Printers
Digital Printers for Textiles

**Short Run Sample Printers**
- Mimaki: (TX-1, TX-2) TX-3: 2,000+ units

**Medium Speed Production Printers**
- Dupont: (3210) 2020: 200+ units
- Robustelli: Monna Lisa: 100+ units
- Konica / Minolta: Nasserenger V: 100+ units

**High Speed Production Printers**
- Reggiani / Huntsman / HP: DReAM: 30+ units
- Osiris ISIS: 4+ units

**Sublimation Transfer Printers**
- Mimaki: (JV4) 4000+ units (5000+)
- Roland: (Hifi Pro) 1500+ units (4-5000+)

**Solvent Printer**
- Mimaki: (JV3) 10,000+ units

Survey by the Center for Excellence of Digital Inkjet Printing of Textiles at Philadelphia University, January 2008
Reconsiderations - Rationales

Digital printing penetration in industrial textile ($67B) 1%

Digital printing penetration in soft signage ($33B) 45%
Reconsiderations - Rationales

- Digital Production Printing: Technology After ITMA 2003
  Upgrading Production Printing Speed and Refining Printing Quality

- Investigating Outside of Traditional Textile Printing Industry
  Desktop printing: Off-Set vs. Digital Printing – Paperless
  Project based (Soft Signage) vs. Yardage based (Traditional Textile)

- Critical Factors of Digital Textile Printing Industry:
  Success of digital textile printing: “Value Printing”

• Design Aesthetics (New design styles and Materiality)
• Definition of Textile Printing (Surface Imaging)
• Business and Workflow (Alternative Manufacturing)
• Sustainable Printing (No storage, On Demand, Research, etc)
Case Studies
Silk printing: (Como region)

- It is known for high end apparel prints including silk scarves and ties. - Mantero and Ratti

- Integrations of conventional and digital productions. (design looks and cost)

- Multiple Mimaki TX-2 printers and Production printers (Robustilli Monna Lisa and Dupont 2020) for productions.

- 6000 meters of productions with TX-2.

- “Speed is not the issue, the quality is.”
Nomega digital printing

- Founded as a dyer - full digital production mill

- 12 Monna Lisa printers for reactive and acid dye print
  (cotton, silk, wool, viscose and polyester)

- Printing charge: 8 - 10 euro per yard plus fabric costs.
  (plus fabric costs: 200 meters minimum)

- 3000 linear meter (daily)
Olonia Stampria (cotton print)

- Home furnishing and Bedding. (30Mi sqm/year)
- Commission and Original prints.
- 3 rotary
  1 flatbed with pigment
  Reggiani DReAM Inkjet printer
- Inkjet fabrics as the accent products to conventionally printed fabrics.
Creation Baumann: Switzerland

- Vertical high-end furnishing fabric producer
- 3 x TX2 and 4 x TX1 with Reactive and Disperse printing for 8 base fabrics including Trevia CS
- 60 designs for 2 collections including 3-4 inkjet design per year.
Best: Berlin

- Textile Signage printer (Flag and Banner)
- Started with Screen Printing (Automatic Flat-Bed Screen)
- Inkjet for Economical Needs
  Saving the space
  Speed
  2 Digital (Reggiani Printers)
  Direct Disperse dye ink on polyester
Other digital printing mills in Europe

Miroglio:
Vertical operation from original designs to production for apparel market.
Annual production: 40 million meter
9 rotary printers in 3 shifts from Mon to Sat. (1200 meter per colorway).
10 x Konica /Minolta Printers– 6 Reactive, 2 acid and 2 disperse
6 x Mimaki TX2 for sampling and strike-offs.

Leggiuno:
Konica / Minolta Printers for high end fashion (cotton, linen / silk).

Luca:
2 x Reggiani DReAM printers for cotton fashion printers.
Digital printing operations in the U.S.

- Increasing numbers of digital printing service operations:
  
  First2Print, Rothtec Engraving, B3 Studio, Fabrics2Dye4, Adaptive Textiles, Custom Printed Fabrics (Zenith Engraving).

- Digital production commission printing mills:
  
  Dream Digital Fabric Printing Services: (Orangeburg, NY)
  Pre-treatment / Post treatment
  Digital Printing Production

  Advanced Digital Textiles (Master Screen): (Charlotte, NC)
  Pre-treatment / Post treatment
  Digital Printing Production

  Carlisle Finishing (formerly Cone Mills): (Carlisle, SC)
  Only specialized in cotton / line prints for home furnishing markets.
  $50 per yard (less than 50 yards) and $21 - 25 per yard (over 50 yards)
Eastern Silk Mills, Elizabeth NJ

- Silk Printing for US fashion
- Started with Table Printing
  - Carriage Printers
  - Turn Table Printers
- Inkjet for Economical Needs
  - Conventional
    - 40 mins (1 color) - 1 piece
    - 1 day (10 colors) - 1 piece
  - * Skill and Experience
  - Digital (Dupont Printers)
    - 2 hours - 1 piece
    - (180 + 180 dpi)
New design possibilities by digital printing technology

- HD Imaging
- New Design Styles
High Definition Imaging (1)

One of the characteristics of digital inkjet printing is an ability to print images without aids of screens and screen engraving.
This does not mean eliminations of “Color Separations”.

Color Separation:

• Helps to generate color-ways
• Hybrid of the conventional printing
• Leads to HD imaging (tonal)
High Definition Imaging (2)

- Rasterizing for conventional printing:
  Consists of raster dots.
  50 to 150 dpi depending on types of printing technologies.

- Digital Printing
  256 grayscales - 540 to 720 lpi (printer’s printing resolutions).
  Tonal generations are true to the original images.
New Design Styles

- Photographic
- Unlimited use of color
- Diminutive
- Digital effect
- Engineered
Photographic
Unlimited Use of Colors
Setola to Run Oxford’s Core Men’s Groups

By BRENDA LLOYD

ATLANTA — Just five months after it acquired Tommy Bahama, Oxford Industries got a second thumbs-up from the industry last week when it snagged Michael J. Setola as president.

The appointment will allow J. Hicks Lanier, who’s been president, chairman and CEO of Oxford Industries since 1984, to share some of the responsibilities at the Atlanta-based apparel manufacturer.

In June the complexion and workload at Oxford changed dramatically when

See SETOLA, page 6

MOSCHINO

Flying Colors
Diminutive
image transferring media benefits textile designs without step and repeat requirements. Second, variable printing industry was initially enthusiastic about the potential freedom of image creation without constrictions of the printing. Conversely, digital printing is based on a pre-set process color of CMYK, whereas photo and dress prints are more than 50 colors representing original colorful creative looks. Depending on the photographer’s or graphic skills of video cameras can be manipulated and printed digitally on cloth. This photographic manipulation works fine but prints have been explored in military uniforms, which are not only developed for the visual images, but also enzymatic bleaching, though the concept of repeat and then print on textiles in a seamless manner. In 2002, the first time, this instant printing technology has created the opportunity for any digital art to be produced for the volume of customer printing and accommodate both successful sales and well-received FR, within one design, most manufacturers’ inspirations are formed by their recent, visual stimulus, and research tasks influenced by a specific design style, printed by screen printing technology today, still retains the same original look as the heating processes are almost impossible to print, especially, in the early stages of this technological development. Even today, image transferring media benefits textile designs without step and repeat requirements. Secondly, any conventional image transferring media was initially enthusiastic about the potential freedom of image creation without constrictions of the printing. Conversely, digital printing is based on a pre-set process color of CMYK, whose combinations are 1,670,744,000 and dress prints are more than 50 colors representing original colorful creative looks. Depending on the photographer’s or graphic skills of video cameras can be manipulated and printed digitally on cloth. This photographic manipulation works fine but prints have been explored in military uniforms, which are not only developed for the visual images, but also enzymatic bleaching, though the concept of repeat and then print on textiles in a seamless manner. In 2002, the first time, this instant printing technology has created the opportunity for any digital art to be produced for the volume of customer printing and accommodate both successful sales and well-received FR, within one design, most manufacturers’ inspirations are formed by their recent, visual stimulus, and research tasks influenced by a specific design style, printed by screen printing technology today, still retains the same original look as the heating processes are almost impossible to print, especially, in the early stages of this technological development. Even today, image transferring media benefits textile designs without step and repeat requirements. Secondly, any conventional
Digital Effects
Engineered
Into the Future

- Materiality

- Surface Imaging

- Alternative Manufacturing

- Research
Textile Materials
(Tactile Quality)
Texas Instruments, rental booth reskin

By: Jack Morton

Miller exhibit

By: Derse
“Our specialty is to blend printing images into tactile, which generate a variety of moods to the final products.”

By Marco Alvarez, Fabric Images
Miller exhibit

By: Derse
Surface Imaging

- Aesthetic shifts from Novelty to Subtlety
- Redefinition of “Textile Print Design”
"We would not like our designs to look like digital. Our designs should look hands-on but retain the quality that only digital printing can do."

By Carlo Mantero
Redefinition of “Textile Print Design”

• Digital Textile Printing emphasizes:
  1. Form and Function of Design (vs. Repeat as restrictions to designs)
  2. Printing as an interaction of Ink and Substrates (porous / non porous)

• Digital Textile Printing in Soft Signage segment:
  1. Project based Printing (vs. Yardage based) – Starbucks
  2. Shifts from PVC to Textiles – UV chemistry
  3. “Fabric Graphics” (IFAI)

• A New definition of “Textile Print Design / Designer” in a future:

  DESIGN / DESIGNERS for SURFACE IMAGING
Alternative Manufacturing

- Neo Cottage Industry Model
- Personalization
- Mass Customization
Neo Cottage Industry Model

- Individual designers with digital textile printer can produce short to medium run production (1-100 yards +).
- **Individual Designers can directly deal with end users.**
- Larger volume can be out sourced to commission digital textile printers.
- Synchronization between small digital printers to mid / high end printers. (new trend)
- A New business Style.

Decentralization
A Need for low end high quality printing solutions

- Inkjet Textile Printing market is fragmented. (no large single market)

**Example:**

SDA (Surface Design Association)

80% over 4000 members (upper-middle class income households) needs inkjet printing solutions to textiles.

- A Need for low end high quality textile printing solutions.
  
  Desk Top and Large Format (54") with software under $10,000.

  Reliable and Good Service.
Personalization with digital printing

In 2010 – 2015, “GenY” becomes a biggest consumer group.

Text massage, Google search, educated, technology oriented........
Experiences with Personalization and Customizations.
Mass Customization

Step 1: provide photo
Email a digital photograph of the home to info@edgewhiteviles.com (jpg, tif or pdf).

Step 2: review proof
Take a look, show it to your client, discuss revisions.

Step 3: approve placement
Our textile designers will walk you through adjustments to placement and scale. Filler items will be added if necessary to balance the design.
More Research
(Problems to be solved)

- Penetration of colorants to the textile substrates
- Color Gamut
- Universal Ink (pigments / dyes)
- Specialty printing (material deposition)
- Hybrid color management (solid, tonal, photographic)
- Sustainable printer constructions
- Speed of printing production
The Center for Excellence of Digital Ink Jet Printing for Textiles
at Philadelphia University (2000)

To provide information in neutral position.

The technology was still early development stage and many commercial advertisement as information sources.

To conduct design / engineering research.

Research projects (design and technology)
Proof-of-concept projects
Testing
Production printing

To conduct educational events.
# Equipments

**Printers**
- **Thermal Head:** DesignJet 500 (HP)
  - DesignJet 10000 (HP)
- **Piezo Head:**
  - TX-1, TX-2, JV3, GP-604 for Flat bed garment (Mimaki)
  - Falcon, Falcon Plus (Mutoh)
  - Hifi Jet (Roland)
  - Epson 3000

**Scanner**
- Contex 42” large format scanner

**Software**
- ErgoSoft, Wasatch, etc.

**Colorants**
- Huntsman Textile Effects, DyStar, Trident ITW,
  - Sawgrass Technologies, etc.

**Others**
- Digifab, Improved technologies, Jacquard inkjet, Test Fabrics, etc.
Research

- **Design research**
  - New design styles
  - New product application and production workflows
  - “Textile Design Analysis Using Computer Visions”
  - “Smart Algorithm for Printed Textile Design”

- **Engineering research**
  - “Creation of Textile-Based Durable Printed Antenna Systems”
  - “Encapsulated Ink for Digital Ink Jet Technology”
  - “Integration of fabric formation and coloration processes
  - “Universal Set of Dyes for Digital Inkjet Textile Printing”
  - “Nonparticulate Textile Colorants for inkjet textile printing”
  - “Inkjet printing textile archives - Barnes Museum”, etc.

- **Proof-of-concept projects**
  - Inkjet printing for Military Camouflage printing
  - Inkjet printing narrow band
  - Printed nonwoven product development
  - Chemical Impregnations, etc,

- **Testing (Print performance, Line acuity, optical density, fastness, etc.)**
  - Various inks and substrates

- **Production** (samples to short runs)
  - Scarves, ties, umbrellas, bags, T-shirts, yardages.
Education

- Conferences and workshops
  - Designer Meets Technology (2004)
  - Designer Meets Technology: Europe (2005)

*Design and Technology Conference, Summer 2009, organized with AATCC, TC2 and Philadelphia University*
Digital printing of textiles (WTP)

Edited by H Ujiie, Centre of Excellence in Digital Ink Jet Printing, Philadelphia University, USA

At present the textile industry produces the majority of its 34 billion square yards of printed textile fabric by screen printing. However as we move into the digital age developments in digital printing of paper are being adapted more and more for the textile market. Inkjet textile printing is growing while growth in analog textile printing remains stagnant. As digital print technologies improve offering faster production and larger cost-effective print runs, digital printing will grow to become the technology that provides the majority of the world’s printed textiles.

This comprehensive introduction to the subject is broken into five sections. After two introductory chapters, it goes on to look in a number of detailed chapters at printer and print head technologies. The next section examines the printer software required for successful colour design and management. The digital printing colouration process is explored next, with chapters on substrate preparation, pigmented ink, aqueous inkjet ink, pre-treatment and printing on cationized cotton with reactive inks. The book is concluded with three chapters on the design and business aspect of digital printing.

*Digital printing of textiles* contains fundamental technical explanations along with current research, and will prove to be an invaluable guide for product developers, retailers, designers and academic researchers.

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