S u r f a c e I m a g i n g

a n e w t r a n s d i s c i p l i n a r y d i s c i p l i n e

H i t o s h i U j i i e

D i r e c t o r o f t h e C e n t e r f o r E x c e l l e n c e i n S u r f a c e I m a g i n g

P h i l a d e l p h i a U n i v e r s i t y

4 2 0 1 H e n r y A v e n u e , P h i l a d e l p h i a , P A , 1 9 1 4 4 U S A

2 1 5 . 8 3 3 . 3 5 4 8 u j i i e H @ P h i l a U . e d u

Definition

- A discipline that visualize any imageries on a wide range of substrates by advanced digital printing technologies including direct colorations, deposition and subtraction printing.

- A new discipline that moves beyond the boundaries of existing traditional fields of disciplines- Transdisciplinary

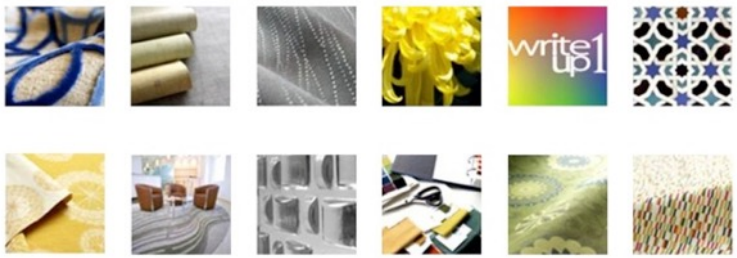
Surface Imaging Design

Contained and Continuous Imaging

Drawings and Paintings

Raster and Vector Imaging

Photo Imaging



Direct Digital Coloration

Porous and Non Porous Substrates

UV, Latex, Sublimation, Organic Solvent, Aqueous Dye.

Digital Fabrication Printing

Material Deposition

Enhanced 3D Relief Surface, Metals, Composites, Functional Materials

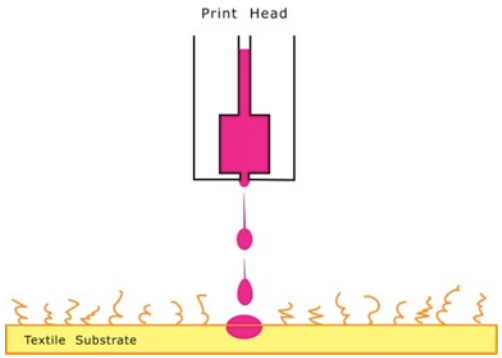
Subtraction Printing

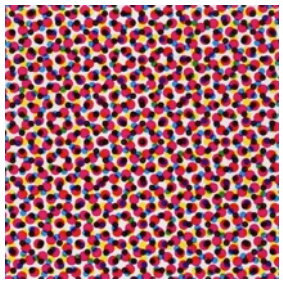
Laser Printing

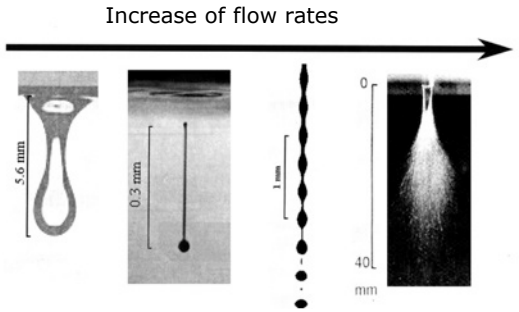
Evolution: Digital Printing for Textile – late 90's

Digital inkjet printing on textile is one of the most challenging technologies among the rest of digital printing technologies – next to printable electronics.

- A wide variety of classes of substrates and colorants
  - no single universal colorants
- Substrates are flexible (not ridged)
  - woven, woven sheer, weft knit, warp knit etc.
- Surface characteristics (lint on surface)
- Performance requirements
  - penetration of colorants, fastness (light, wash, crock, etc.)







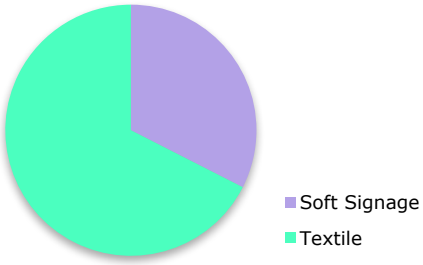
History

• 1878	The principal mechanism of inkjet technology (Lord Rayleigh)
• 1960s	First inkjet system (Continuous Flow Inkjet System)
• 1972	Piezoelectric D.O.D. heads by Clevite Corp in Ohio
• **1975/76**	**Millitron Printing System by Milliken - Carpet and upholstery fabrics.**
• 1979	Thermal D.O.D. inkjet heads. (HP and Canon -bubble jet)
• 1980's	Desktop Publishing
• 1984	HP thermal D.O.D. desktop printer
• 1988/89	Advancement of CCD (charge-coupled device) for flatbed scanners.
	Iris Continuous Flow Inkjet Printer by Iris Graphics – paper proofing.
• 1990's	Screen printer, Photo LAB, Sign Printer – Moving to Digital
• 1994/96	Epson piezoelectric D.O.D. desktop printer
	Seiren Viscotex System (Production inkjet printing on cloth)
	Encad TX 1500 series (Thermal D.O.D. heads)
• 1998/99	Wide Format Printer (Epson, Roland, Mimaki) – graphic, photography and textile proofing
	Development of archival paper ink
• 2000's	Industrial Digital Printing- Archival Colorants (UV, Solvent, Textile, Material depositions)
• **2003**	**Production Inkjet Textile Printers** (Reggiani, Konica/Minolta, Robustelli, Mimaki, Honghua, Zimmer)
	Flat-Bed Garment Printers (Kornit, Brother, Mimaki)
• 2005	Archival ink for consumer photography market (Epson UltraChrome K3 ink)
• 2010's	ITMA 2011 High Speed Production Textile Printers
	(EFI/Reggiani, Dover/MS, Stork SPG, Konica/Minolta, Durst, Zimmer, Epson/Robustelli, Mimaki, Kornit, dGen, Arioli, Honghua, DGI, Ichinose / Toshin, Roland)
• **2015 –**	**Single pass inkjet textile production printing system (ITMA 2015 -)**

State of the Art of Textile Printing Industry

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

End Uer Expenditures



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

Sources: Web Consulting 2005 and I.T. Strategies 2006

- Worldwide Printing Growth (Industrial Textile Printing)

29.5+ Billion meters per year (2013)

50+% for fashion, 40% for interior

At least 1% per year of increase

Reasons:

Acceleration of fashion cycles

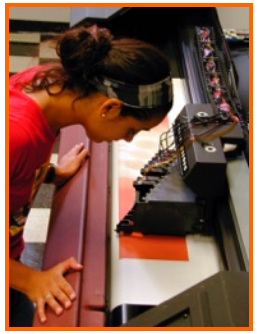
Continuous world population growth

Source: Osiris, 2008; Reggiani Macchine, 2013

Scanning to Single pass inline

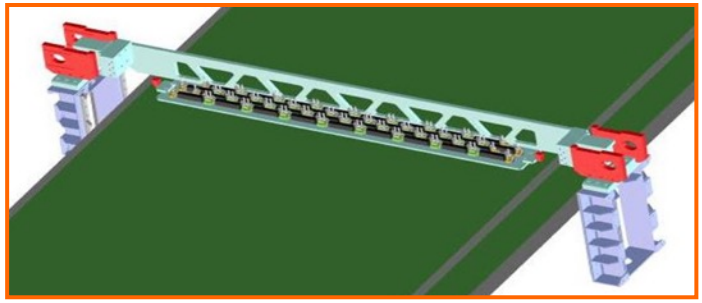
Scanning printer

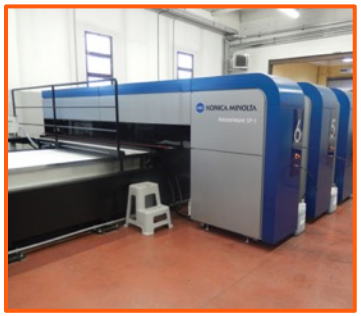
Most of inkjet printers are scanning type, in which a carriage with print heads and ink delivering system moves and prints on the substrate. Information is encoded in scanning strips on the carriage beam. Imagery is typically printed by multiple passages of the print heads.

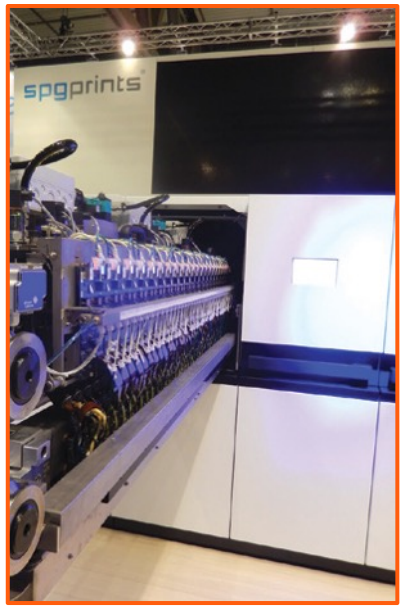


Single pass inline printer (ITMA 2015: MS, Konica/Minolta, Stork-SPG, Honghua)

Multiple print heads are placed from edge to edge for the substrate width. Ink is ejected in a single pass mode from the heads in high speed. Perfect for high speed production but it is a high investment system.







Case Study - Como region

Digital Textile Printing Capital – early 2000 to 2017

- It is known for high end prints including for fashion and home.

  Avantgard Studio, Chiara, De-Ca Stamp, Di Casssna Pirzardi, Lipomo, Luce, Maver, Mantero, Miroglio, Nomega, Olonia, Ratti, Seride, etc.

- Started with multiple Mimaki TX printers (with Epson DX2 / DX4) in early 2000 have been replaced with high speed production printers.

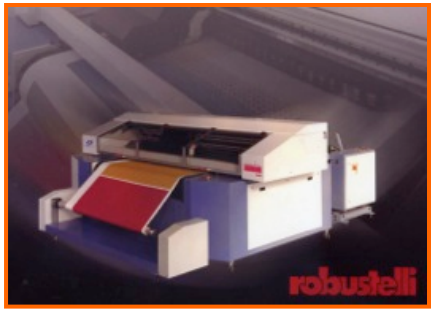
  Epson - Monna Lisa, EFI Reggiani - ReNOIR, Dover MS - JP / JPK, etc.

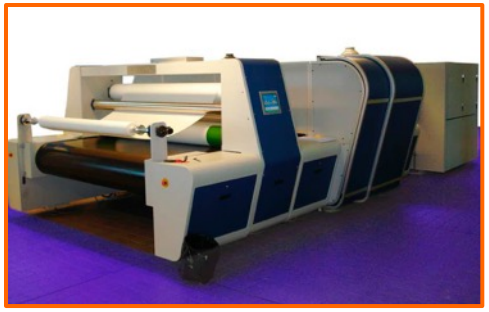
- Integrations of conventional and digital productions.

- End users demand for Digital Printing production.

- One of the most installation numbers of digital printer in a world.

- "Speed is not the issue, the quality is."



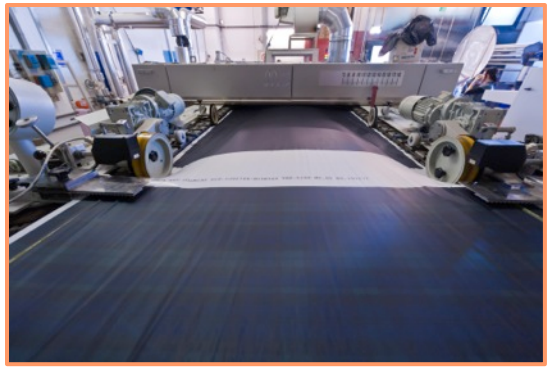
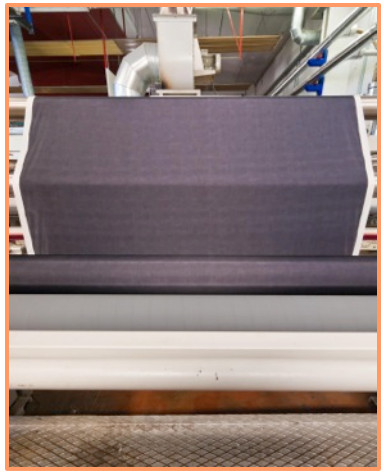


Case Study - Como region

Finishing Operation





- Steaming, washing, finishing and tentering
- Former engraver becomes finishing operation for digital textile printing
- One of the biggest problems in the US

Heimtextil 2014

One of the main annual tradeshows for interior textiles

- A larger popularity for digital printing with reactive dye on bedding (3.2 m)

  Conventionally, a majority of bedding has been printed by pigments.
- Market domination of latex pigment technology on wall covering

  A large scale wall murals with HP latex technology

Menderes

- Vertical home textile mills in Turkey (Bedding)
- Yarn spinning - Fabric constructions (weave & Knit) - Printing & Finishing
- 400,000 meter / day: Printing and dyeing
- One of MS LaRio installation site (1 single pass printer = 20x multi pass printers)

Description	Digital Textile Printing		Traditional Textile Printing
	Single Pass	Multi Pass	
Number of Colors per Design	Unlimited		Limited to Screens
Max. Dimensions of Design	Unlimited		Limited to Screen Number
Resolution of Design	Up to 600 dpi		Screen's Theoretical Limit (≈150 dpi)
Ecological Effects	Close to Zero		High Amount of Energy is needed for the treatment of the waste water, excess dyes
Minimum Quantities	200 Sheet Sets		1000 Sheet Sets
Down Time for Changes	Close to Zero		30-60 mins.
Strike-off/Sample Scheduling	1-3 Days		1-3 Weeks
Consistency of Printing Quality	Very Consistent		Should be Checked Periodically
Printing Speed	**Up to 75m/min**	1-8m/min	Up to 50m/min

	2013	2014	2020
Menderes	Digital: 1%	Digital: 10%	Digital: 50%
Worldwide	Digital: 1%	Digital: 1%	Digital: 2-4%

Textile printing industry in the U.S.

Apparel:	Almost diminished - a couple of specialized printers (swimwear / silk)
Home Furnishing (Decorative):	Several vat dye rotary printers – (technical applications for military)
Home Furnishing (Domestic):	Diminished – Pigment printers

Dupont targeted digital production printer for this market in 2001 - (Artistri 3210: 3.2 meter wide pigment printer)

Digital Textile Printing in the US

- Many digital printing operations are from engravers and new comers.

  CAD Fab, First2Print, Rothtec Engraving, Advanced Digital Textiles (Master Screen), Ultimate Textile (Cheran Digital Imaging), B3 Studio, Fabrics2Dye4, Adaptive Textiles, Spoonflower, etc.

- Lack of driving factors for the digital textile printing marketplace (after 2008)

  In 2000's, the US market was stimulated by sales and marketing forces of printing manufactures – Dupont, Reggiani, etc.

Dupont / Ichinose Toshin / Seiko
Artistri 2020: 2002-2008
35 pl static drop

Reggiani / Huntsman / HP (Scitex Vison) DReAM: 2003 – 2009
40 pl static drop

- Lack of resources for Pre and Post treatment in wet processing – favor to dry processing

Until 2010 (late 1990's to 2010)

Digital printing penetration in industrial textile ($67B)

1.2%

Digital printing penetration in soft signage ($33B)

45%

Today's Reality

Digital printing penetration in industrial textile ($67B)

3.8%

Digital printing penetration in soft signage ($33B)

45%

Within 10 years

Digital printing penetration in industrial textile ($67B)

5 + %

Popularity of Rotary Screen Printing (1963) – **more than 10 years**

Introduction of production digital textile printer - **2003**

Sources: I.T. Strategies 2013

Analysis

Rationale for Surface Imaging Initiative

- Cool factors: New opportunities.

  new design creativity / no engraving / minimum machine downtime / sustainable (minimum dye waste, minimum inventory) / personalization / mass-customization / short run production / fast turn around / no color registration problems / etc….

- Transdisciplinary movements:

  "…digital process can blur the boundaries and distinctiveness between specialisms in a number of ways that allow for multiple interdisciplinary outputs."
  (Crafting Textiles in the Digital Age, edited by Faith Kane et al, 2016, Broomsbury Publishing.)

- Lack of understanding and communication among machine manufactures, printing operations and application users including designers, project leaders and end users.

  No connections among design, engineering and business
  Lack of systems thinking

- Design, engineering and business components in this industry have not been properly integrated, partly because they have retrofitted their systems and processes into preexisting workflows.

  New ways of thinking and concepts

New Design Creativities

New Design Styles

- Photographic
- Unlimited use of color
- Diminutive
- Digital effect
- Engineered


FLAVOR
PAPER

BILL CLINTON, CHINA SUIT SALESMAN? / 3

DNR

FIRST IN MEN'S WEAR NEWS AND TRENDS $10

MONDAY, NOVEMBE

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.

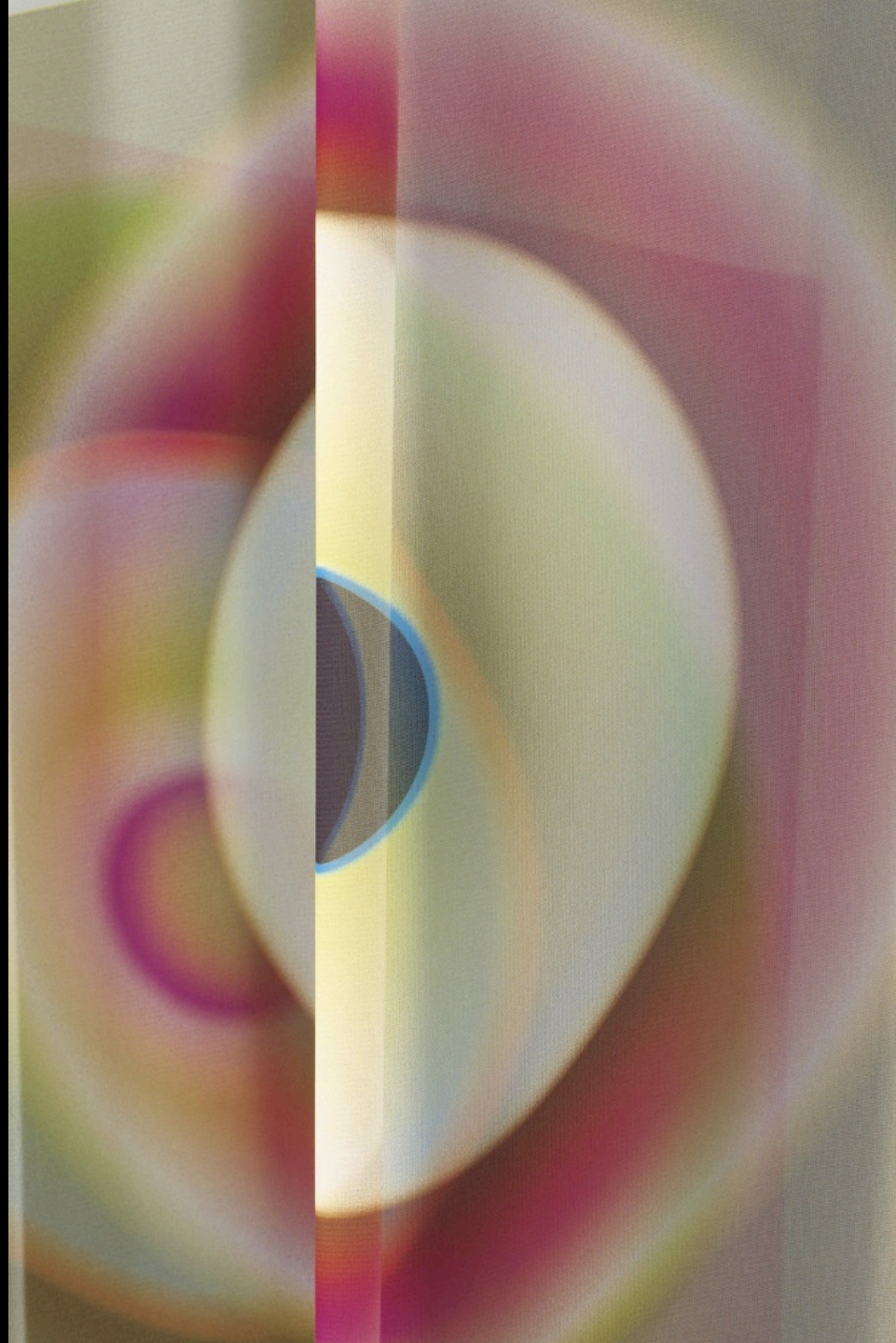
The appointment will allow J. Hicks Lanier, who's been president, chairman and CEO of Oxford Industries since 1981, to share some of the responsibilities at the Atlanta-based apparel manufacturer.

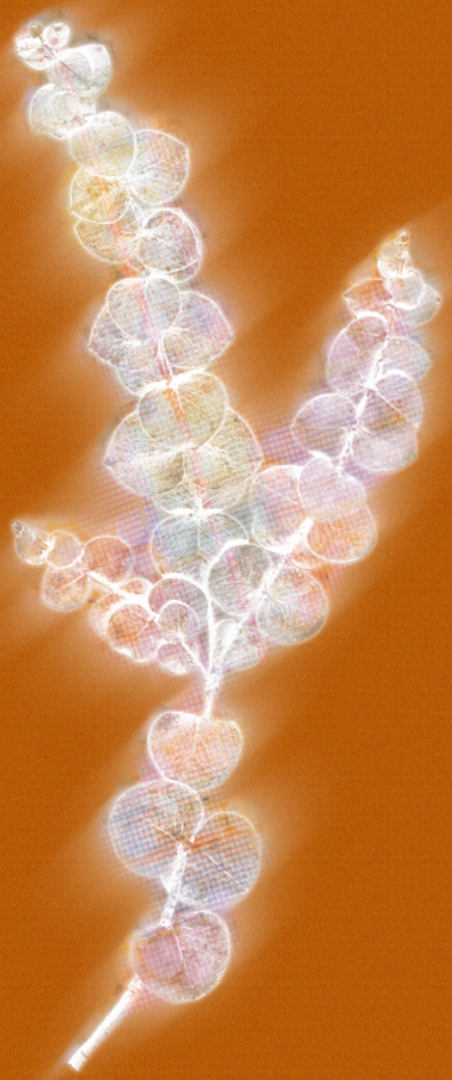
In June the complexion and workload at Oxford changed dramatically when

See **SETOLA**, page 6

MOSCHINO

Flying Colors





From Graphic Signage

To Decorative Environmental Graphics

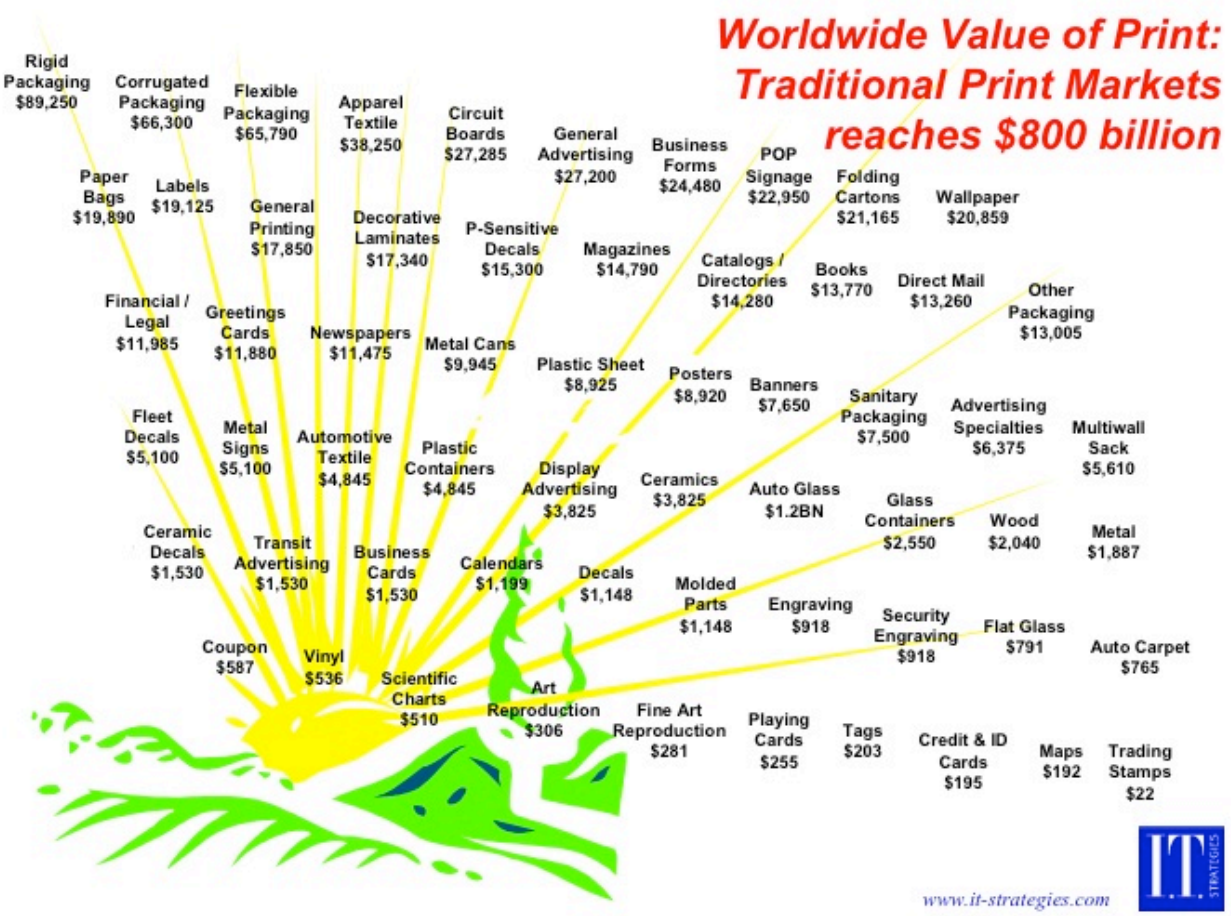
(Architectural Substrates, Wood, Glass, Laminates, Flooring, Interior Textiles, etc.)

Digital Printing Penetration

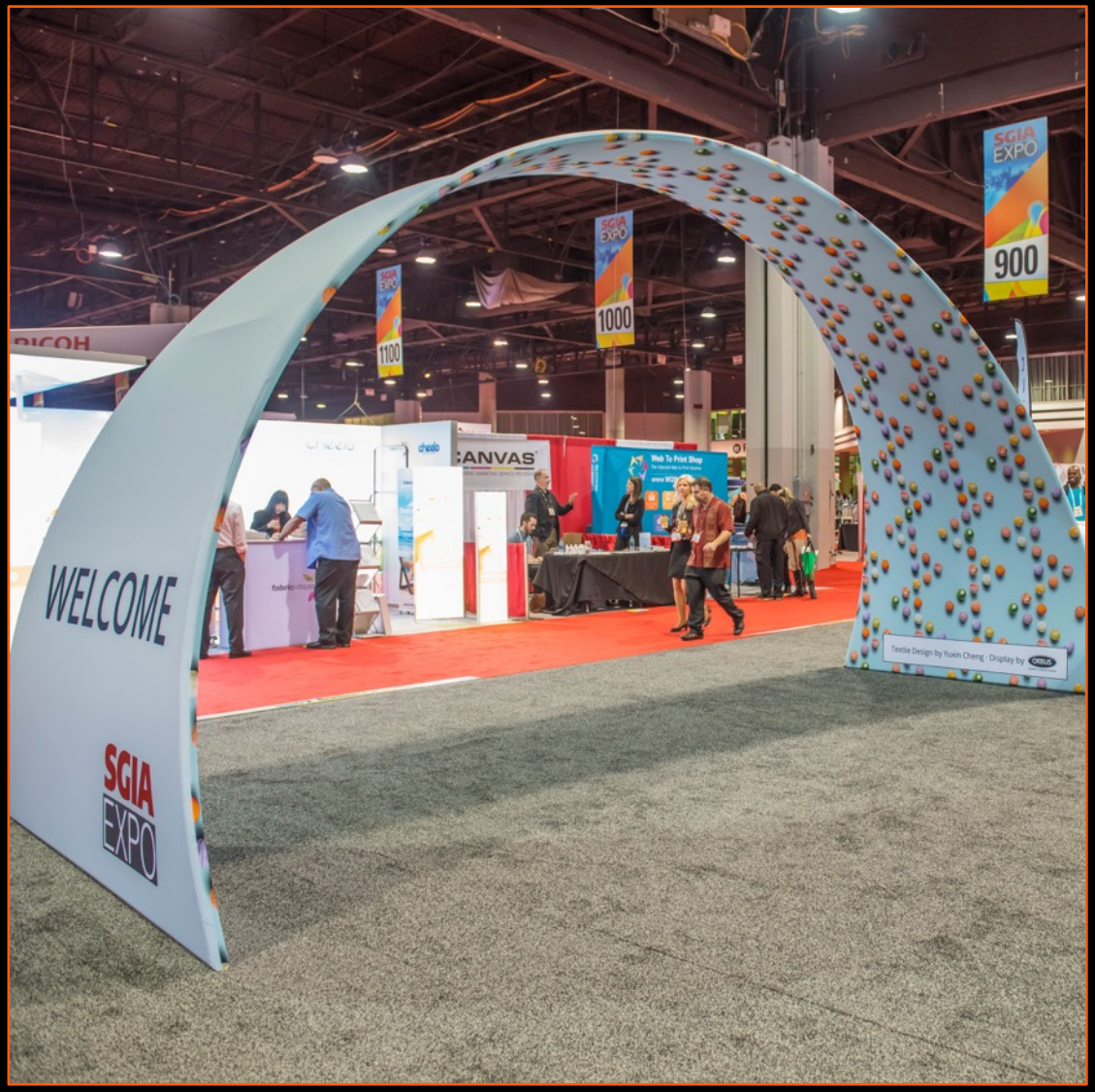
Soft Signage (45%) - Industrial Textile (1%)

Surface Imaging is Large and Growing Market

Surface Imaging industry – 800 billion dollar market and over 10% CAGR in North America




POWER?
HOSE BODY?
WHOSE BELIEFS?
ANYTHING
FORGET


WELCOME
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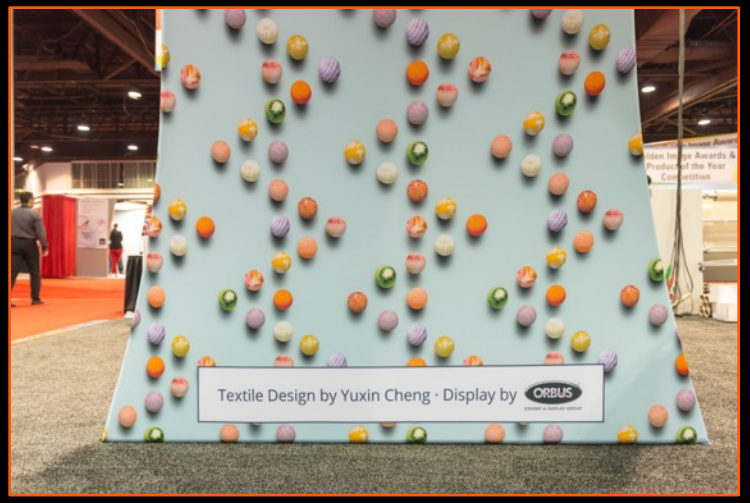
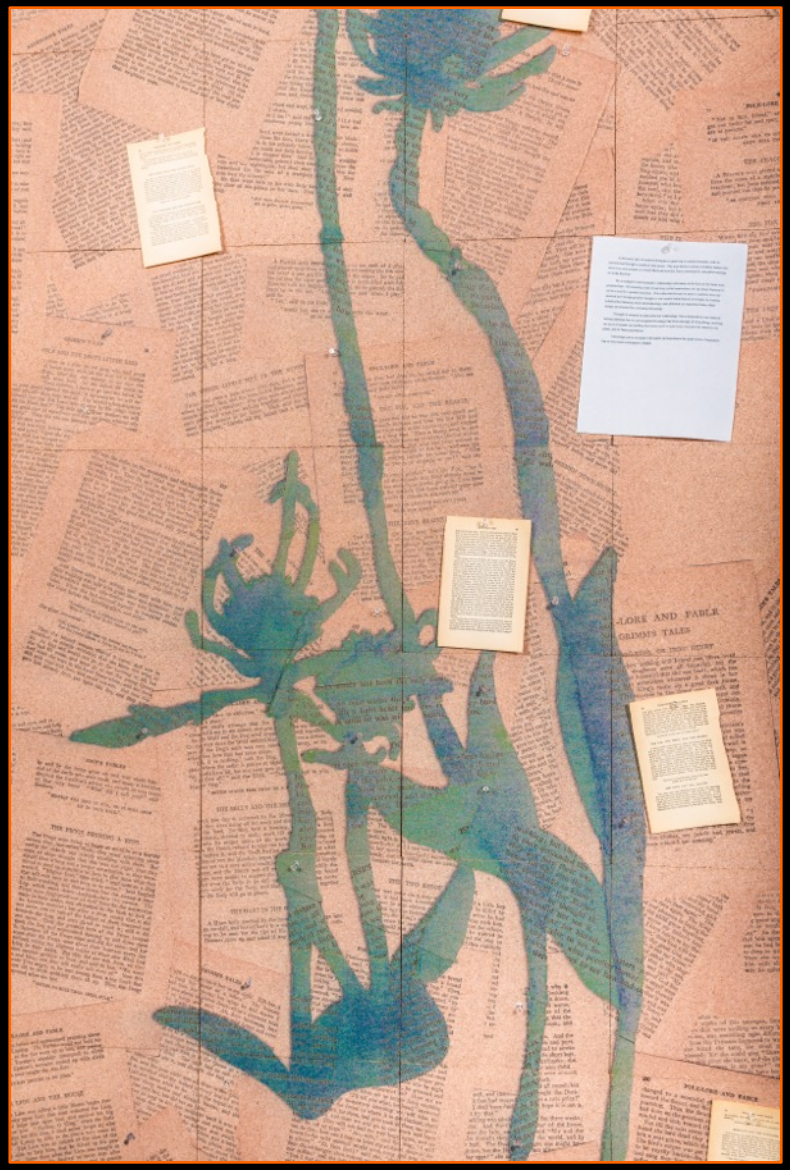
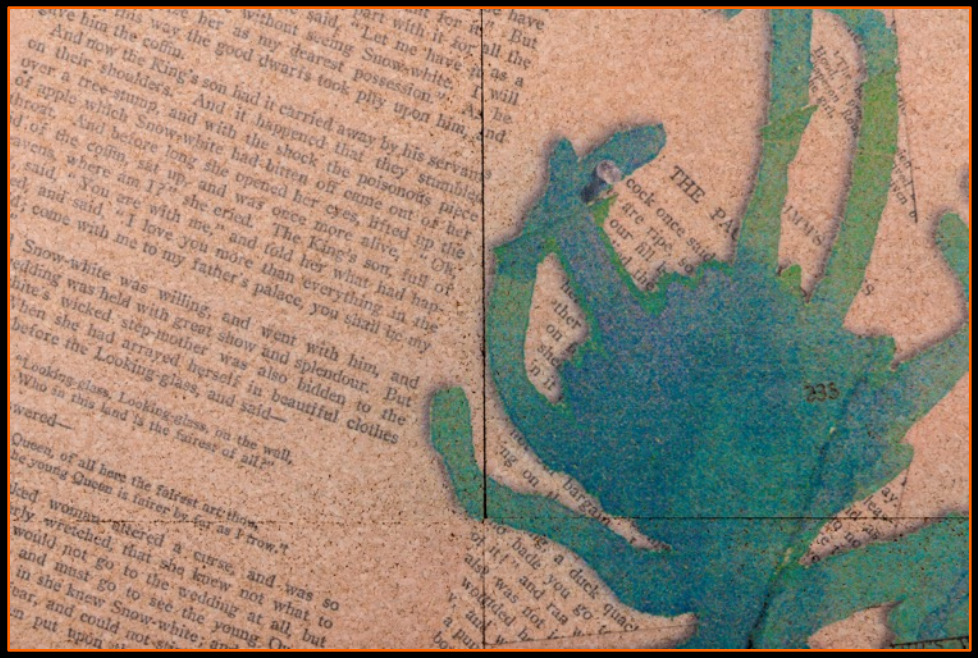
CANVAS
Web To Print Shop
Textile Design by Yuxin Cheng · Display by ORBUS

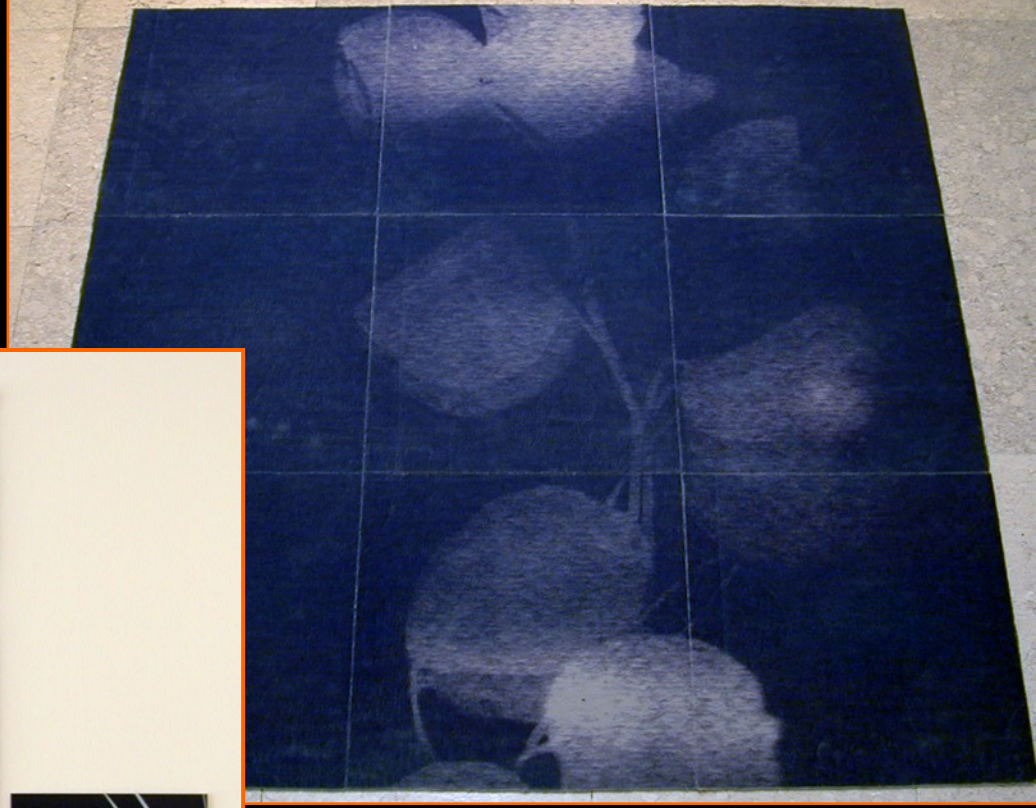

Textile Design by Yuxin Cheng · Display by ORBUS


LOS ANGELES
PURE FIX

Reva, Greenaer
Surface Imaging by Ella Doran







Composite Bridge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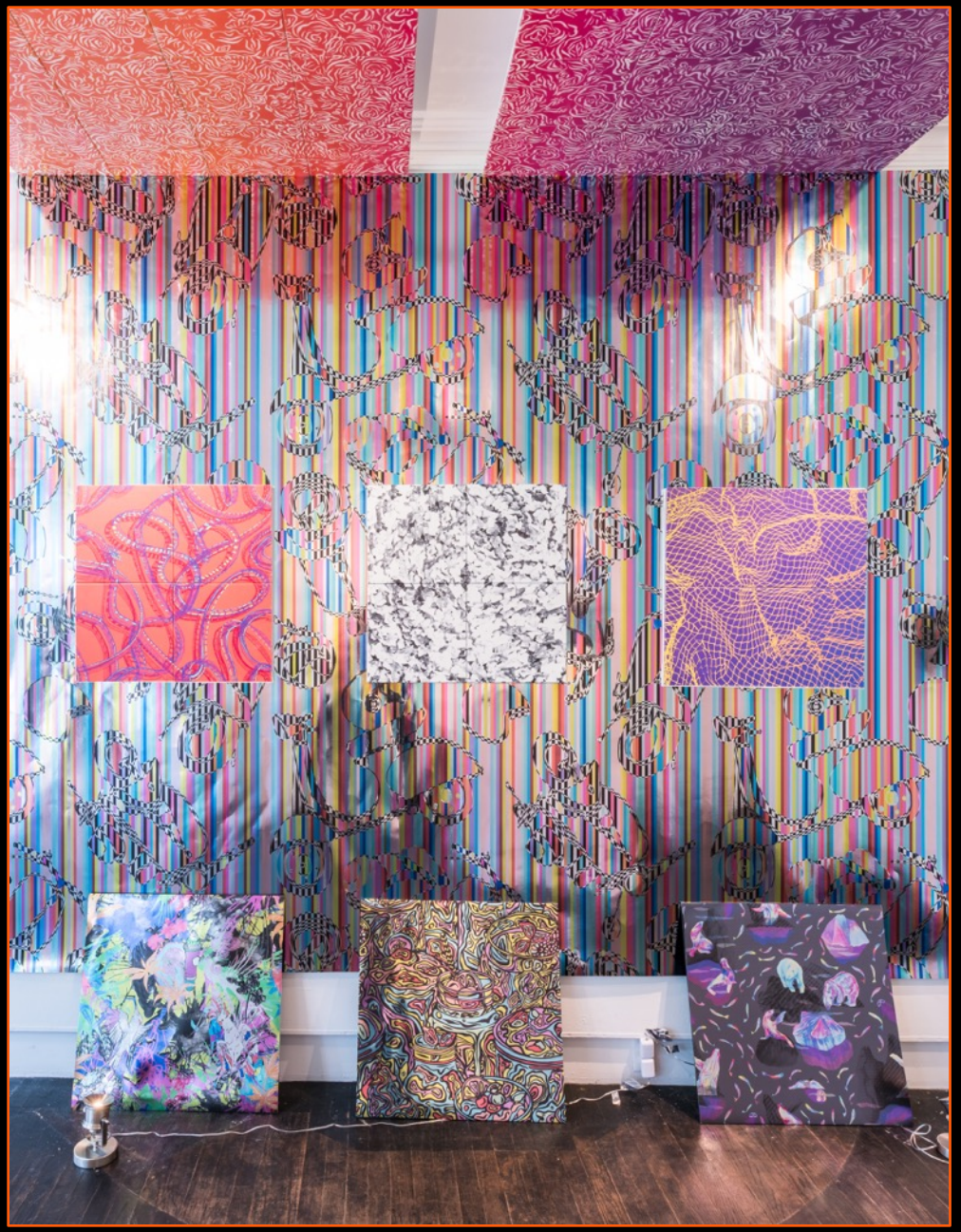

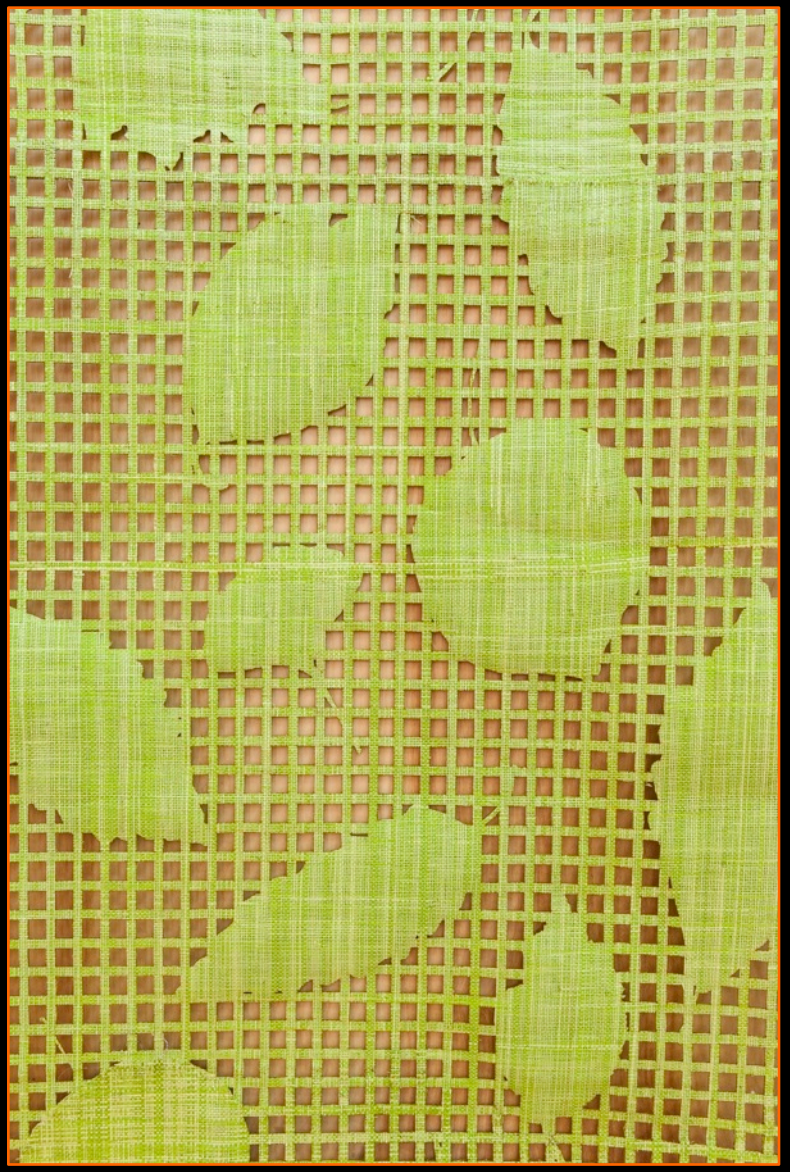

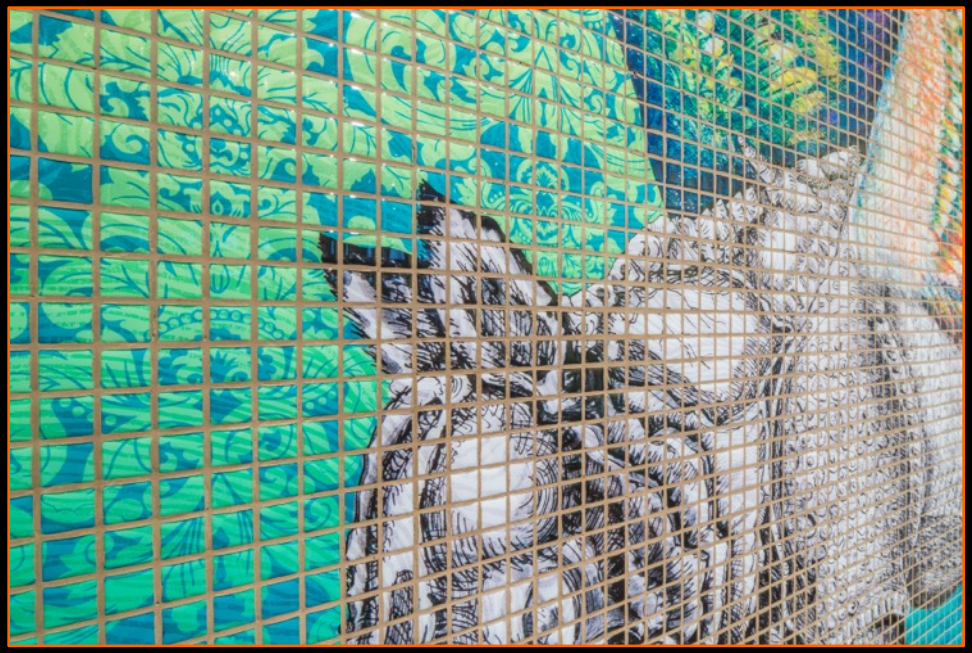

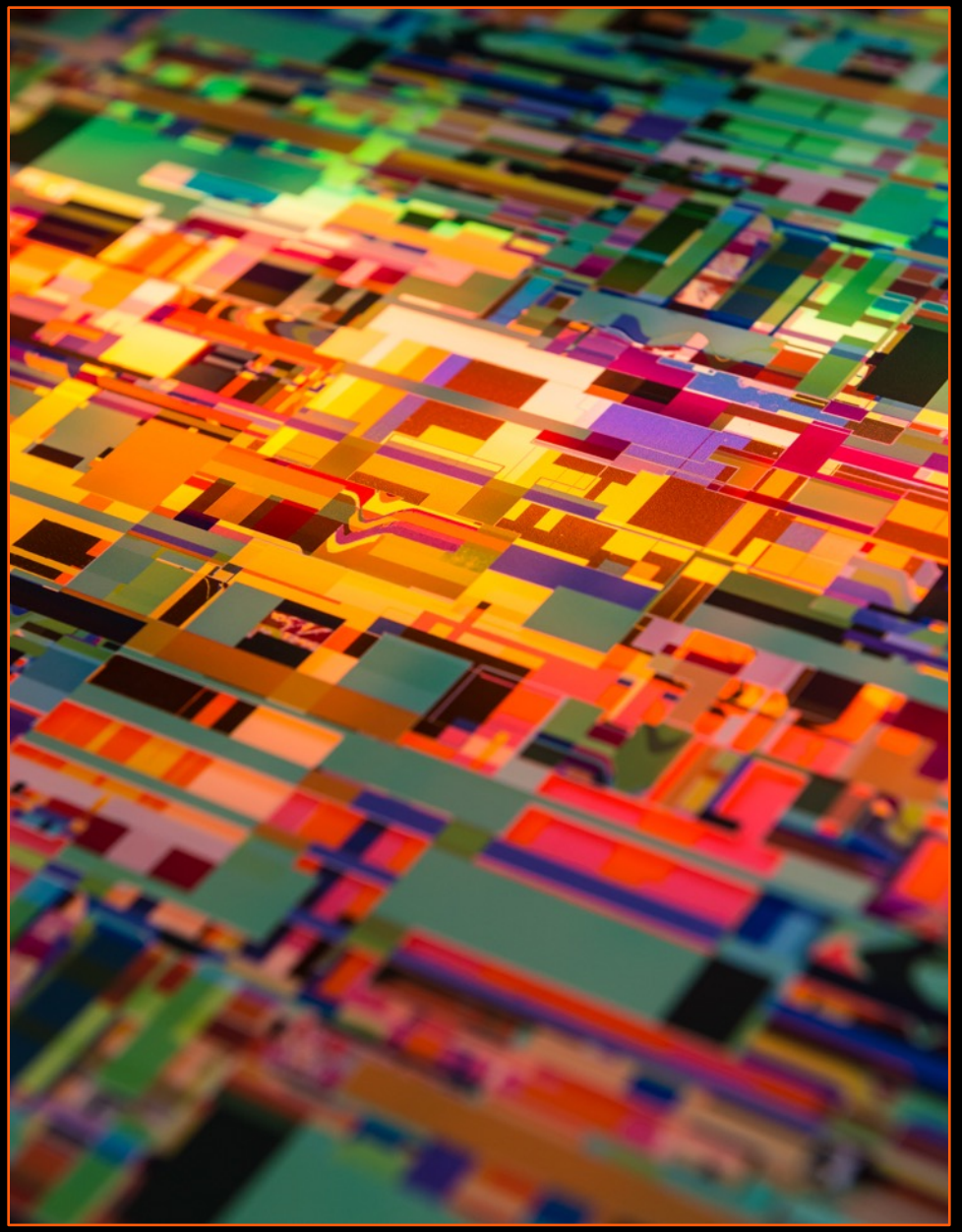

M.S. in Surface Imaging Program

Philadelphia University

The *MS in Surface Imaging* offers students the opportunity to develop imagery for various physical forms using a variety of advanced digital printing technologies.

Students will explore direct surface imaging on diverse porous and non-porous substrates. Fabrication printing, including additive material deposition and subtraction printing technologies (enhanced 3D and laser printing), will become an integral part of the program.

Program

- Uniqueness and Compact

  Only program exists worldwide

  33 credit with minimal prerequisites in 16 months.

- Advanced Digital Printing System

  Digital means going beyond the traditional fields of disciplines and boundaries.

  Specialist to Versatilist – T Shaped Skills

  Transdisciplinary program for a future design practitioner, product developer, product manager, environmental graphics, interior products, apparel products and all facets of imaging industries.

- Systems Thinking

  Integration of design, engineering and business.

  Concept | Development | Production | Distribution | Marketing | Selling

- Innovative state-of- the art facilities

  Affiliation with the Center for Excellence in Surface Imaging – required internship

  Provide Business Incubators for entrepreneurial approaches to the program

P r o g r a m

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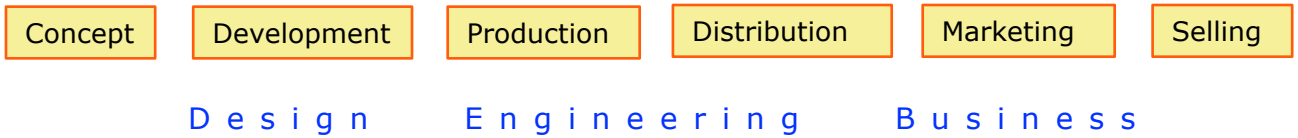


- Innovative state-of- the art facilities

  Affiliation with the Center for Excellence in Surface Imaging – required internship

  Provide Business Incubators for entrepreneurial approaches to the program

Courses and Curriculum

- 1 Year (16 months) MS degree program
- MS degree program for full-time and part-time students for a total of 33 credits
- Program starts from Summer semester and end at the following Summer semester.

	Total credit hours (33 CR) Core courses (30 CR) Designated elective (3 CR)	**Designated elective**
MS SI Foundation starts (Summer – **3 - 6 CR**)	MSSI-500 Surface Imaging Design Foundation **3CR** Business Foundation iMBF 504 Accounting iMBF 505 Finance **1.5 + 1.5 CR***	MSSI-791 Internship for Surface Imaging 3CR
MS SI Program starts **Year 1** (Fall – **9 CR**)	MSSI-601 Surface Imaging Design I **3CR**** MSSI-607 Printing Technology for Surface Imaging **3CR** MSSI-602 Introduction to Materials and Polymer Science **3CR**	Study Abroad Short Trip 3CR
(Spring – **9 CR**)	MSSI-701 Surface Imaging Design II **3CR** **Designated Elective** **3CR***** MSSI-700 Transdisciplinary Project I **3CR**	iMBA-759 Entrepreneurship 3CR****** (Business Plan Preparation) Elective studio 3CR*******
(Summer – **9 CR**)	MSSI-800 Surface Imaging Master Project **9CR** (Portfolio / Business Plan)	MSSI-702 Transdisciplinary Project II - 3CR

* Students with a business education/background may waive this requirement if admitted with Advanced Standing. (1.5 credit each).

** Philadelphia University undergraduate students can take SI Design 1 as an advanced elective course upon approval of Program Director.

*** Selection comes from lists in Designated elective.

**** Master project requires creation of Business Plan and this is a prerequisite for those who do not have knowledge and experience of business plan creation. The Program Director will make the final decision and the course is offered under SBA.

***** This is a studio elective course that can be chosen from any graduate level design studio courses offered in the University.

The Center for Excellence in Surface Imaging

The State of the Art - Advanced Digital Printing Center

- To enhance and improve Professional imagining industry.

To provide and exchange:

information in neutral position.

To educate:

future leaders for the industry.

To conduct:

research

proof of concept

testing

educational events

printing service

Printer	Software	Colorants
Mutoh ValueJet 1628TD 62”wide Acid Dye Ink for Textile	ErgoSoft TEXPRINT	Dupont Textile Acid Dye ink
Mutoh ValueJet 1626UH 64” wide Roll to Roll UV		
Mimaki TS300P - 62”wide Disperse Dye ink for Textile	Wasatch SoftRIP	Solunaris Textile Reactive Dye ink
Mimaki TX300P - 62”wide (2) Reactive / Acid Dye Ink for Textile	X’ Rite i1Profiler Color Management	
Mimaki UFJ 6042 24 x 17 wide Flatbed UV ink	AVA Design Software	
Mimaki JFX 200 4’ x 8’ wide Flatbed UV ink		
Mimaki JV 400 LX – 62” wide Roll to Roll Latex ink		
Mimaki CJV 30 – 160 62” wide (print and Cut) Roll to Roll Eco Solvent ink		
Roland RE 640– 62” wide Roll to Roll Eco Solvent ink		
Roland RT 640– 62” wide Roll to Roll DteSub Ink		
Roland GX 300 – 36” wide Roll to Roll Cutter		
Epson SureColor F2000 Direct to Garment Flatbed Pigment ink		
Epson SureColor F6200 – 44” wide DyeSub ink for Textile		
Epson SureColor P9000 – 44” wide Archival Photo ink		

Textile Applications

Printing system for all colorations for all fiber classes

MIMAKI Textile Printing Systems

MIMAKI TX300P: 2 units
Acid and Reactive Dye Ink

MIMAKI TS300P: 2 units
Florescent DyeSub Ink

EPSON Textile Printing US Beta site:

Printing Performance test

Pigment and disperse ink test and PhilaU testing standard for inkjet textile ink

EPSON SureColor F2000
Direct to Garment printer

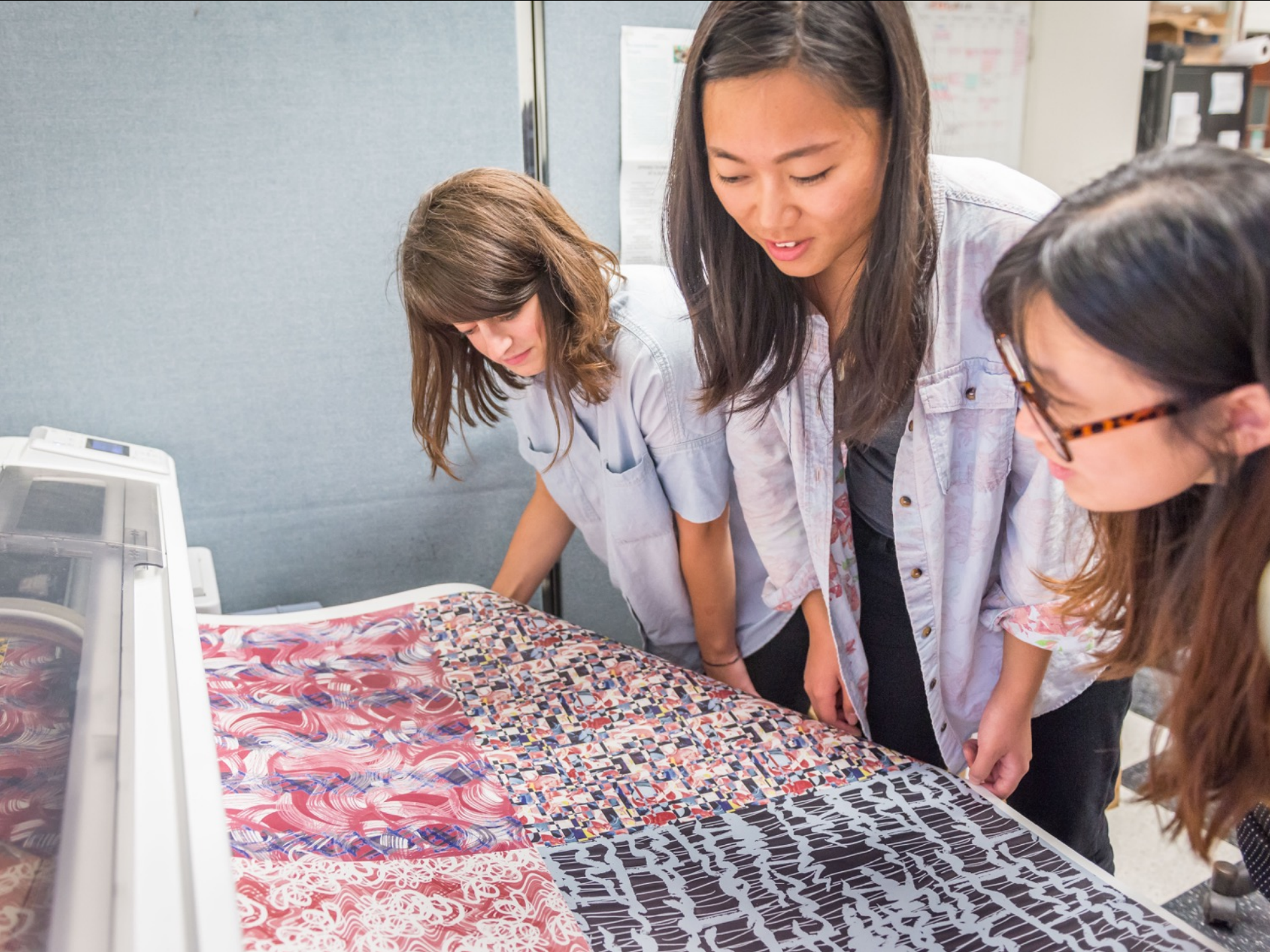
EPSON SureColor F6200
Disperse Dye Transfer printer

EPSON SureColor P9000
Achival Photo Printer

ROLAND / MUTOH Textile Printing Systems

Roland RT640 / Mutoh ValueJet 1624TD


EPSON
SureColor
F6200
TX300P-1800



Non Porous Application

Printing system for all available colorations

Mimaki JFX-200 UV flatbed printer:

UV flat bed printer for 4’ x 8’ ridged substrates

Upto 2 inch thick substrates

UV printer with colors, white, and clear

Mimaki JV-400 LX Latex printer:

Roll to roll latex ink printer

For non porous films, PVC, non woven

Mimaki UJF-6042 UV flatbed printer:

UV Pad Printer for the bed size 24 inch x 16 inch

UV printer with colors, white, primer and clear

Craft printing

Mutoh ValueJ – 1626UH UV printer:

Roll to roll / Flatbed Hybrid UV Printer

UV printer with colors, white, and clear

Others:

Mimaki CJV 30 -160 (62” roll to roll print and cut with eco solvent)
Roland RE 640 (62” roll to roll eco solvent), Roland GX 300 (36” roll to roll cutter), etc.


EXIT
Mimaki

Research

- **Design research**
  - New design styles
  - New product application and production workflows
  - "Smart Algorithm for Printed Textile Design"
- **Marketing research**
  - A Various Digital Textile Printing Marketing consultations and researches for private companies.
- **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"
  - "Inkjet printing textile archives - Barnes Museum", etc.
- **Proof-of-concept projects**
  - Inkjet printing for Military Camouflage printing
  - Inkjet printing narrow band
  - Automotive polyester tubing
  - Chemical Impregnations, etc,
- **Testing (Print performance, Line acuity, optical density, fastness, etc.)**
  - Various inks and substrates; Software.
- **Production** (samples to short runs)
  - Scarves, ties, umbrellas, bags, T- shirts, yardages.

Education

- Conferences and workshops

  Digital Inkjet Printing 101 Conference (2002)

  Digital Inkjet Printing Workshop (2003)

  Designer Meets Technology (2004)

  Digital Textile Design and Printing Workshop (2005)

  Designer Meets Technology: Europe (2005)

  Digital Textile Design and Printing Workshop (2006)

  Digital Textile Design and Printing Workshop (2007)

  Digital Textile Printing Workshop for Textile Conservators (2008)

  Digital Surface Imaging and Printing for Textiles Workshop (2013)

  Digital Surface Imaging and Printing for Textiles Workshop (2014)

  Surface Imaging Symposium (2015)

Application for 2017-2018

www.PhilaU.edu/MSSurfaceImaging

Next program starts May 16, 2017

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