



## On Demand Package Production for Rigid and Flexible Substrates

PIRA Inkjet Technology  
27.-28.4.2004 Thistle Hotel, Brighton, UK  
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VTT TECHNICAL RESEARCH CENTRE OF FINLAND

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Data Matrix code



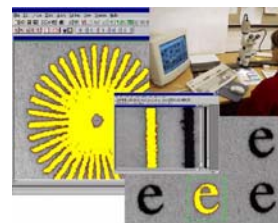
## VTT - Technical Research Center of Finland

- Impartial and multidisciplinary expert organisation
  - Approximately 3,000 employees
  - Turnover approximately €220 million
  - Six research institutes
    - VTT Information Technology
    - VTT Electronics
    - VTT Industrial Systems
    - VTT Biotechnology
    - VTT Processes
    - VTT Building and Transport
- Clients and co-operation partners are industrial enterprises, other companies and businesses, universities and research institutes.
- Produces new technologies in co-operation with domestic and foreign partners.



## VTT Information Technology, Media

- Personnel 37 in three research groups
  - Information Carriers, Color Management and Multiple Media
- Information Carriers
  - Performance of paper and new information carriers in media processes
  - Core technologies
    - Interaction mechanisms of ink jet printing
    - Digital package printing
    - Performance of novel information carriers
    - Runnability and paper economy
    - Management of functional paper properties
    - 3D modelling of printing materials



## On demand printing

- Small series at short notice economically
- Printing done just in time
- Benefits
  - Shorter production and delivery times
  - Customised and personalised products
  - Investment costs decrease
  - Amount of waste decreases
  - No need for warehousing
- Weaknesses
  - Data transmission standards still under development
  - Not suitable for all kinds of printed products



## On demand printing in packaging

- Trends in packaging industry
  - Packages for mass markets → Packages for particular consumer segments
  - Production to stock → Production by orders
  - Selective consumers → Shorter life cycles for packages
  - Fast price changes → Smaller series
- Benefits of on demand package printing
  - Variable data → Customised and personalised packages, language versions, small series
  - Shorter production chain → Shorter delivery times
  - Less material consumption and waste → Cost savings and less environmental load



## Digital package printing

- Enables on demand package printing
- Benefits
  - Printed pattern changed easily and high quality graphics
  - Logistics of package production gets easier
  - Variable data enables better tracking of packages
  - Shorter time for new products for reaching the market
  - Expenses better managed
    - Added value to retail stores and consumers
- Weaknesses
  - Digital colour printing still more expensive than colour offset
  - High maintenance costs
- In 2010 almost 20 % of all packages will be digitally printed (PIRA International, 2002)



<http://www.deltacustombox.com>



## Ink jet in package printing now

- Dates, bar codes, batch numbers i.e. variable data directly on labels and packages
- All kinds of printing substrates
  - Rigid or flexible
  - Smooth or rough
  - Flat or round
  - Fibre-based, glass, metal, plastic
- Most common printing method continuous ink jet
  - Mono colour
  - Low resolution
  - High speed
  - Online printing



<http://www.domino-printing.com>



## Ink jet in package printing in future



<http://www.dotrix.be>

- Whole package ink jet printed
- Especially cardboard and corrugated i.e. fibre-based packages suitable for ink jet printing
- Already exists sheet-fed and web-fed ink jet presses for package printing
  - Based on drop-on-demand ink jet technology
  - Full colour
  - Several printheads per colour organized in a row or a matrix
  - Variable data
  - Resolution at least 300 dpi
  - High speed
- Most suitable packaging sectors medical, food and chemical packages
- Also used for printing a protective layer on top of a package



## Inkjet presses for rigid substrates

- Sheet-fed presses
- Piezoelectric ink jet technology
- Short-run printing, personalisation
- Corrugated board, foam board, cardboard
- Ink requirements: fast drying, no spreading
- Medium speed

Scitex Vision CORjet



<http://www.bel2000.com>



### Inkjet presses for flexible substrates

- Web- or sheet-fed presses
- Piezoelectric ink jet technology
- Short-run printing, personalisation
- Labels, cardboard, security printing, textile printing, wall covers, plastic substrates
- UV curing inks best for various substrates
  - Special colours
- High speed
- High resolution

Dotrix the.Factory

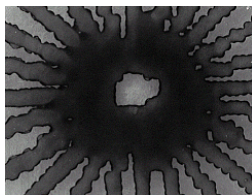


<http://www.dotrix.be>

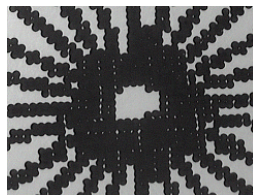


### Effect of substrate on ink jet print quality

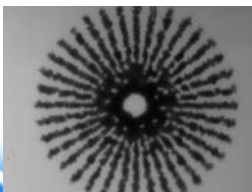
- Image quality and dynamic interactions



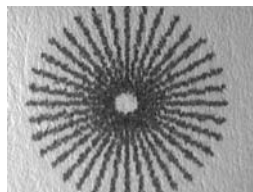
LD-PE coated film



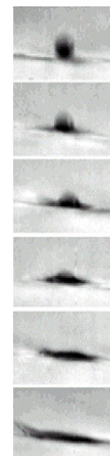
Folding boxboard



Ink jet paper



Uncoated paper

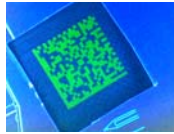


Behaviour of an ink drop on paper during the first 15  $\mu$ s after the printing



## New coding methods

- Two-dimensional bar codes
- Invisible printing
- Microtext
- Digital watermarks



Two-dimensional bar code printed with an invisible ink  
→ Invisible code



Original picture

Original picture with a digital watermark

Digital watermark



## New coding methods in package production

- Storing large amount of information in small areas
- Hiding information
  - Unrelevant information to consumers
- Anti-counterfeiting
  - Softwares, medicines, cosmetics, brand clothing, music and video recordings, other luxury products
  - Counterfeiters copy the package precisely not the product itself → Protect the package!
  - Globally 500-1000 billion dollars lost to counterfeiters (Converting Magazine, 2001)

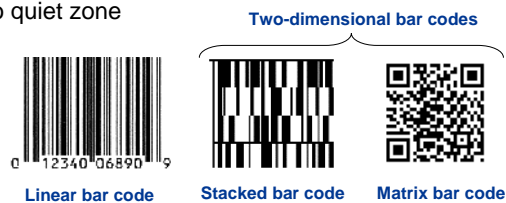


Two-dimensional bar code with information in the symbol:  
*VTT Information Technology. Pira Inkjet Technology Conference, April 27th to 28th 2004 in UK.*



## Two-dimensional bar codes

- Lines of bars or cells (polygonal elements) organised in a square or a rectangle according to particular bar code symbology standard
- Benefits
  - Large information capacity
  - Independent database
  - Error correction algorithms → Durable information
  - Physical size scalable
  - Small or no quiet zone



## Two-dimensional bar codes in supply chain

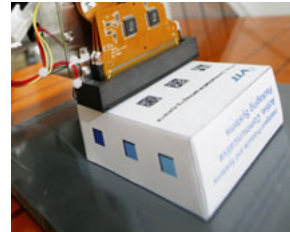
- Carry large amounts of information and information travels together with the package
- Information can be accessed anywhere if a suitable reading device is available
- Information can be encrypted → Anti-counterfeiting





## Two-dimensional bar codes and ink jet printing

- Printing done directly on package surface or on separate label
  - Before, during or after packaging
- Print quality of codes depends on
  - Resolution
  - Substrate
  - Ink
- Every consecutively printed bar code can be different
- Both continuous and drop-on-demand ink jet suitable



VTT Information Technology's ink jet printing environment based on high quality and robust printheads



## Case: Investigating Data Matrix codes at VTT Information Technology

- Black and white squares (cells) organised in a square matrix
  - Symbol sizes from 10 × 10 to 144 × 144 cells in rows × columns
- Black borders (locator pattern) in two sides of the symbol
- Information capacity:

Rows × columns	Numeric characters	Alphanumeric characters	8-bit ASCII characters
10 × 10	6	3	1
24 × 24	72	52	34
40 × 40	228	169	112
64 × 64	560	418	278
144 × 144	3116	2335	1556



24 × 24

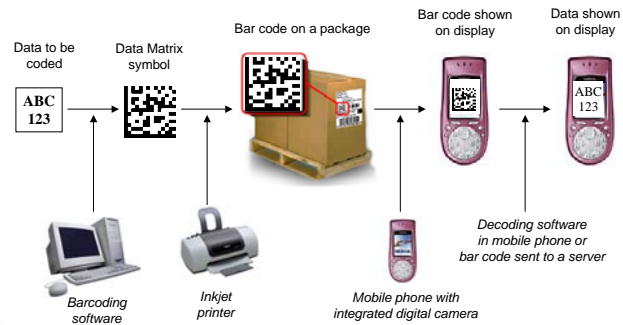


40 × 40



## VTT objectives

- How Data Matrix codes can be produced, used and detected in packaging supply chain
- To outline products, services, logistic systems and companies which can exploit developed coding and detecting systems



## Imaging Data Matrix codes with a camera phone

- Camera phone distance from the code → 40 to 80 mm
- Cell size → at least 0.20 mm
- Code dimensions → 24 × 24 code with 0.20 mm cell size = 4.8 × 4.8 mm
- Information capacity → 64 × 64 maximum for current camera phones
- Camera lens → Macrolenses needed
- Ink jet printing → 300 dpi enough for larger cell sizes
- Substrate → Spreading



## Summary

- Trends in package industry support shifting to on demand package production
- Digital printing enables on demand package printing
- Ink jet printing suitable for printing codes on packages and for printing the whole package
- New coding methods enable storing large amounts of data on small areas
- Two-dimensional bar codes offer great benefits to package production and packaging supply chain
- Camera phones can be used for detecting two-dimensional bar codes



## Thank you!

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