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Structural changes in packaging printing production

Dr. Anastasios E. Politis
politisresearch@techlink.gr, tasosp@kth.se

Athens TEI and Hellenic Open University

Traditional Packaging production

Packaging design

Prepress for packaging

Packaging printing

Finishing - further processing

Identification elements: Barcodes

A new era for packaging?

- Smart,
- Intelligent,
- Active,
- Adaptive,
- Communicative,
- Hybrid,
-,
-,

What do all they mean for packaging printing production?

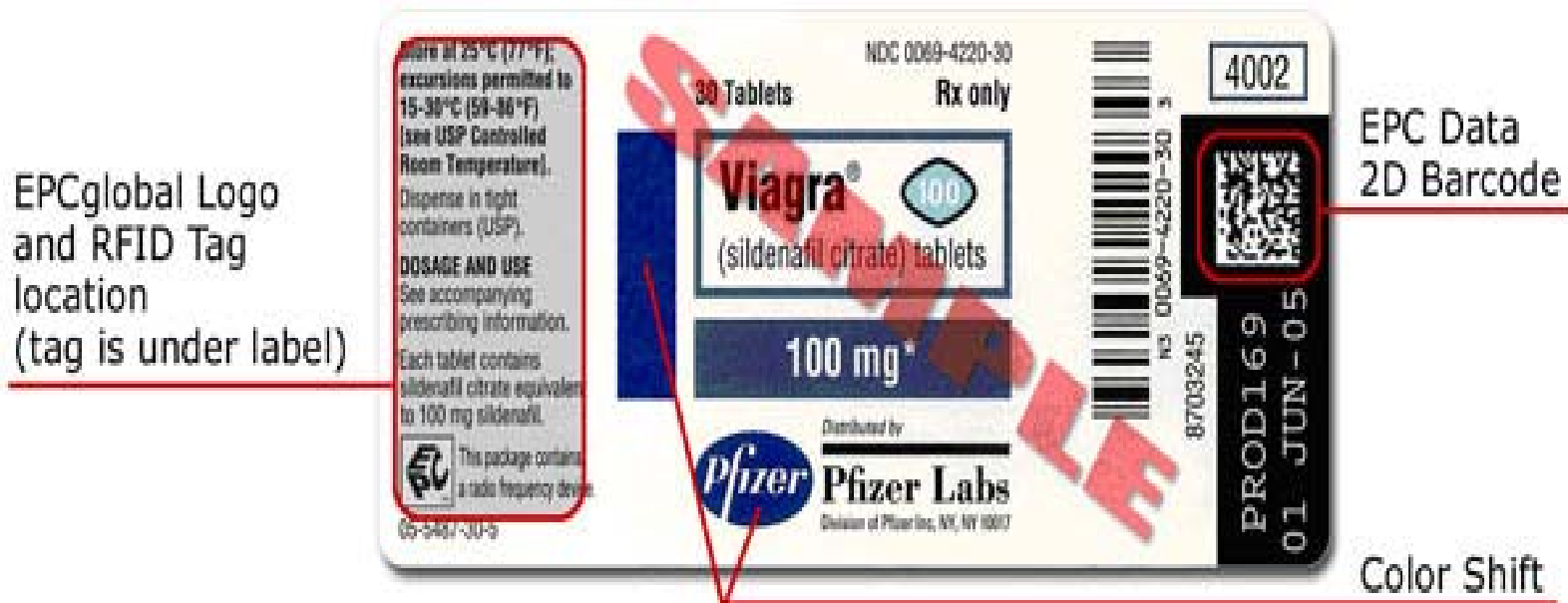
The new Packaging

- ✓ New technologies to be applied on materials and processes
- ✓ Innovative substrates (such as printable polymers)
- ✓ Tagging applications (such as RFID systems)
- ✓ Most significant: Integration of digital data on a package

As a result:

- ✓ Packaging is changing, transformed to a «hybrid» information carrier
- ✓ Becomes a physical carrier of both printed and electronic information.

The new look of packaging e.g. the Viagra box



Source: Pfizer, www.pfizer.com/counterfeit/viagra/rfid

Considerations for packaging printing production

- How smart packaging is printed?
- Which printing process is more suitable?
- What changes might occur?
- How the existing production structure will be affected?
- How far (and when) is this expected to happen?

Challenges for packaging printing

- Digital information on packaging
- Factors and parameters that might affect packaging design and production.
- Definition of what is important and what is not (as it regards smart packaging)
- Prerequisite: Investigation of technologies, developments and applications of smart packaging.

Trends and developments in supply chain and packaging

- Packaging lies in a quite strong relation with the supply chain.
- being subjected to changes and developments caused within the more generic field of the supply chain.
- shorter delivery times, larger selections and smaller product quantities.
- higher and higher demands on package production and packaging logistics.

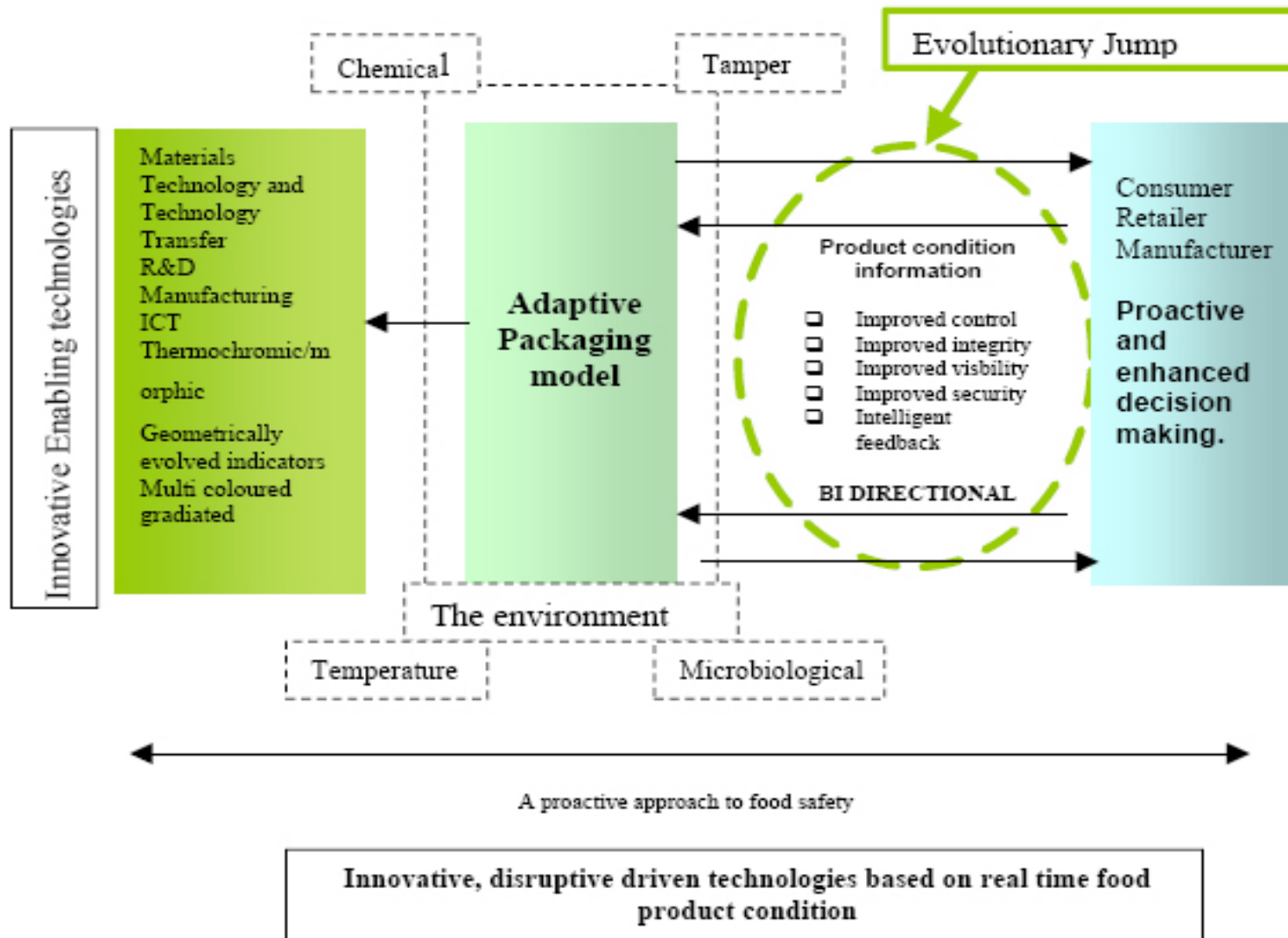
Developing printing technologies provide new tools for solving problems, boosting production and giving value addition to packages.

- increasingly important task for packaging is to improve brand protection (VTT, 2002).

Which drivers for change for smart packaging?

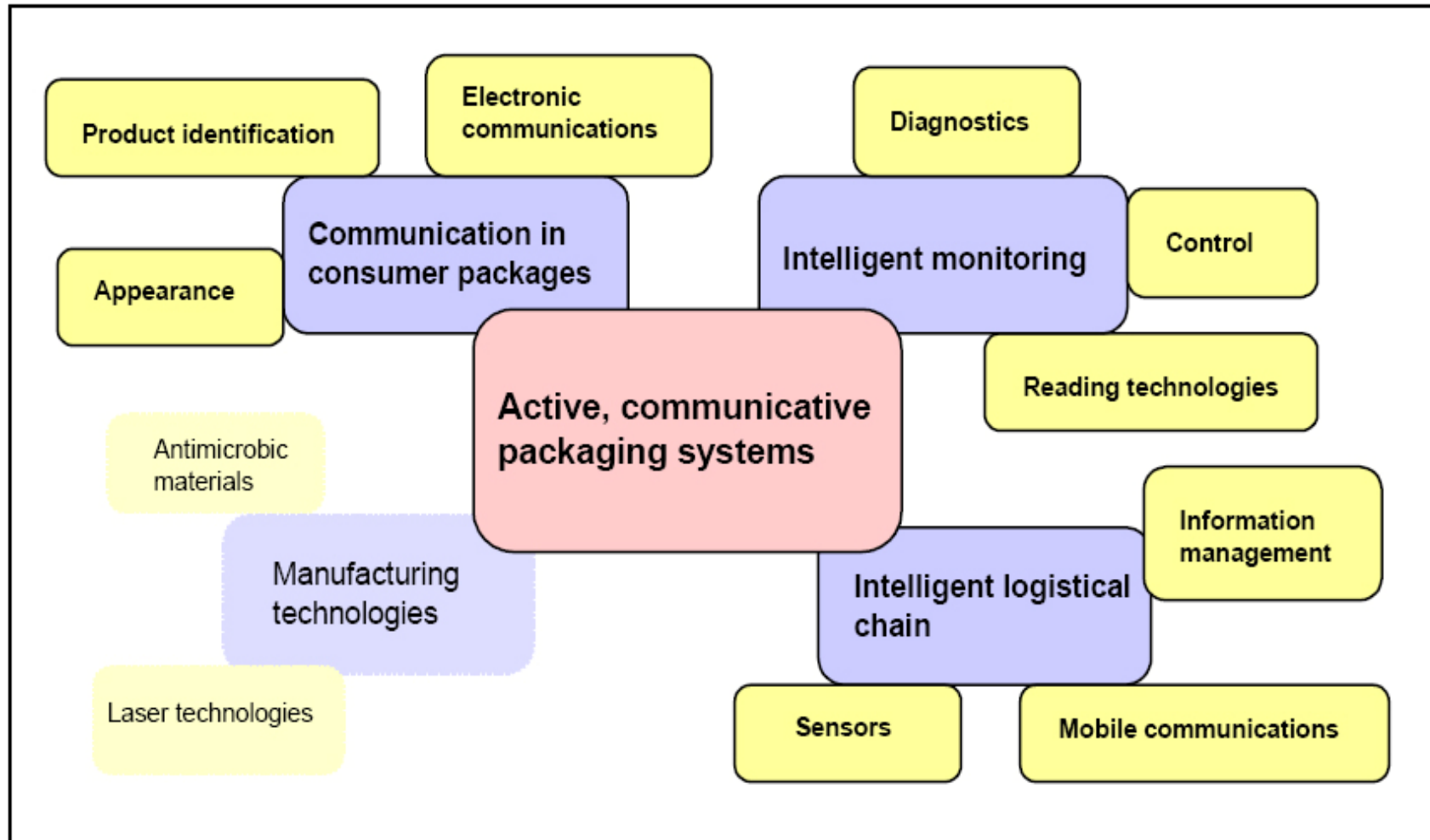
- a) Materials optimization, materials compatibility, device modelling, inkjet architecture.
- b) Benefits to ink jet printing electronics.
- c) Low-cost atmospheric processing.
- d) Compatible with variety of substrates
- e) Reduced materials costs.
- f) Reduced environmental impact.
- g) Large area processing.
- h) Alignment during deposition.
- i) Direct control of composition, gradients (Lindner, 2005).

Adaptive packaging



*The Conceptual Adaptive Packaging Evolutionary Model
Cooney and Winkless, (2003).*

Active, communicative packaging



*Technology map of Active, Communicative Packaging Systems.
Source: VTT Information Technology, Finland*

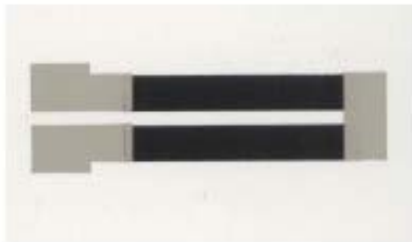
Smart packaging printing

- Combination of traditional printing with CMYK colours, circuits printed with additional colors and integration of additional elements such as supplemental electronics (Baumann, 2006).
- Roll to roll (reel to reel) manufacturing technology applied for printed electronics and smart packaging applications.
- Application of UV-lithography, flexo and screen printing, coating, laminating and die-bonding processes for producing various forms of electronics such as polymer transistors (Bock, 2006).
- Organic electronics are thin, flexible and lightweight - they can be printed with the traditional printing methods of flexible substrates (offset, gravure, flexography, ink-jet and laser printing processes (Hecker, 2006).

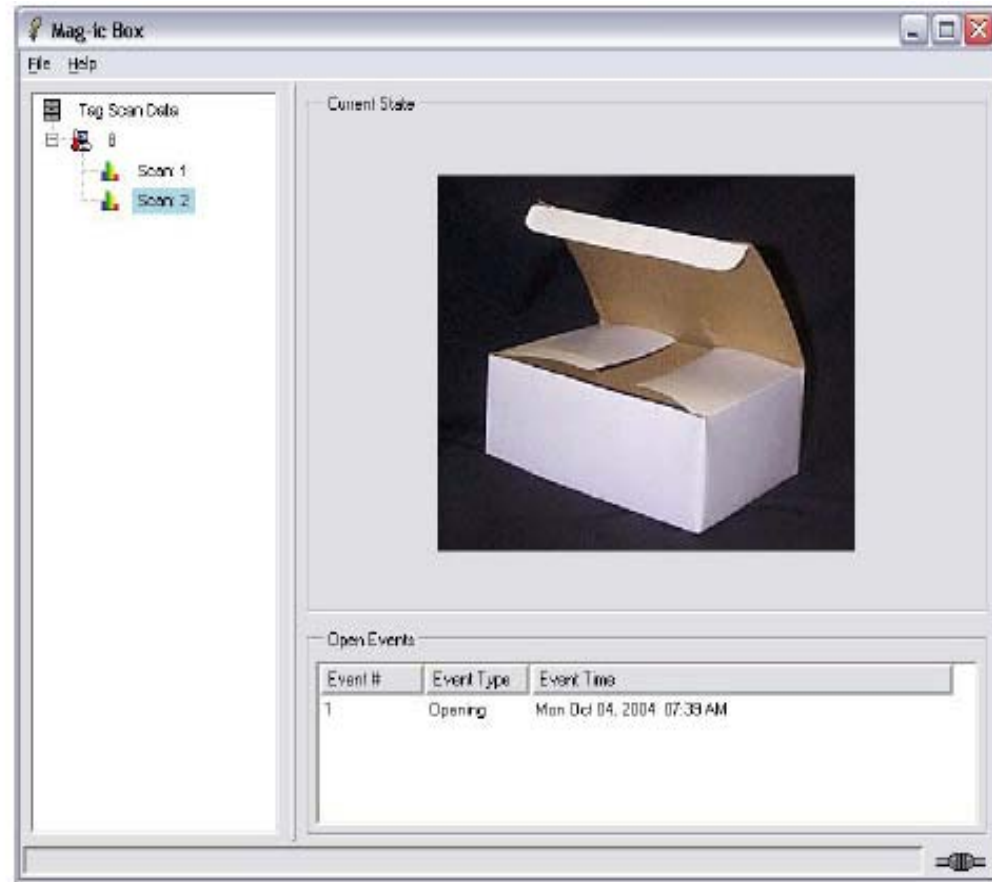
Reel-to-reel technology

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Xink ink technology



Actual Sensor sample printed with XINK ink.



Conductive ink sensors change properties, e.g. when the hinge of a box is opened and closed



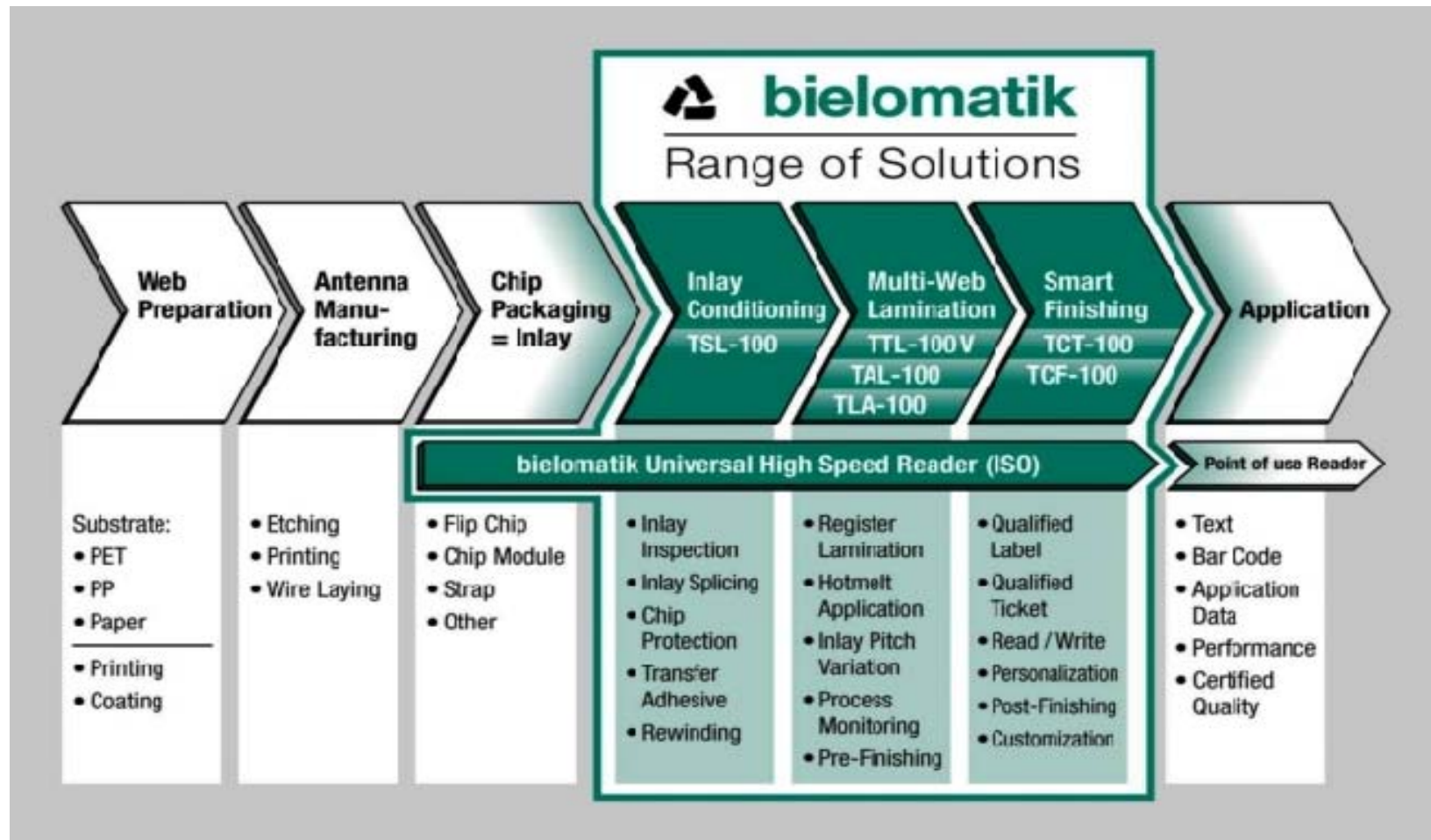
Printed (or) Printable Electronics

- Printed Electronics - typically being thin film silicon, inorganic or organic semiconductors, used to form Thin Film Transistor Circuits (TFTCs), also employing thin film conductors and dielectrics.
- TFTCs can be printed using high resolution printing processes such as inkjet printing, lithography, gravure;
- Unlike silicon, other components such as batteries, sensors, displays, etc., can be printed using similar materials and processes.
- Printable Electronics: as “The Chemistry of Making Devices with Printing Processes” (Kahn, 2005).

Smart packaging printing workflows

- Design and print antennas (with semiconductor ink)
- Print (texts, images, graphics, colour printing)
- Put a chip (at the necessary point)
- Lamination
- Folding / transformation / transfer / distribution (Baumann and Weiss, 2005).

Smart packaging printing workflows - e.g. BIELOMATIK



RFID System: - The Principle of Operation
Source: Bielomatik (www.bielomatik.com)

RFID: Inlays (labels) or direct printing?

- **RFID: A first step towards truly smart packaging into the supply chain.**
- **Use RFID inlays or labels, vs. RFID integrated into packaging need to be addressed.**
- **Important issue: use existing printing processes to achieve low cost antennas.**

- **Barcodes: 80% currently printed on the package, 20% attached as labels.**
- **RFID ratio: start at 99+% labels or inlays.**
- **Equilibrium value in 2009 may still be 50% (Precisia, 2004).**

New structures for packaging printing

- Huge potential market for the so-called “smart” applications.
- Packaging is one of the sectors where the “smart” applications are of significant interest.
- Packaging printing production will have to adapt to the new demands of the retail market and industry, whatever this means for the traditional printing companies as it regards changes in production, equipment workflow and management.
- Important issue: Competition of labels (inlays) vs direct smart packaging printing.

- **Struggle on technologies to be established in the market as the dominating application.**
- **RFID seem to take the lead, however, its application is currently found in secondary packaging, transport and identification in storages and pallets.**
- **Printing of RFIDs, are mainly labels attached as normal labels on to the packages.**
- **RFID technology is competing with printed electronics field (organic polymers), where the active carrier is the substrate itself.**

Smart packaging applications currently realized as:

- Labels to be embedded on the package substrate
- Through direct printing, mainly on new substrates with “smart” characteristics
- Via an inlay process (e.g. mainly laminating or embossing)

The majority of smart packaging elements (tags, antennas, printed polymers) are thin, flexible and printable with all major printing processes.

Smart packaging printing: Only general recommendations

- All major printing processes are used in smart packaging applications.
- Packaging design, prepress and plate/cylinder making does not seem to be affected at present.
- However, it is quite possible that printing processes will need to be adapted into new production environments.
- Changes are expected in production workflow, and management attitudes and requirements.
- Decisions might be needed regarding new investments.
- Packaging printers need to cope with new materials and substrates.
- New competence will be required.

Packaging printing production *will* change

- Smart packaging production is (currently) based on labels.
- Other technologies evolve further.
- Not possible to make an accurate prediction on which technology will be the most applicable in the near future.
- Possibly both, for different applications / types of packaging.

Further developments

- Examine the suitability of each printing process for the integration of smart packaging applications.
- Explore implication for specific processes in packaging design and production (prepress, printing forms, inks, substrates, finishing).
- Explore Packaging design (new design approaches of the smart packaging elements)

A range of various implications will possibly occur and need to be addressed regarding further developments

- **appropriate procedure to implement smart packaging applications,**
- **the orientation of investments,**
- **the management attitudes and requirements and**
- **the competence characteristics of the human capital.**