GIS GLOBAL INKJET SYSTEMS

Inkjet in Packaging – Trends, Challenges and Future Developments

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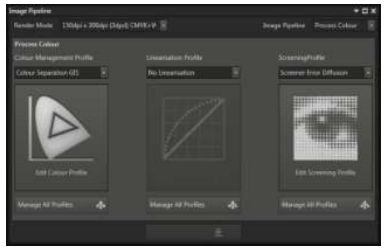
IMI Inkjet Printing Conference

Orlando, FL 6-8th February 2019

IMI
Emerging Technology Events in North America

GIS – Company Overview

- **Leading provider of technology solutions to industrial inkjet systems builders**
- **Supported printhead manufacturers**
  - Fujifilm Dimatix, Konica Minolta, Kyocera, Ricoh, SII, Toshiba Tec, Xaar
- **Founded November 2006**
  - Privately owned
- **Based in Cambridge, UK**
  - Technical support in UK, China and Japan
- **Employees >70**
- **Patent protected technology**
- **Supplier & partner to over 130 customers worldwide**



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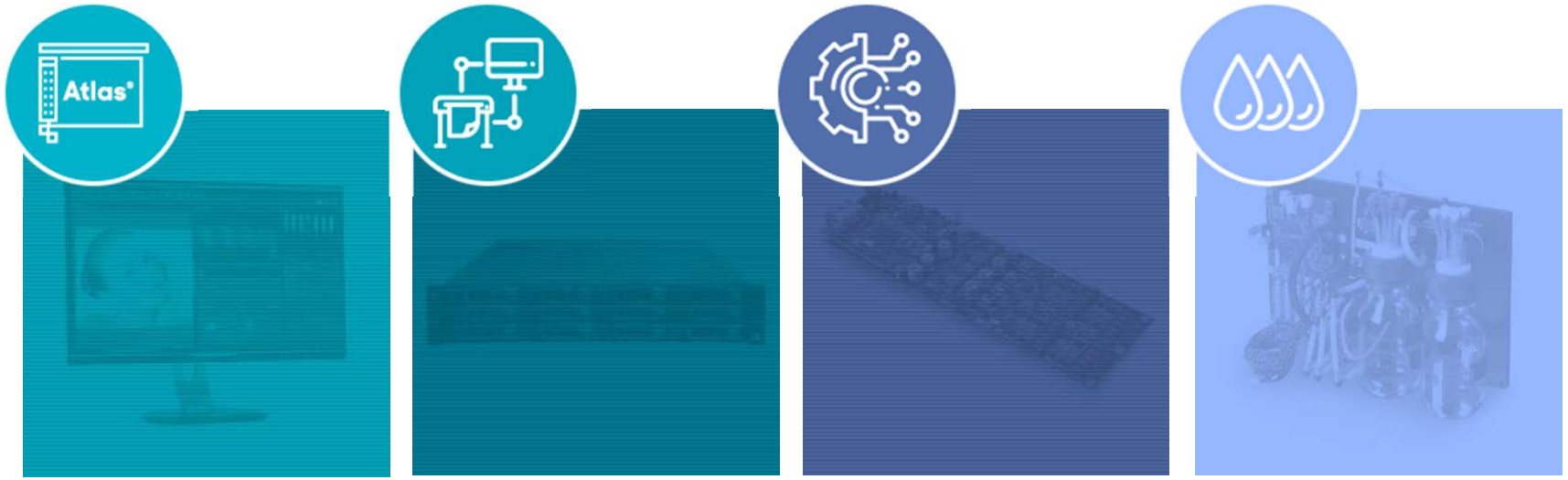

DFE
Atlas® User Interface

Machine Control
Atlas® Server

Print Controllers
Drive Electronics

IDS
Ink Systems

- **GIS provides key technology to industrial inkjet systems builders, specialist integrators and large end users**
- **From pixels to droplets: we supply technology for the whole data pipeline – from image to print**

Disclaimer

Global Inkjet Systems supplies inkjet technology and components to 130+ original equipment manufacturers world-wide. As a matter of policy, we do not disclose our customer relationships.

The following slides contain images chosen to illustrate the range of inkjet print systems which are available in the market. The presence, or absence, of any manufacturer's products in these images does not in any way imply a commercial relationship between that manufacturer and GIS.

Acknowledgement

Many thanks to Sean Smyth and Smithers Pira for the market size data
https://www.smitherspira.com/

Agenda

- **Digital Packaging - State of the market**
  - "The great ultimate market" Mark Hanley, IT Strategies
- **Latest news on trends, products and positioning**
  - Labels
  - Corrugated
  - Cartons
  - Flexible packaging
  - Direct to Shape
- **Key challenges for high end single pass systems**
- **Software solutions**
  - Linearisation
  - Missing nozzles
  - Rotation/skew correction
  - Colour correction

Image source: company web sites

2017 Packaging Market

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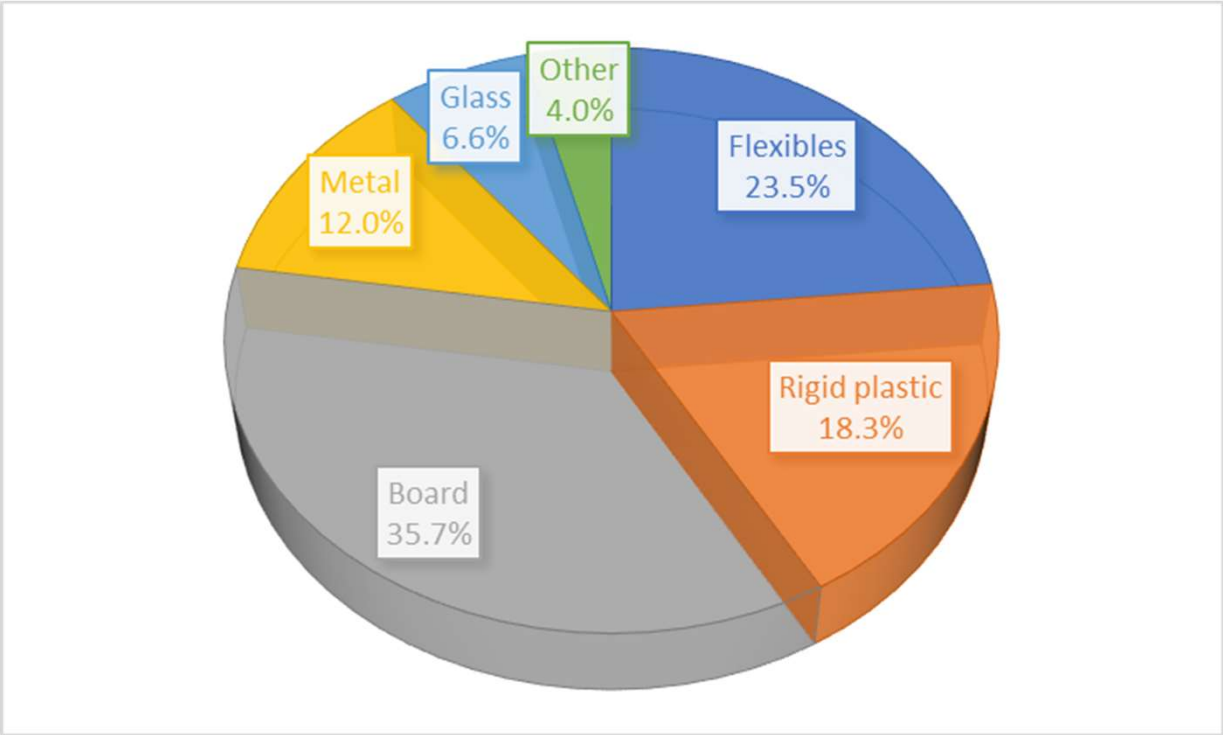
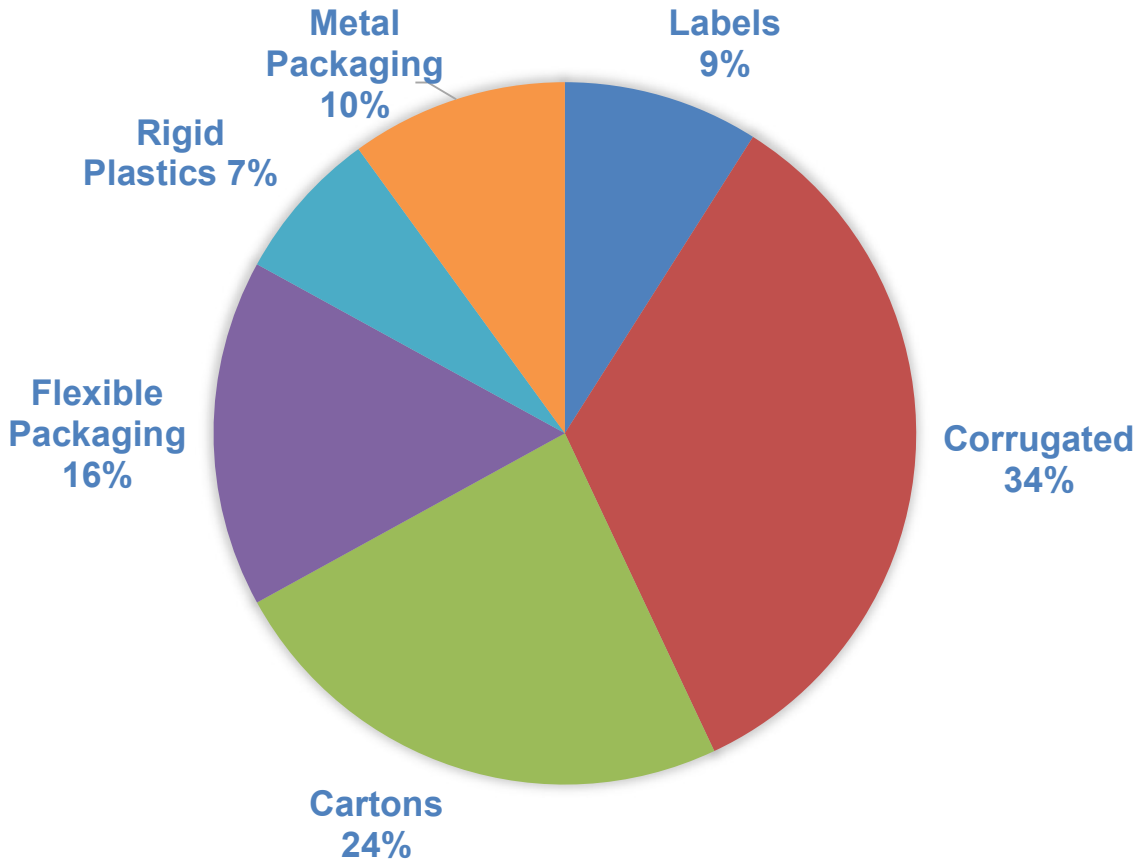
Value $851bn in 2017 - forecast to reach $1trillion 2023



- **Printed packaging $392 bn – under half the total**
  - **Non-printed** – wood barrels, crates and boxes; rigid plastic trays, clear lidding and shrink film; heavy corrugated; black plastic sacks; glass bottles and jars etc.
- **Printed packaging**
  - Dominated by food / beverage (2/3 of total)

Source: Smithers Pira

2017 Printed Packaging $392 bn

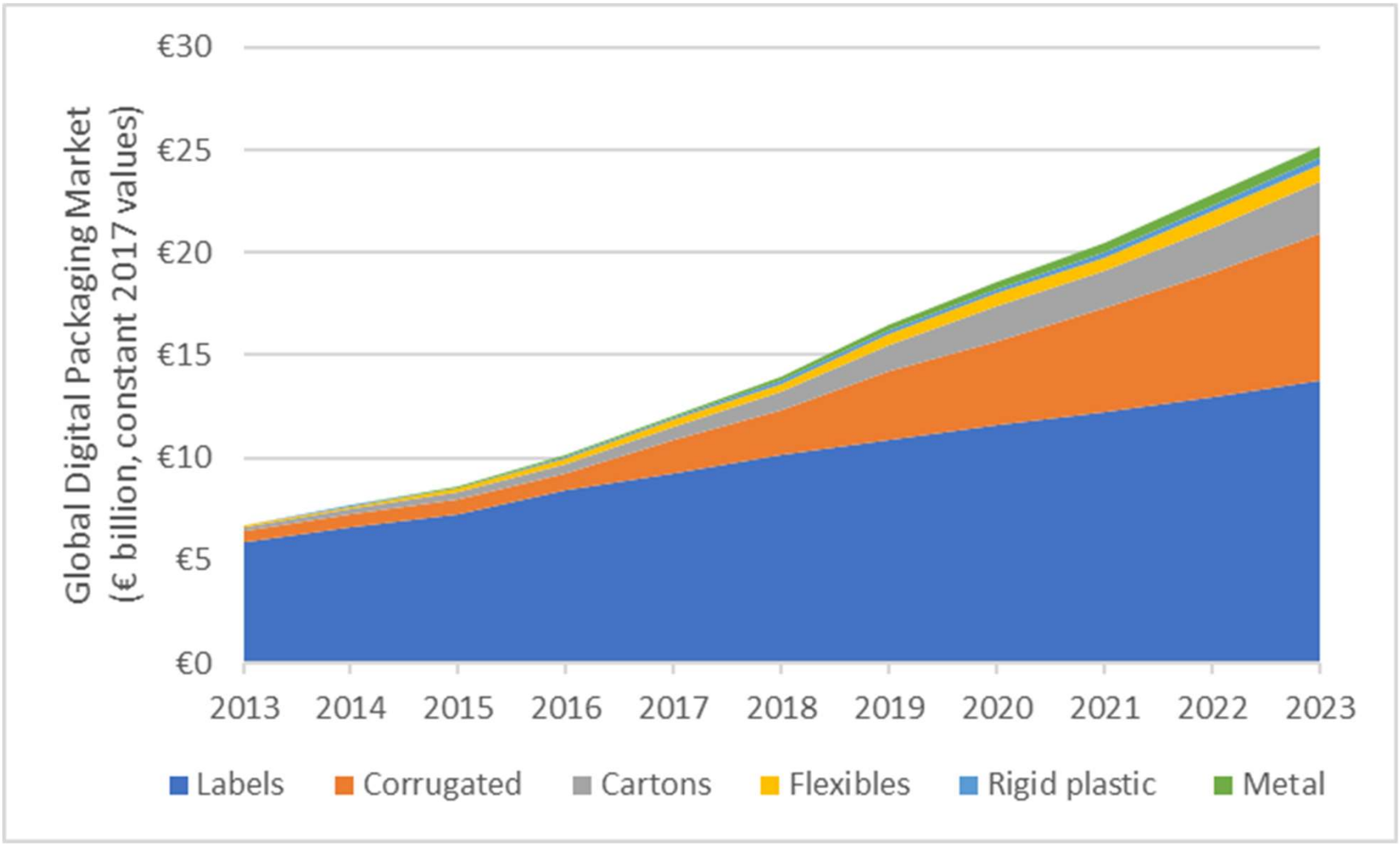


Sheetfed offset litho	101,534.2
Heatset (web) offset litho	5,811.8
Coldset (web) offset litho	2,892.2
Gravure	48,383.5
Flexo	154,609.7
Screen	2,874.7
Letterpress	3,611.1
Other	58,993.5
Electrophotography	7,170.1
Inkjet	5,862.5
Total	391,743.4

- Dominated by flexo, sheet offset litho & gravure
- Digital 3.3%

Source: Smithers Pira

2017 Digital Packaging



Source: Smithers Pira

Drivers for Adoption

- **New technology coming to market – technology push**
- **Hybrid - using digital and analogue**
  - Utilise the strengths of each
- **Economic short runs**
- **Increasing fragmentation**
  - Small brands – craft brewers, artisan products
- **Process simplification**
- **Fast turn round**
- **Supply chain benefits**
- **Consumer engagement**
  - “Instagram-able” packaging
- **Personalisation**

Market Sectors – An Update

Labels - Hybrid Devices

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- **Hybrid presses**
  - Omet/Durst
  - Uteco/Kodak
  - Edale/FFEI
  - Mark Andy
  - Nilpeter
  - Gallus
- **Printbars/Print Engines**
  - IIJ
  - Domino
  - Fujifilm
  - Many more…

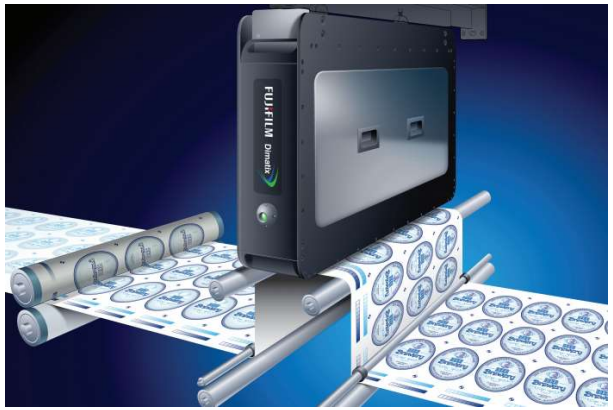

Image source: Company web sites

Labels

- **Gallus - Smartfire**
  - Launched May 2018
  - Memjet
- **Mouvent - LB702-WB**
  - Fujifilm Samba printheads
  - Up to 340mm wide substrates
  - Water based inks
- **Canon LabelStream 4000**
  - UV inkjet/ Xaar 2001 printheads

Image source: Company web sites

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Corrugated Pre & Post Print (2016/17)

SCREEN

BHS

inca incadigital.com

Image source: Company web sites

Corrugated – 2018

- **HP T1190 (305m/min) and HPT1170 (183m/min)** - to replace/upgrade the existing T1100s
- **Now 6 colours CMYKOV**
- **Wider width at 2.8m**
  - Worked with Koenig & Bauer on media transport system

Image source: Company web site

Corrugated - 2018

- **Koenig & Bauer – CorruJET**
  - Single pass post print
  - 6,000 sheets/hour (1.3m x 1.7m)
  - Fujifilm Samba printheads
  - 1200 x 1200dpi or 1200 x 600dpi
  - Water based inks

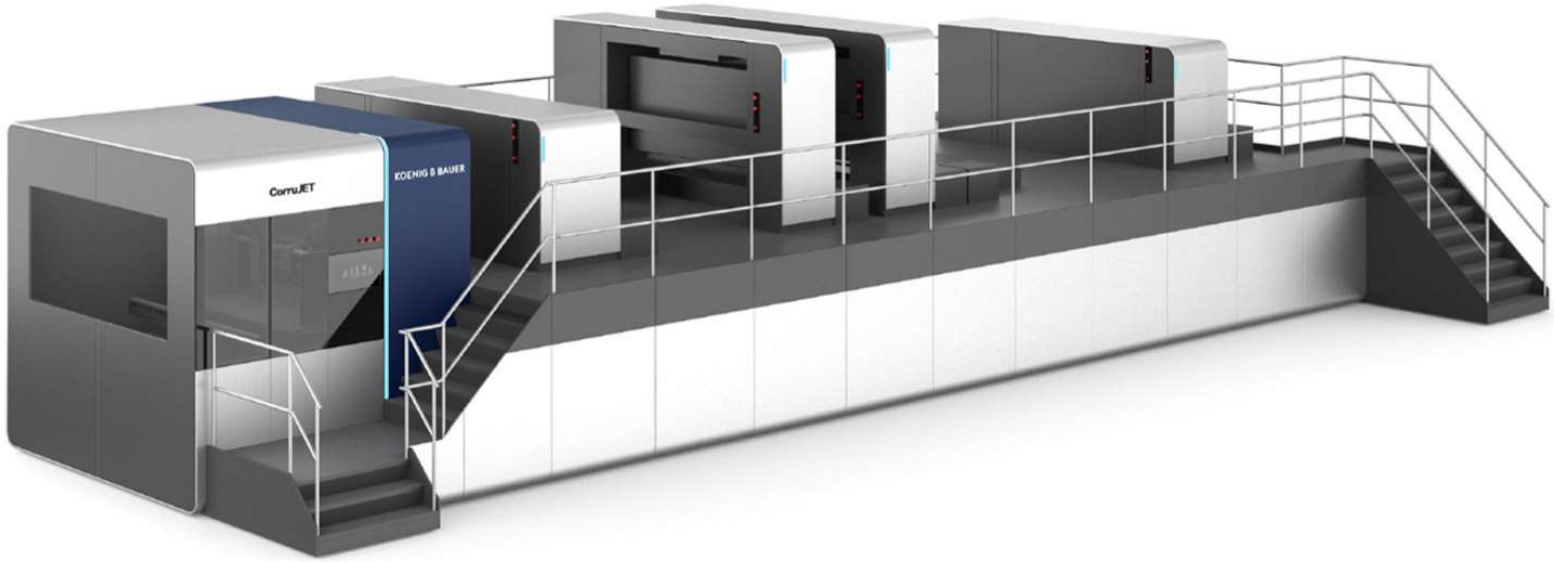


Image source: Company web site

Sino-Corrugated China 2017/18

- **Largest consumer of corrugated board**
- **Single pass- all post-print systems**
  - Handway/Erajet – Glory 1604
  - CPPES T-One – Colorjet CJ1800U
  - Foshan WinLink/DongFang Precision
  - Wonderjet WD200-32A/64A
  - MasterWork – MK1060DP

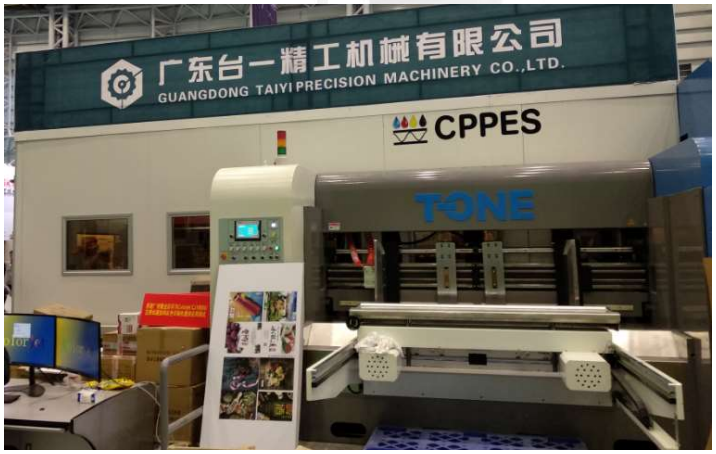


Image source: GIS and company web sites

FESPA 2018 - Digital Corrugated Experience

- **Inca Digital - Onset X3**
- **Barberan – Jetmaster series**
- **BCS - Autobox**
  - Modular box making system/single pass
- **Macarbox**
  - 700mm to 1.6m wide/CMYK/single pass
- **Engico – Aqua 250**
  - XY / 2.5m max print width
- **Memjet**
  - Xante – Excelagraphix 4800
  - New Solution – NS Multi Xeikon
- **May 2018: plans for post-print system**

Image source: GIS and company web sites

Cartons

- **20 December 2018 – Koenig & Bauer and Durst announce 50/50 joint venture**
  - First milestone for the JV, manufacturing of the VariJET press for digital folding carton printing for drupa 2020

Image source: Koenig & Bauer

Cartons

PMI's First Folding Carton Digital Printer

Press Configuration Gallus Label Fire Hybrid

Installed at PMI's Neuchatel Innovation Development Centre

Concept Validation after 12 months:

- ✓ Digital color standards
- ✓ Approved designs
- ✓ Commercial production

"This changes everything" – Tony Snyder, VP Product Portfolio Management & Development

Source: Philip Morris presentation at Smithers Pira European Packaging Conference Berlin 2018

Cartons

- **17 January 2019 - Tetrapak announces collaboration with Koenig & Bauer**
  - RotaJET 168 - currently being built and will be installed at Tetra Pak's converting plant at Denton, Texas.
  - Field testing of the new, digitally-printed carton packages is expected to begin in early 2020 with North American customers.
    - "Simplify the complexity of design handling, reducing time from design to print and opening up new opportunities for flexibility in order placement and product customisation"

Image source: Company web sites

Flexible Packaging (2016)

Landa W10
Fujifilm Samba print heads
Aqueous inks

Fujifilm MJP20W Eucon technology
UV LED inks
Fujifilm Samba printheads

Kodak S Series Prosper heads - 7 colours 200m/min concept press with **Uteco** film transport – aqueous inks with primer

Think Lab, Japan
Kyocera KJ4B printheads
Aqueous inks from Kao

Kodak Ultrastream demonstration

Image source: GIS and company web sites

Flexible Packaging

- **Uteco – Sapphire Evo**
  - Hybrid flexo and Kodak Stream CIJ technology
  - Water based inks
  - 650mm web width
  - 250-300m/min
- **Uteco – Gaia**
  - INX food-compliant EB inks
  - COMET ebeam Technologies
  - Fujifilm Samba G3L
    - 100mpm

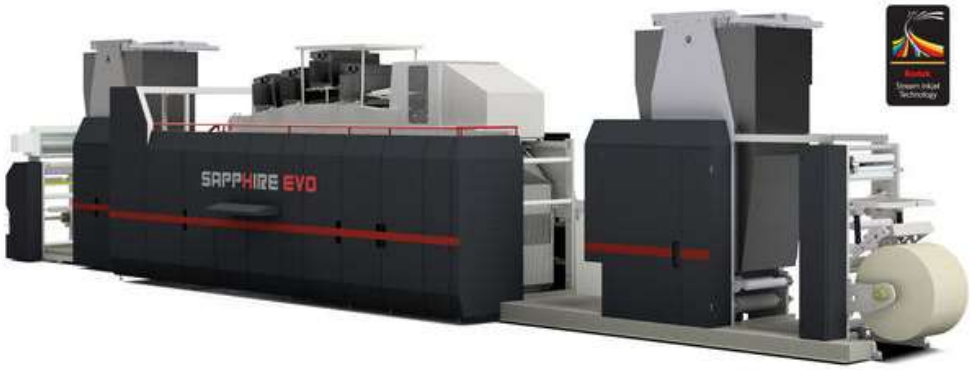


Image source: Company web sites

Flexible Packaging

- **Rigoli - MVZ 1000**
  - Launched June 2018 at IPACK-IMA
  - Memjet single pass roll to roll
  - 9m/min @ 1600 x 1600dpi
  - 18m/min @1600 x 800dpi
  - CMYKK / Up to 1.067mm wide
  - Water based dye inks

- **Windmöller & Holscher**
  - September 2018 – W&H announced inkjet project
  - Using Xaar 5601 printheads for flexible packaging system
  - No timelines or further details available

Image source: Company web sites

Direct to Shape (DTS)

- **Velox – IDS 250**
  - Up to 250 containers/min
  - Up to 1200dpi
  - 12 UV inks – CMYK. W, OGV, reflex Blue, LC, LM,LK
  - Selective varnish – Gloss & Matte
  - Selective embossing
  - 1st installation at Lageentubes, Israel

Image source: Company web sites

Challenges and Solutions

Why Such Small % Market Penetration?

- **Packaging supply chain is complex**
- **Regulatory concerns**
- **Increased legislation**
- **Conservatism**
- **Substrates**
- **Reliability**
- **Brand colours**
- **Spot colours**
- **Colour consistency**
- **Post-print conversion**
  - Lamination, foiling, folding etc

Image source: Smithers Pira – Sean Smyth

Software Solutions

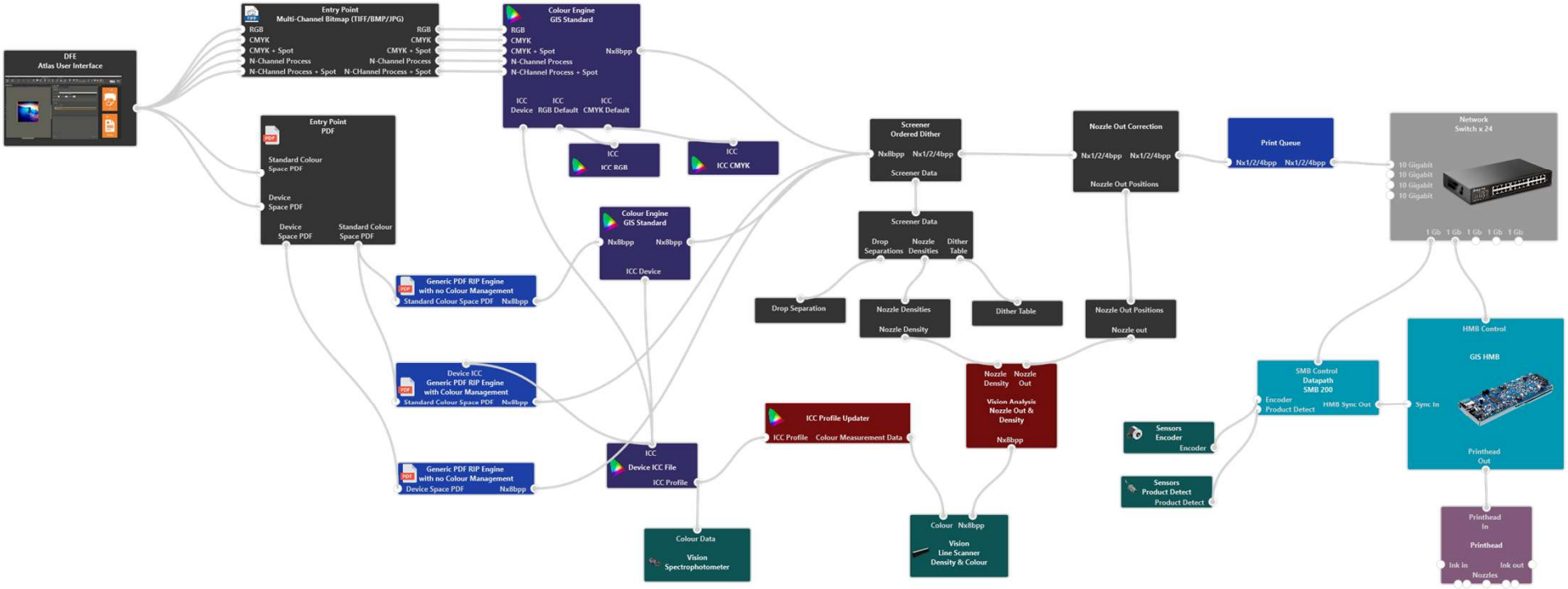
- **Nothing is perfect and inkjet printing is no exception**
- **However, software can compensate for many print quality issues**

- **Intelligent image management**
  - Colour correction
  - Linearization
  - Nozzle density correction
  - Nozzle out compensation
  - Printhead stitch correction
  - Geometry correction

- **Closed loop vs low latency**
  - How quickly does correction need to be made?

Real-time Workflows

GIS Atlas Architect



MIME entry points

Colour Management

Screening & Nozzle Correction

Print Queue to Hardware

Achieving Flat Colours

- **Printhead Linearisation**
  - Print large areas of solids/flat colours
  - Drop volumes not always consistent across printhead
  - “Non-linearity” in drop volume
  - Even small difference can affect final print
  - We want uniformity - flat colours
- **Electronic/printhead solutions**
  - Depending on printhead technology
    - Trim each nozzle/cluster of nozzles/nozzle bank
- **Image correction – offers greatest capability**
  - RIP’ed data (contone or screened) can be manipulated to:-
    - Reduce the number of drops in given area, or
    - Reduce the size or value of the greyscale drop in a given area

Printhead Density Correction

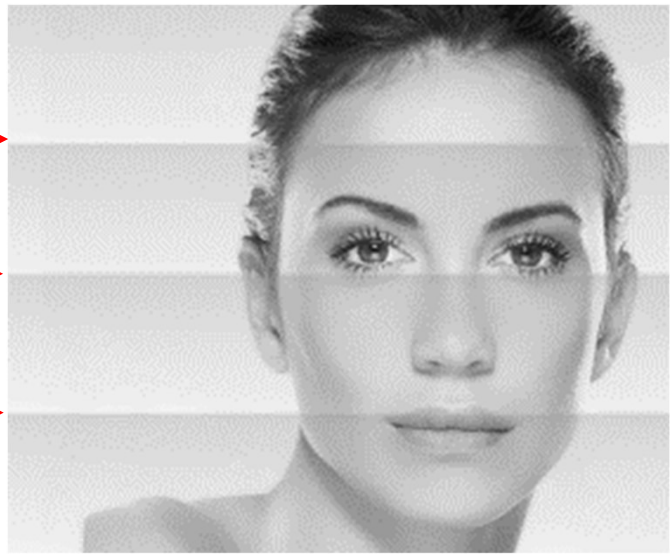
- **Electronic/printhead solutions**
  - Depending on printhead technology
    - Trim each nozzle/cluster of nozzles/nozzle bank
      - Trimming can introduce drop alignment problems
        - (Tuning for volume will modify velocity)
- **Image correction – offers greatest capability (GIS)**
  - RIP'ed data (contone or screened) can be manipulated to:-
    - Reduce the number of drops in given area, or
    - Reduce the size or value of the greyscale drop in a given area

Digital Printhead Linearization
(via image correction)

Printhead banding →

Printhead banding →

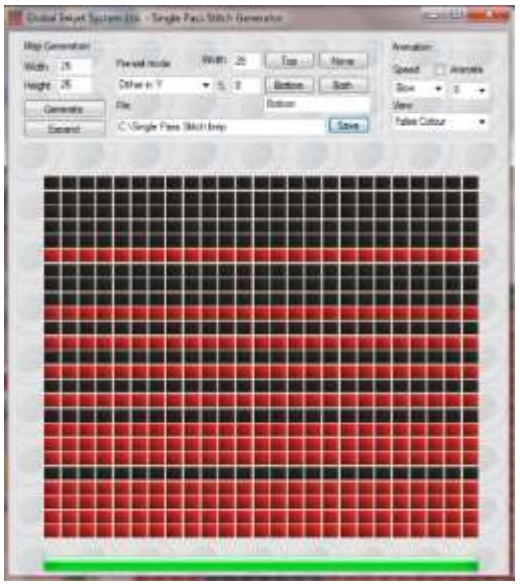
Printhead banding →



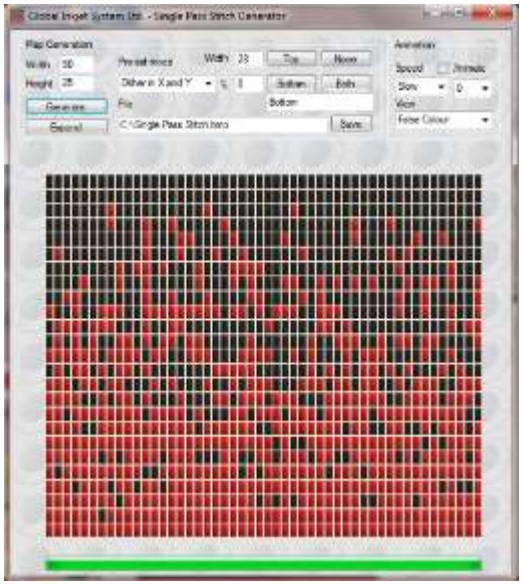
Linearized printhead →

Hard Stitching

- **Masking (Hard Stitching)**
  - Nozzle on/nozzle off
  - Wide variety of options
- **Stitches can massively improve output quality & different applications benefit from different strategies**



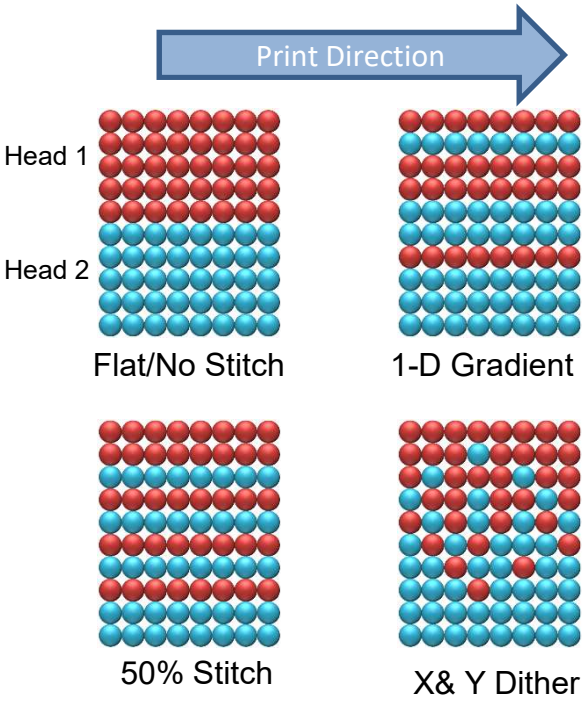
2-D Density



X & Y Dither

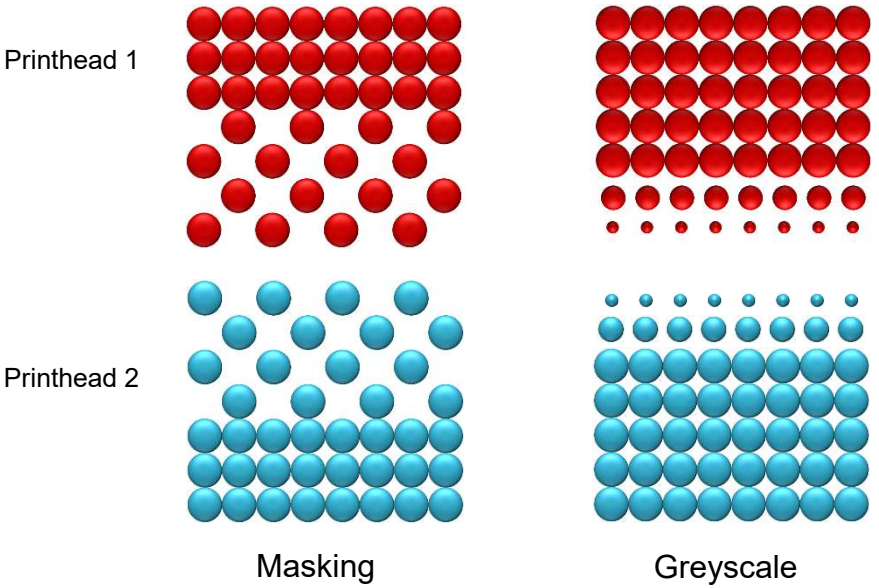
GIS Stitching Tool

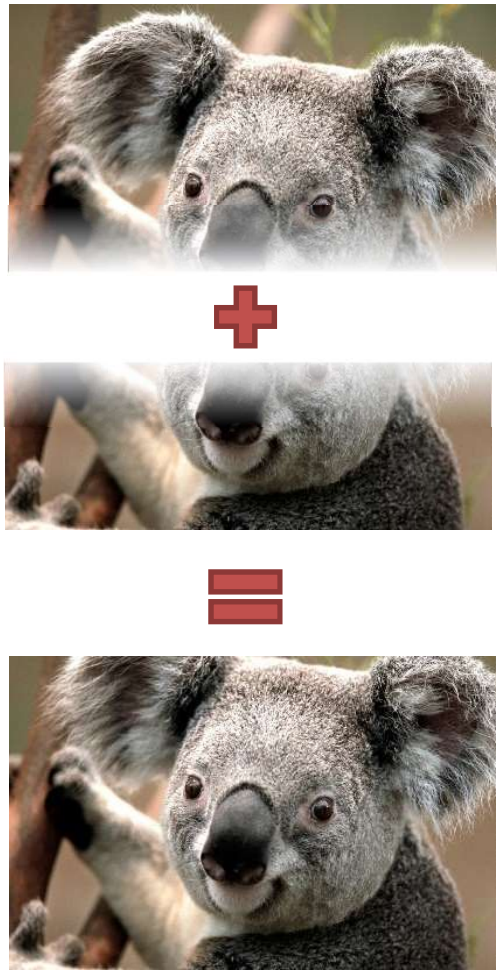
Examples of masking stitches



Greyscale Stitching

- **Greyscale stitching makes full use of the greyscale capabilities of the head**
  - Slowly reduces the density of the image printed by one printhead while increasing the density printed by the next printhead
- **Only adds value over masking in areas where the density of the image is greater than the smallest drop size**





GIS Stitching Tool

Missing Nozzles

Nozzle sizes are getting smaller

- More easily blocked or deflected

Large print bar arrays

- Many more nozzles
- Higher probability of issues and lower MTBF
- Need coping strategies

Strategy 1 : Redundancy

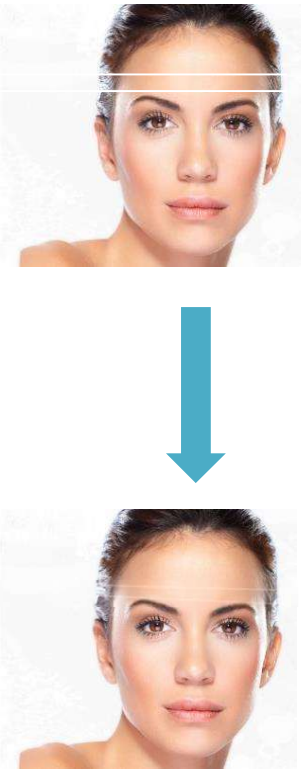
- Add second row of printheads per colour so when one nozzle fails another can be used
  - Expensive

Strategy 2 : Hide the problem

- Identify where a nozzle is faulty and spread the jetting responsibility to neighbouring nozzles and/or colours

Nozzle Out Compensation

- **Isolated nozzles work best**
  - Clusters of nozzles much more difficult to hide
  - Technology works best where there is some substrate bleed/drop overlap
- **Many different strategies exist using neighbouring nozzles**
  - Correction in contone or screened data
    - GIS believes best results achieved with contone correction
  - Hide error in same colour plane to neighbouring nozzles
  - Hide error in other inks - in multi-ink backgrounds
    - If Cyan nozzle fails - could add a little black to hide white space
    - If Black fails – use composite (CMY) black
- **Works best in mid & light mid tones**
  - Also improves dark tones
- **Helps disguise/makes the missing nozzle less visible**
  - Less white space



Nozzle Out Compensation

Original image

Missing nozzles

Nozzle Out Compensation

Rotation / Skew / Stretch Correction

- **Key challenge is alignment & registration with pre-printed substrate**
  - Pieces/sheets or in-line web
- **Many different possible distortions (image and/or media) – can be solved by:-**
  - Mechanical
  - Vision systems + software

Translation (X & Y)

- Product detect (X translation)
- Feeders or software offset (Y translation)

Rotation

- Feeders
- Vision system + fiducials + software

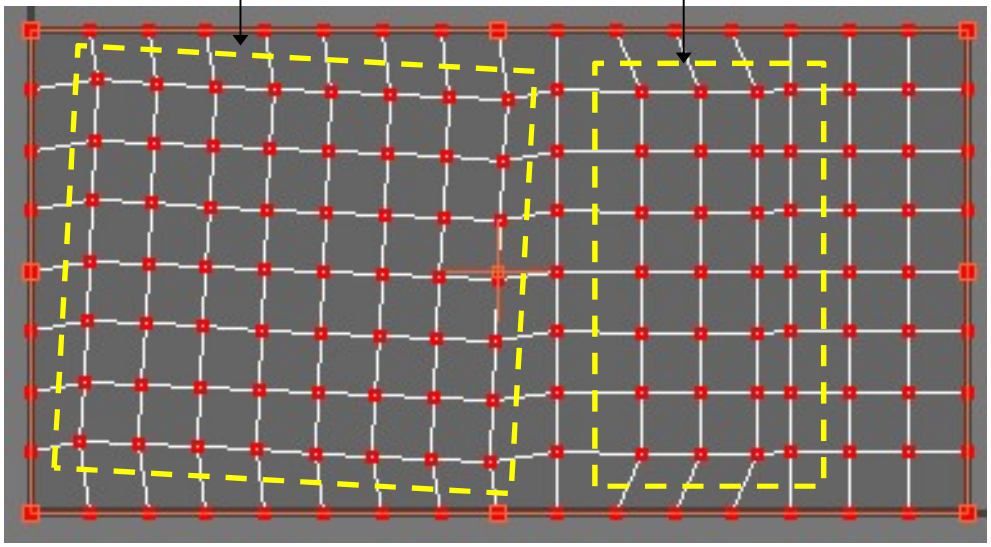
Rotation / Skew / Stretch Correction

Trapezoid / Skew

- Vision system + fiducials + software

Stretch and Compression (X & Y)

- Vision system + fiducials + software
- Encoder + product detect



GIS Correction Map For Finishing Layer (inverse of error)

Mesh based correction accurately places finishing data in the desired location. Handles all translation, rotation, stretch, compression and skew as well as localized distortion correction

- General software conversion approach
- If you can measure the error – it can be corrected

Closed Loop vs Low Latency

- **Some corrections do not need to be instantaneous**
  - Colour correction
  - Nozzle density
- **While some should be close to instantaneous**
  - Nozzle out
  - Alignment and registration

Summary

- **Packaging – key growth opportunity for inkjet – but lot of challenges**
  - Market structure
  - Technology requirements
- **Software compensation can significantly improve image performance for system inaccuracies and errors**
  - The order in which compensations are applied within the workflow can impact the effectiveness and efficiency of the overall data path
  - Some corrections can be carried out at irregular intervals, others require real-time correction

Image source: EFI web site

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