colloquium at
International School of Information Management, University of Mysore
March 7th, 2012 in Mysore, India

From print to AR —
smart media of the future

by Arved Hübler

member
of

oe-a
Organic Electronics
Association

iarigai
print and media research

Institut für Print- und Medientechnik der TU Chemnitz
[Institute for Print and Media Technology at Chemnitz University of Technology]
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representative India: Kiran Prayagi, Akurli Road, Kandivali, East Mumbai - 400 101 / India • Phone: +91 9820441799 • **http://pm-india.in**

PM INDIA
Linking High Potentials

pm
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CHEMNITZ UNIVERSITY OF TECHNOLOGY

pmINDIA: linking high potentials

PM INDIA
Linking High Potentials

Education:

M.Sc. double degree
Print & Media technology
Manipal University
TU Chemnitz

Indian students → Chemnitz
German students → Manipal

Supported by DAAD/BMBF

Research:

Industrial & academic projects
Establishing an
Indo-German
Applied Research Center

Contact office:

Kiran Prayagi, Akurli Road,
Kandivali, East Mumbai - 400 101
Phone: +91 9820441799
http://www.pm-india.in

Conferences

Color science 1.3.12 Mumbai
Printed electronics 9/12 Bangalore
**Packaging printing** 11/11 Mumbai

Industrial Networking

Institute for Print & Media Technology
of Chemnitz University of Technology
since 1956

✦ world leading institute for print media technologies
✦ 125 students, 50 faculty members, 2 professors
✦ interdisciplinary research: printed electronics, digital & conventional printing, digital documents
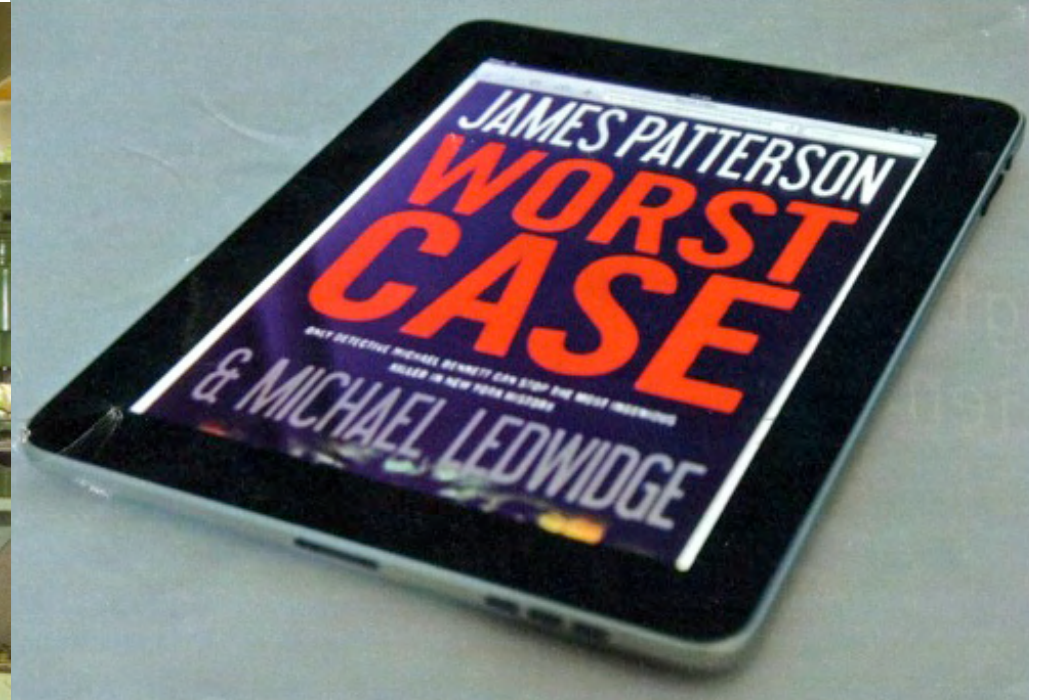✦ 3 study programmes, one in English (M.Sc.)
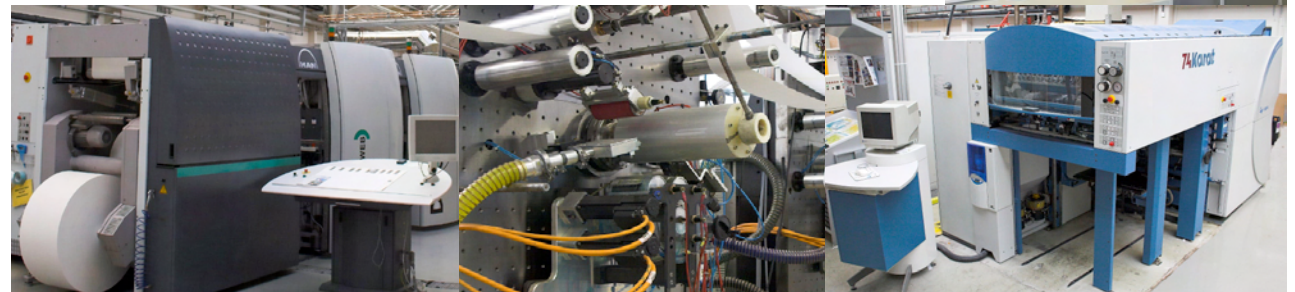
From print to AR —
smart media of the future

pmTUC printing lab: web printing (offset, gravure, flexo)

future of media

printing: dead end ?

Microsoft presented:
„The last newspaper in 2018"

Microsoft CEO Steve Ballmer:
„The last newspaper in 2018"

?

2000

2008

2018

2000
ongoing decline
of sold copies

2007
GOSS sold to
China Electric

2008
Amazon
Kindle

2009
Apple
iPad

2011
Manroland
insolvent

more than 100
US newspaper
titles closed

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at
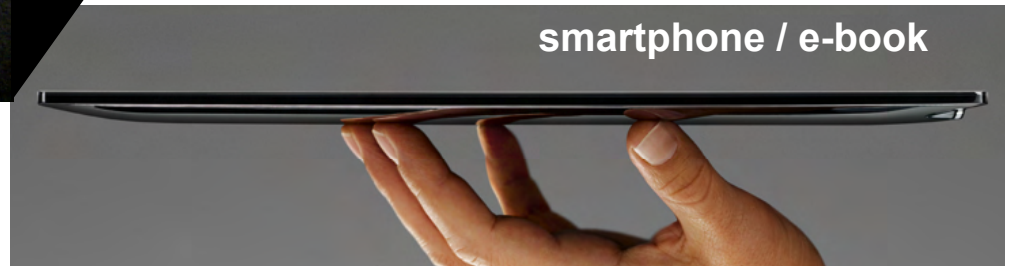© 1.4. 2011 CHEMNITZ UNIVERSITY OF TECHNOLOGY

since 80 years: wrong forecasts

printed book

www.print-is-dead.com

smartphone / e-book

the first test image of
the first tv-set 1929 in
„Reichspostzentralamt
Berlin, Germany"

tv-set

computer

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of

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long-term view on media …

→ knowledge society

innovation

information media

⇒ printed electronics!

high throughput micro-structuring

graphic arts industry

production tool

writing

gravure

Gutenberg's mass printing

→ civilization

Sumerian & Egyptian writing

Phoenician alphabet Indian numerals

5,000 years ago

500 years ago

today

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the meaning of »media« …

Siemens Epyrus[2]

**PEP-C
Newspaper-on-Demand**

electronic media ?

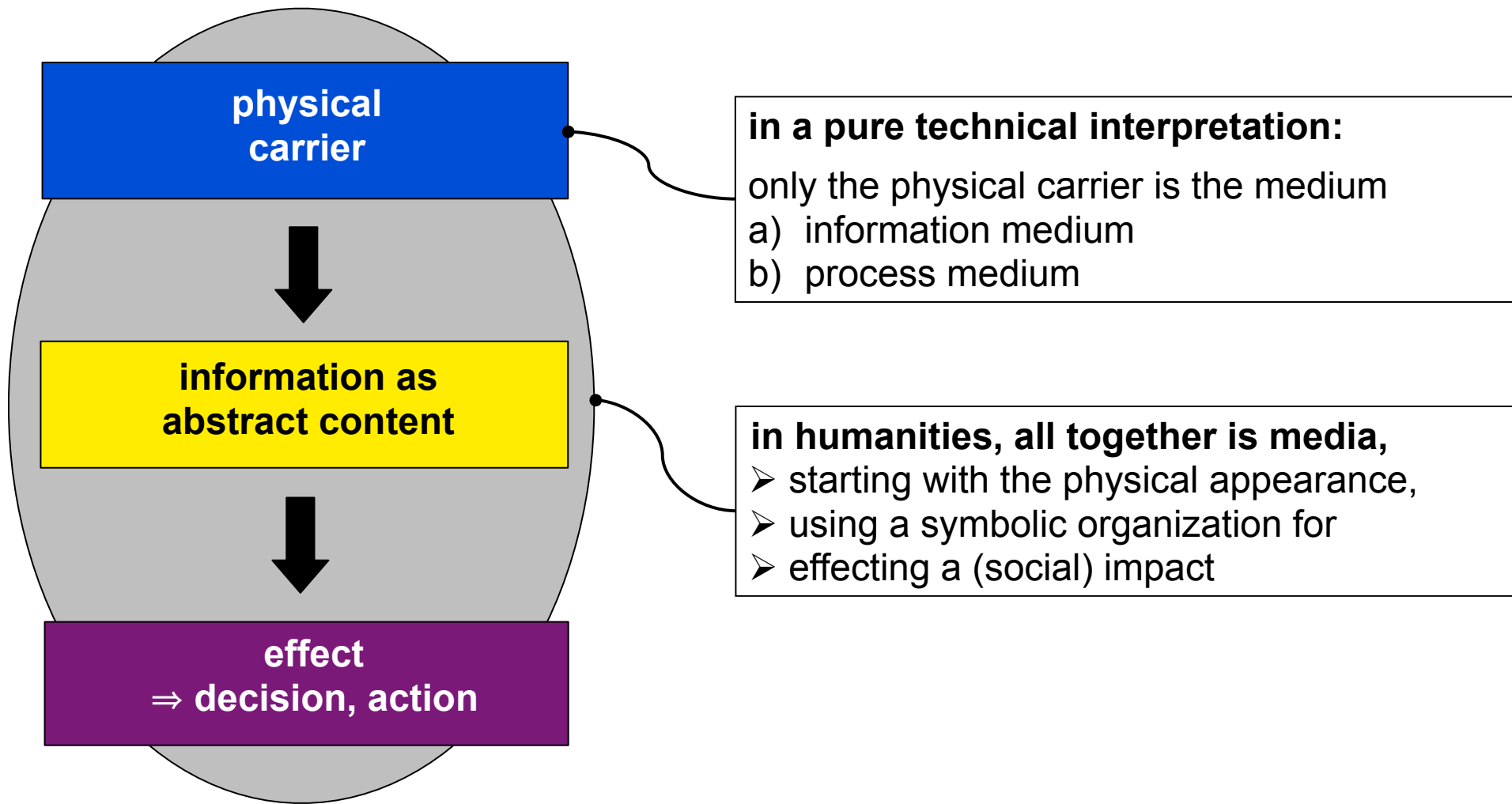media society ?   mass media ?

smart media ?

multimedia ?

"media smog" ?
David Lewis, media psychologist[1]   new media ?

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the understanding of the term "media"

medium = means, device, middle
(*german: Mittel, Mittler*)

physical carrier

information as abstract content

effect ⇒ decision, action

in a pure technical interpretation:

only the physical carrier is the medium
a) information medium
b) process medium

in humanities, all together is media,
➢ starting with the physical appearance,
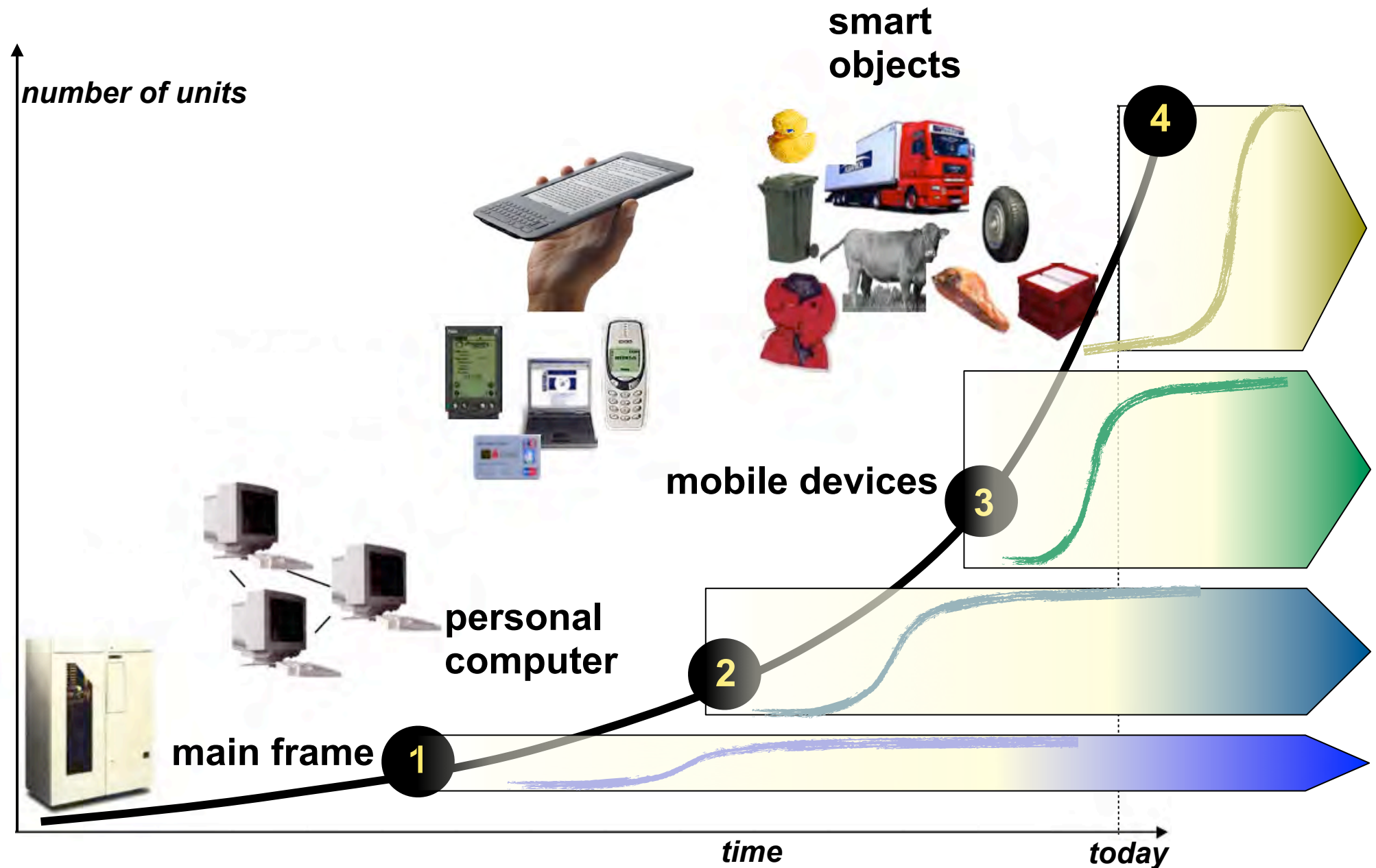➢ using a symbolic organization for
➢ effecting a (social) impact

**From print to AR —
smart media of the future**

pmTUC characterizing lab

future of electronics

future of electronics
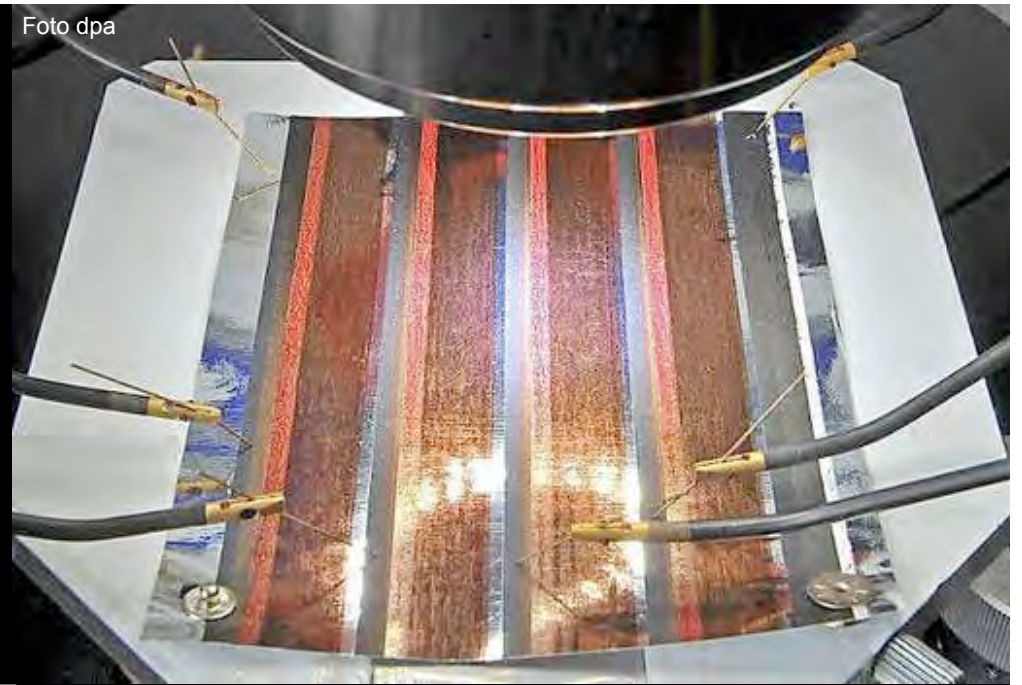

smart objects

number of units

mobile devices

personal computer

main frame

1

2

3

4

time

today

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future of electronics   # future of printronics

high end electronics
small, flexible, integrated, mobile

computing & communication devices

smart objects
intelligence in every day-to-day item,

internet of the things

further technology development:
better functionality by
„more Moore" (higher resolution)
& „more than Moore" (higher integration)

printed electronics
1. using new materials (small molecules, polymers, nano particles)
2. medium resolution [~ 20 μm]
3. advanced process integration
    = high productivity

conventional micro electronics and micro systems
1. core devices on silicon wafer
2. very high resolution [< 45 nm]
3. low level process integration
    = low productivity

The quest for a **new production technology:**
1,000x higher productivity

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Foto dpa

pmTUC characterizing lab

From print to AR —
smart media of the future

printed electronics

what's about printed electronics?

functional material:

organic electronics • plastic electronics	inorg. electronics

monomer materials	polymer materials		hybrid materials		inorganic nano materials	Silicon
	polytronics	←		→	*nanotronics*	traditional electronics

Polyaniline *Polypyrrole* *Polythiophenes*

Polyethylenedioxythiophene *Poly (p-phenylene vinylene)s*
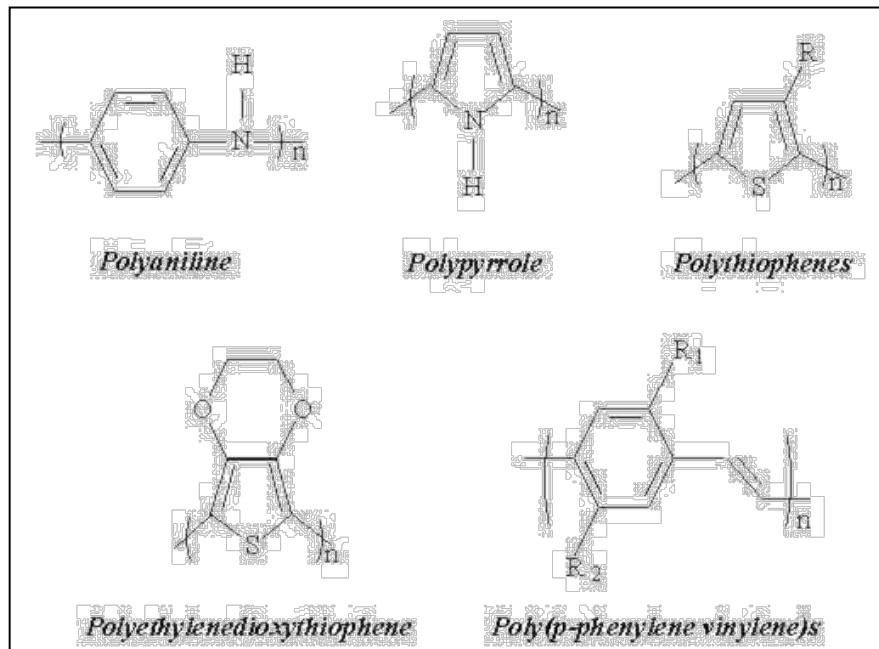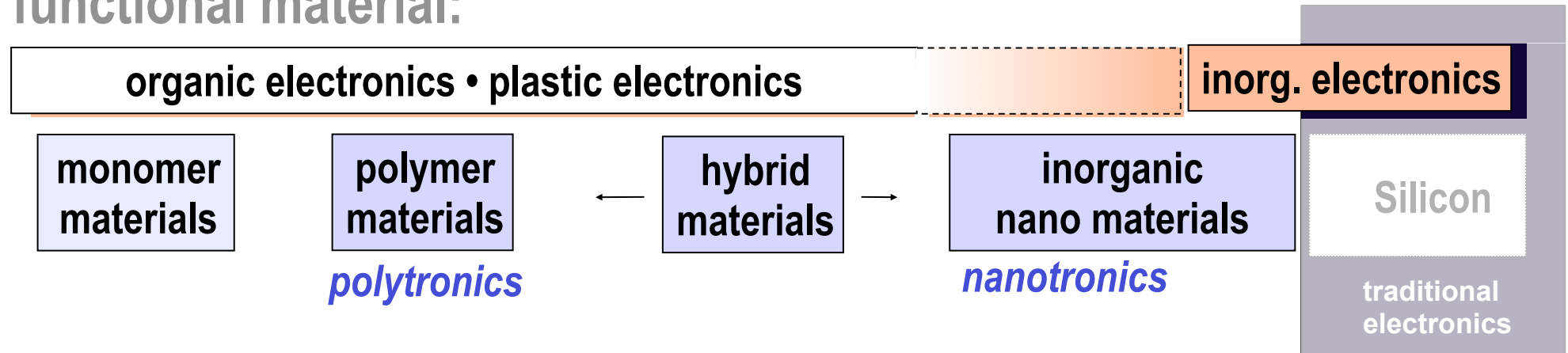
1st basic innovation:
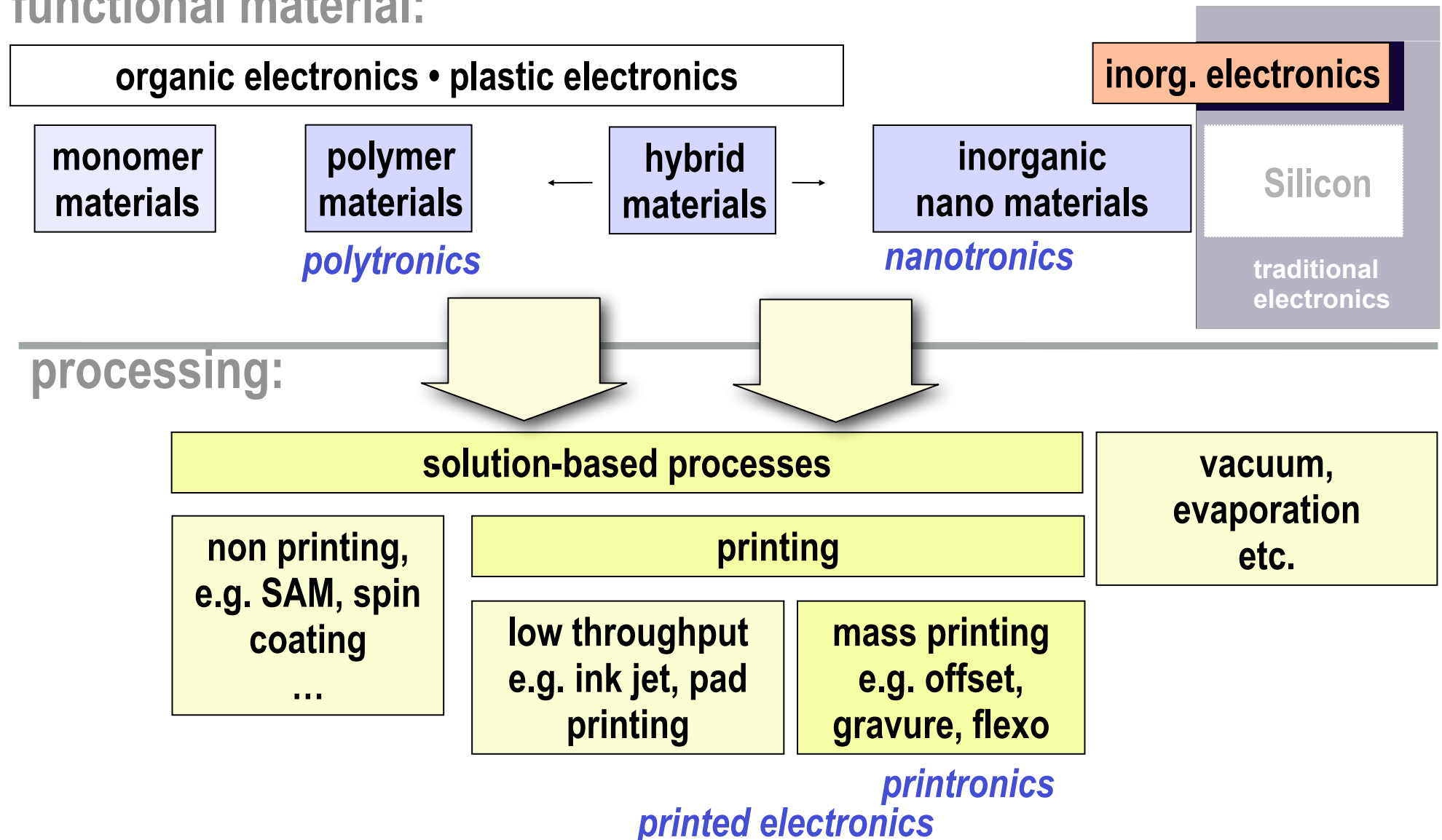new materials with electronic functionality, e.g. conducting, semi-conducting, light emitting, …
(Noble Prize 2000 to Alain Heeger et. al.)
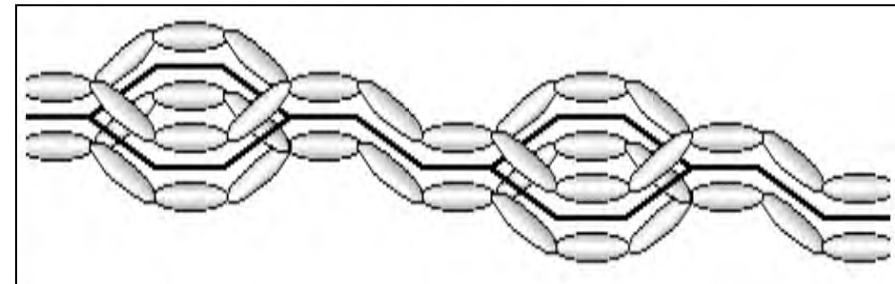
Delocalized π-electrons generate a p- or n-charge transport in the polymer chain.

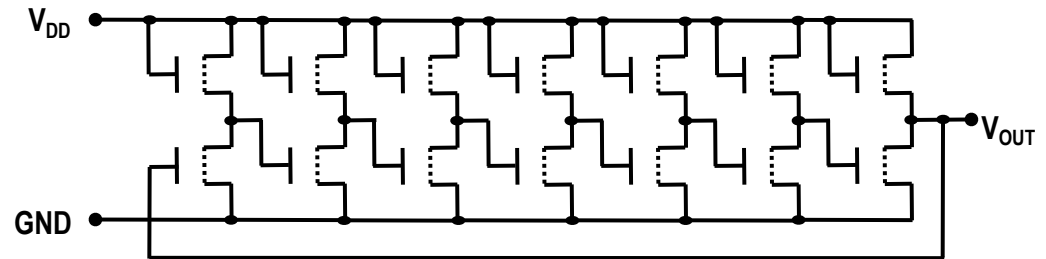# systematics

functional material:

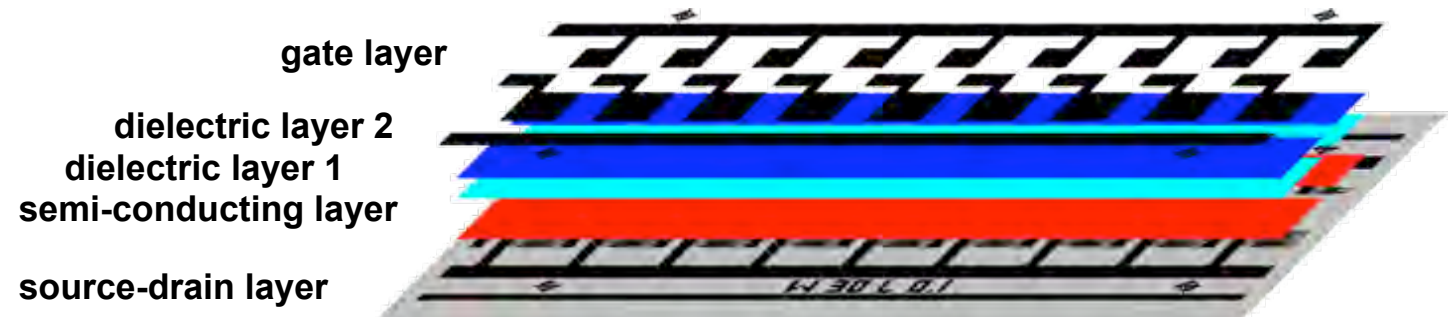| organic electronics • plastic electronics |
|---|

monomer materials		polymer materials		←	hybrid materials	→	inorganic nano materials

polytronics

nanotronics

inorg. electronics

Silicon

traditional electronics

processing:

solution-based processes

non printing, e.g. SAM, spin coating …	printing
	low throughput e.g. ink jet, pad printing	mass printing e.g. offset, gravure, flexo

vacuum, evaporation etc.

printronics

printed electronics

the idea

2nd basic innovation:

Use the new capabilities of fluid processing.
No mask structuring as in traditional electronics
but
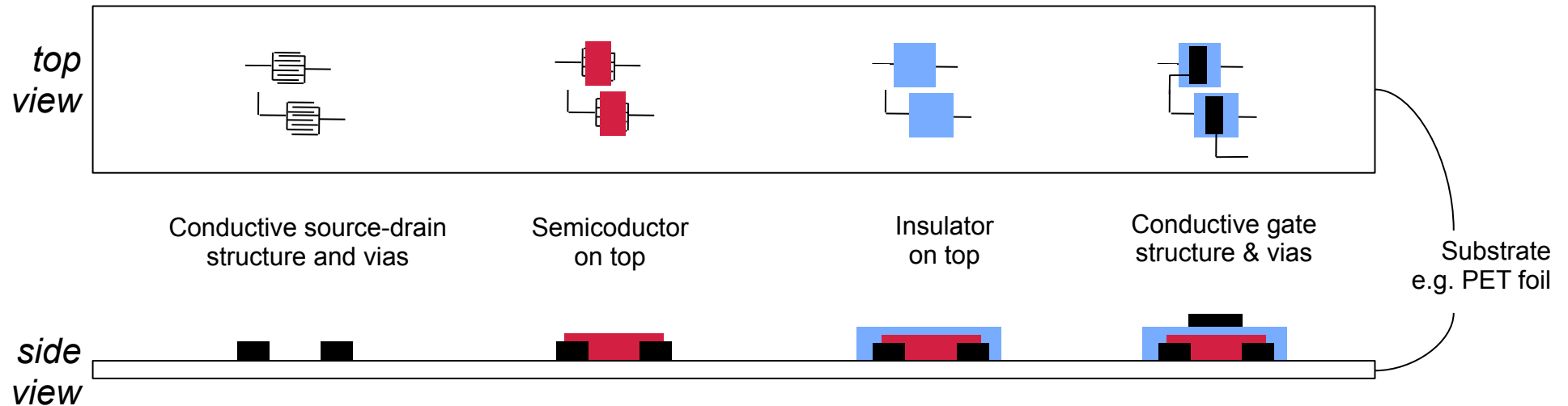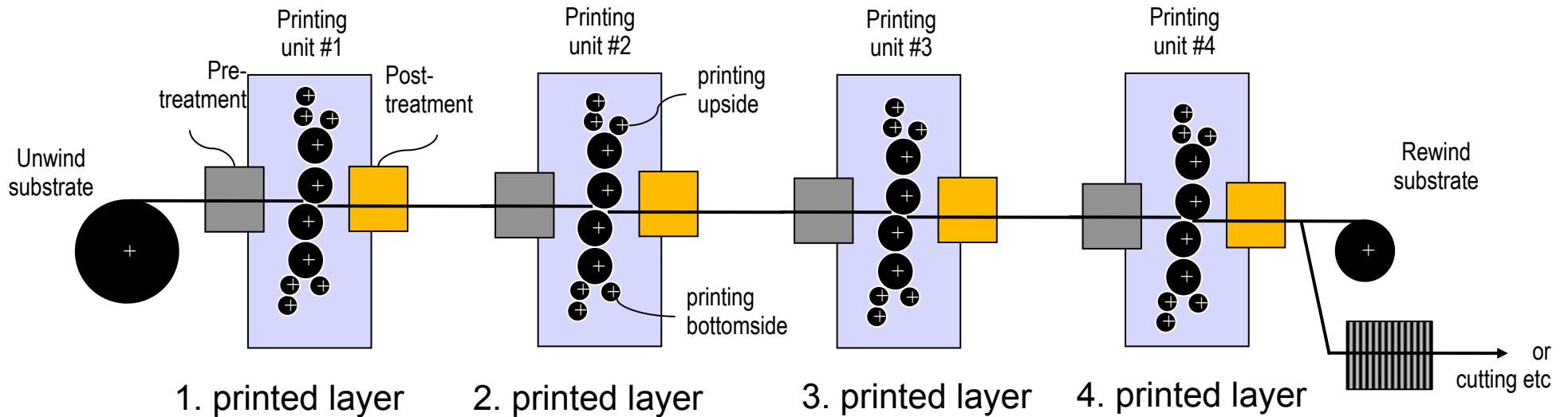printed structures to realize the electronic functions.

a ring oscillator: a small integrated circuitry, build by a few numbers of transistors

gate layer

dielectric layer 2
dielectric layer 1
semi-conducting layer

source-drain layer

the vision: mass printed electronics

Printing unit #1
Printing unit #2
Printing unit #3
Printing unit #4

Pre-treatment
Post-treatment
printing upside
printing bottomside

Unwind substrate
Rewind substrate
or cutting etc

1. printed layer
2. printed layer
3. printed layer
4. printed layer

top view

Conductive source-drain structure and vias
Semicoductor on top
Insulator on top
Conductive gate structure & vias

Substrate e.g. PET foil

side view

easy integration, no PCB needed.

the art of production

Wafer fab: clean room & vacuum processing
10,000 wafers per week
each wafer 30 cm diameter
8.4 m² per hour
smallest structure: 32 nm

low production automation, low through-put with a lot of expensive operators

highly integrated and automated production, very few operators required
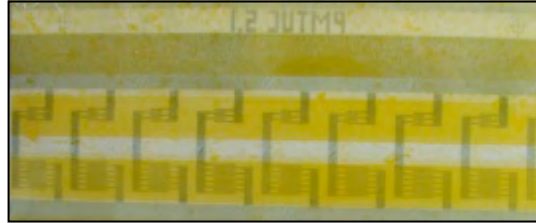
printing:
normal production conditions
15 m/s • 4,32 m max web width
233,280 m² per hour
smallest structure: 20 µm

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development in printed electronics

2003 first mass printed transistor

2005 first integrated circuit based on mass printing

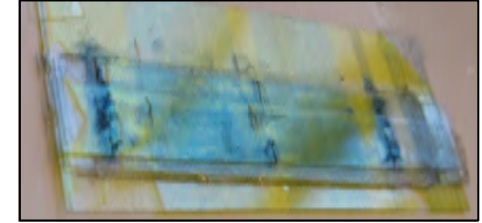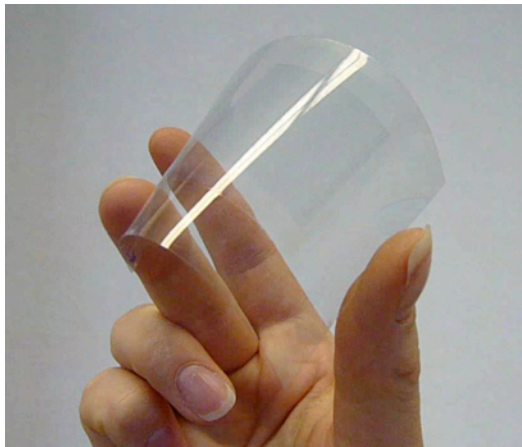**2007** first integrated circuit on paper
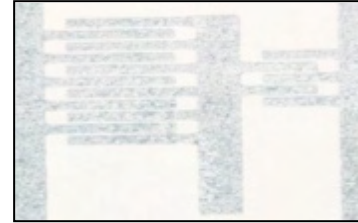
2010 first 3D-circuit

2012 first printed loudspeaker

lab press at pmTUC
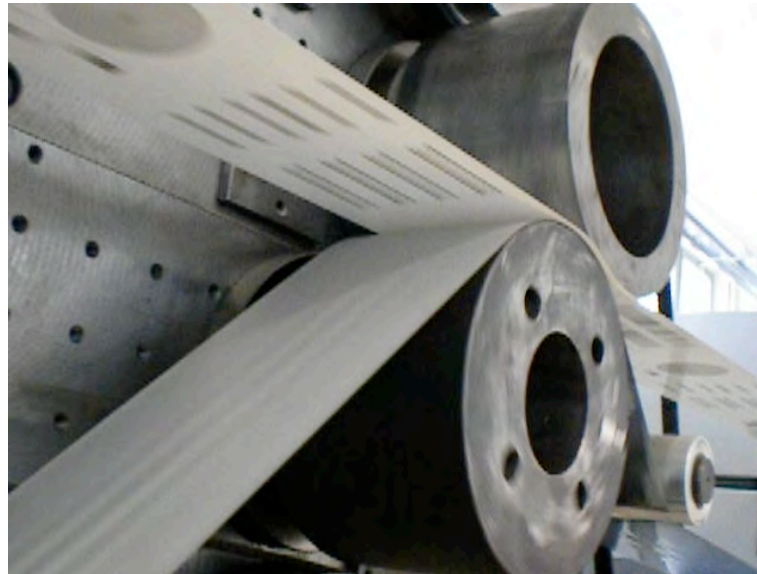
2011 first paper solar cell

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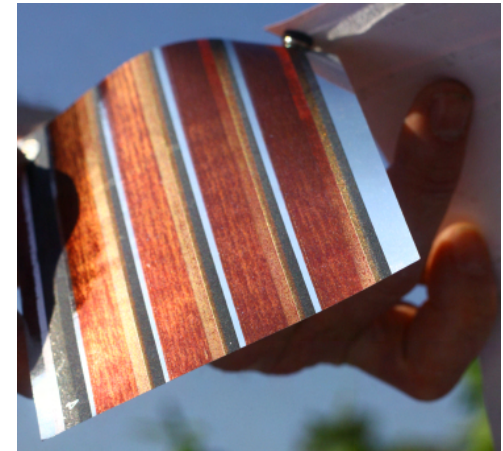
paradigm shift in markets & products?

… but this will change with 3PV

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19
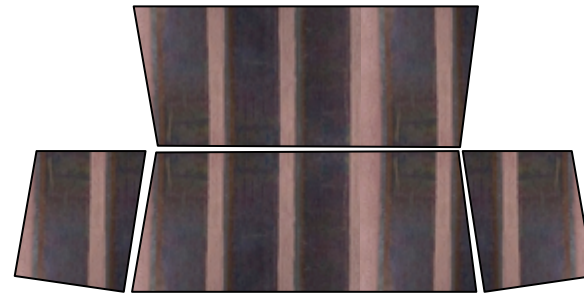
packaging?

3PV solar panel is printed inside a package like a cardboard box, shopping bag, sack, …
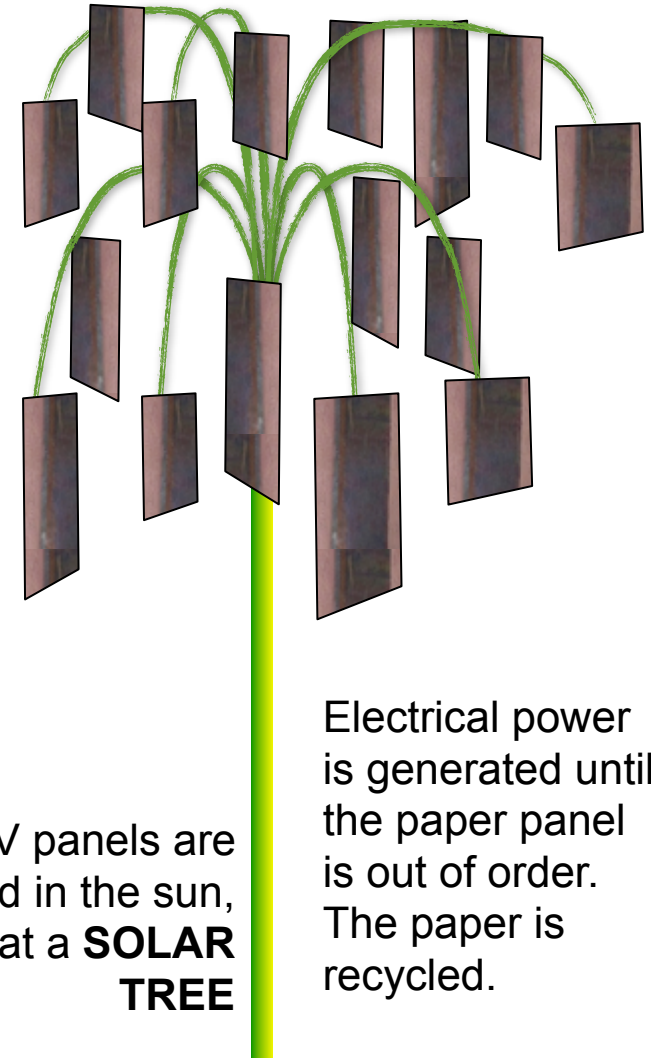

After the user has unpacked the items, the package is turned inside out.

✦ free substrate for 3PV

✦ free distribution for 3PV

✦ advertisement for brands

The 3PV panels are clipped in the sun, e.g. at a **SOLAR TREE**

Electrical power is generated until the paper panel is out of order. The paper is recycled.

Foto dpa

sources: pmTUC, McDonalds
authors: A. Hübler

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basic research: printed smart systems

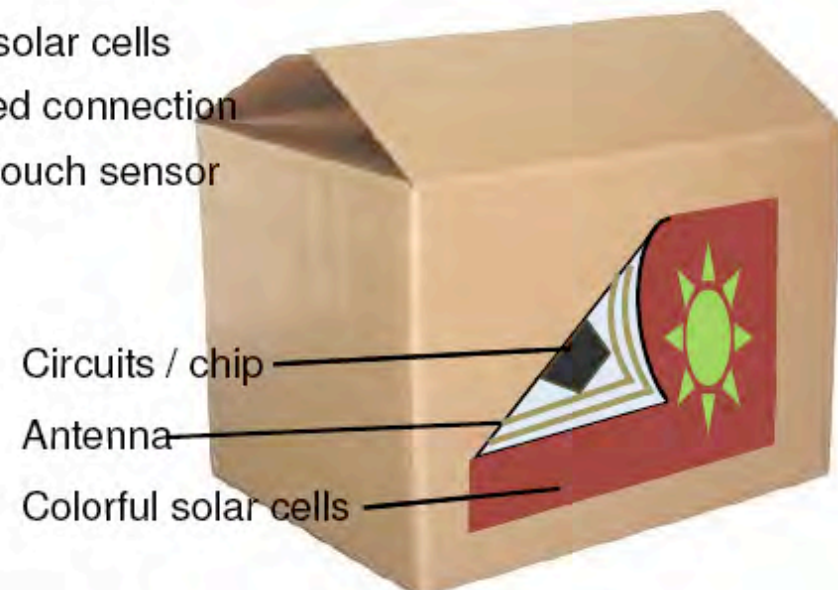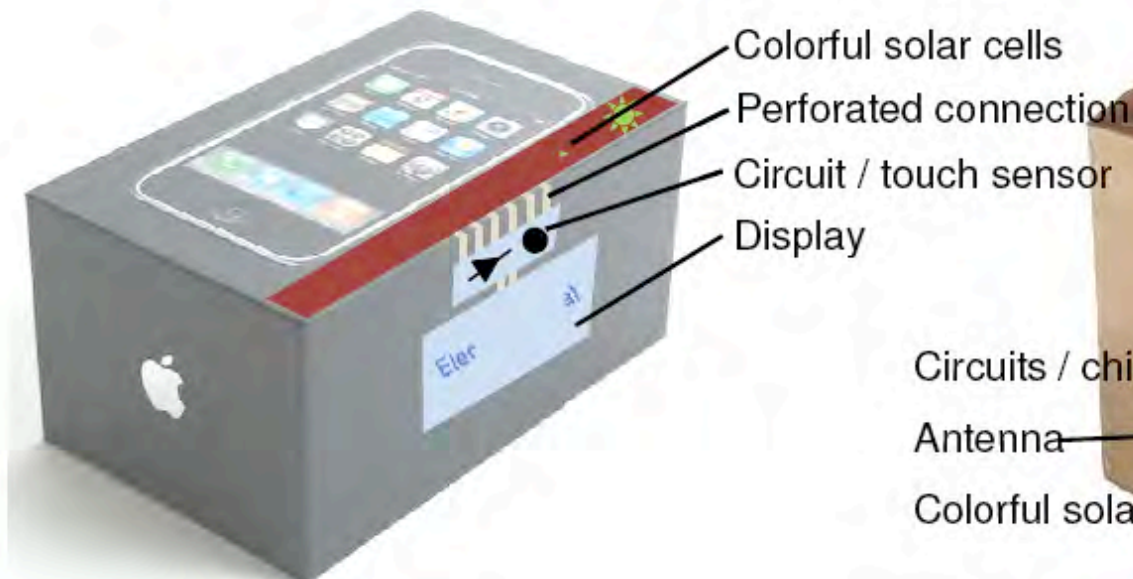**integrate printed**
circuitry
battery
supercap
loudspeaker
sensor
active RF-ID tag: 3PV + RF-ID
scanner/light detector
alarm sensor: 3PV+loudspeaker

OPV module

rechargeable battery

DC-control circuits

Colorful solar cells
Perforated connection
Circuit / touch sensor
Display

Eier

Circuits / chip
Antenna
Colorful solar cells

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media technologies

growth rate
± 3% p.a.

growth rate
+ 8% p.a.

bridging the
gap between
media worlds:
**in the future,
the difference between
printed & electronic
media disappears**

*world
media
market
share*

*news
paper*

**mass
printing**

PoD

printed electronics

**office
printing**

E-paper

navi

PC/int

PDA

**mp3
player**

mobile

phone

E-game

tv, radio
music

E-book

low (changing / updating content, two
way communication)

information *high*

F L E X I B I L I T Y

high **handling**

(mobile, no power supply,
no weight, foldable)

low

pmTUC printing lab: web printing (offset, gravure, flexo)

From print to AR —
smart media of the future

coding of information
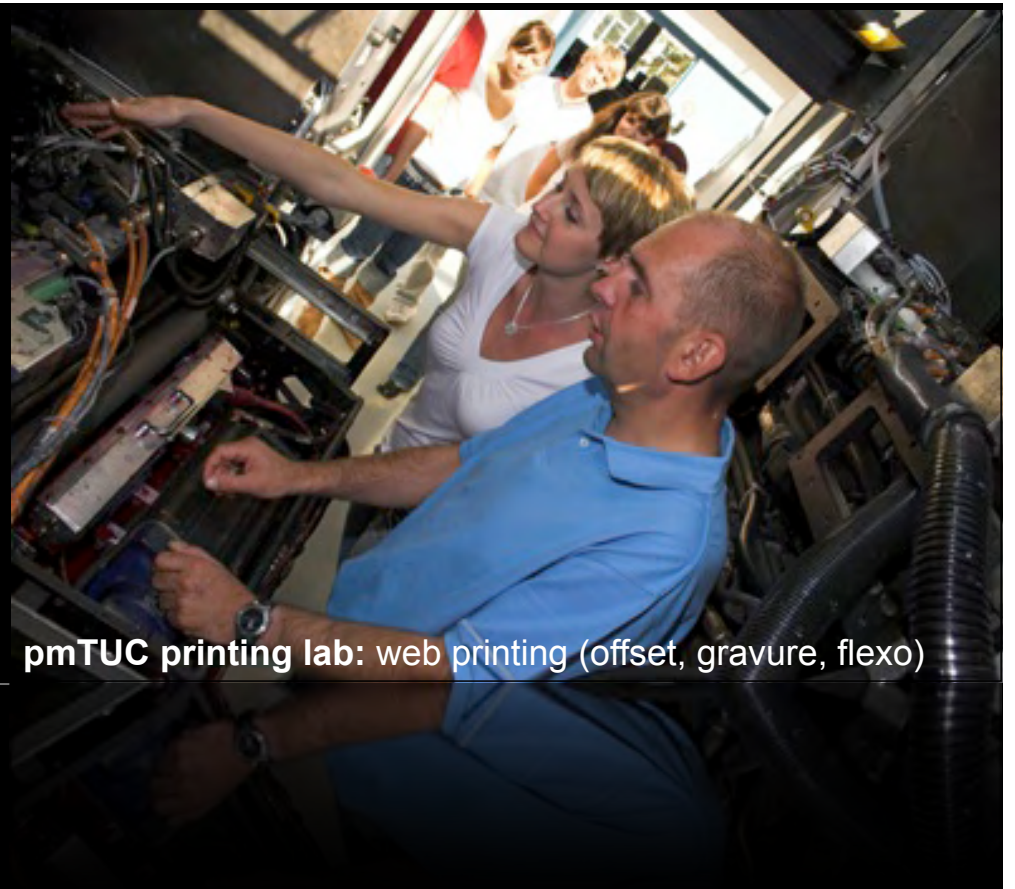
the understanding of the term "media"

medium = means, device, middle
(*german: Mittel, Mittler*)

physical carrier

CODING

information as abstract content

effect
⇒ **decision, action**

in a pure technical interpretation:

only the physical carrier is the medium
a) information medium
b) process medium

in humanities, all together is media,
➢ starting with the physical appearance,
➢ using a symbolic organization for
➢ effecting a (social) impact
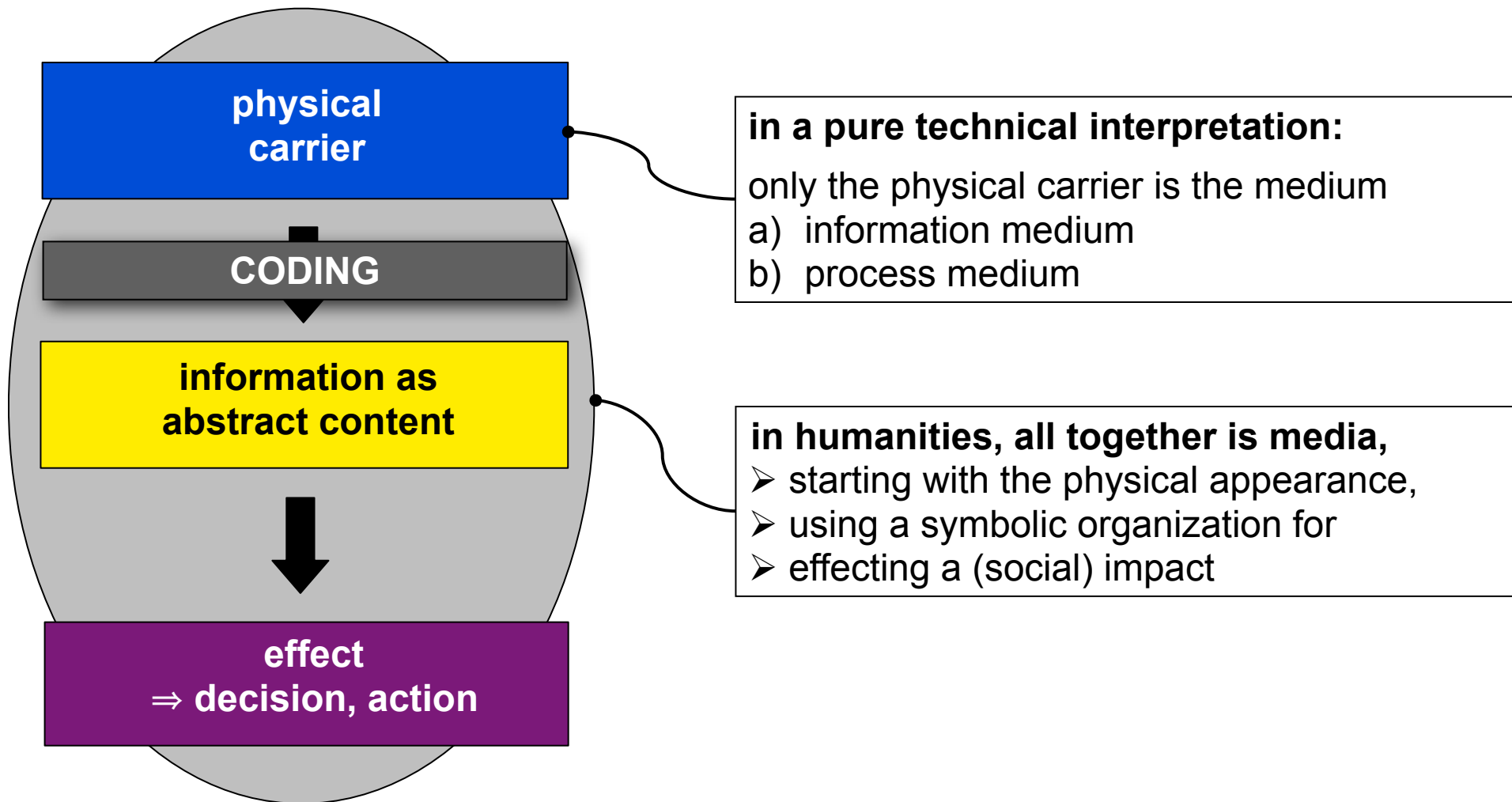
moveable type printing

Johannes Gutenberg
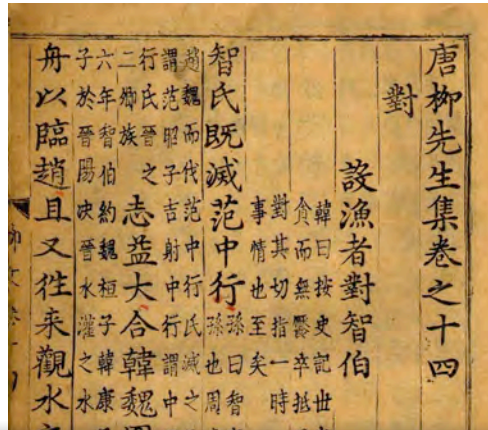* ~1400 in Mainz/Germany
+ 3.2.1468 in Mainz

In **1440** Gutenberg started to print his first Bible with moveable types

In **1434** the Publications Office was ordered by the Korean king to cast a bronze font of 200,000 pieces of Chinese type named Kabin-Ja.

1438 the first document was printed

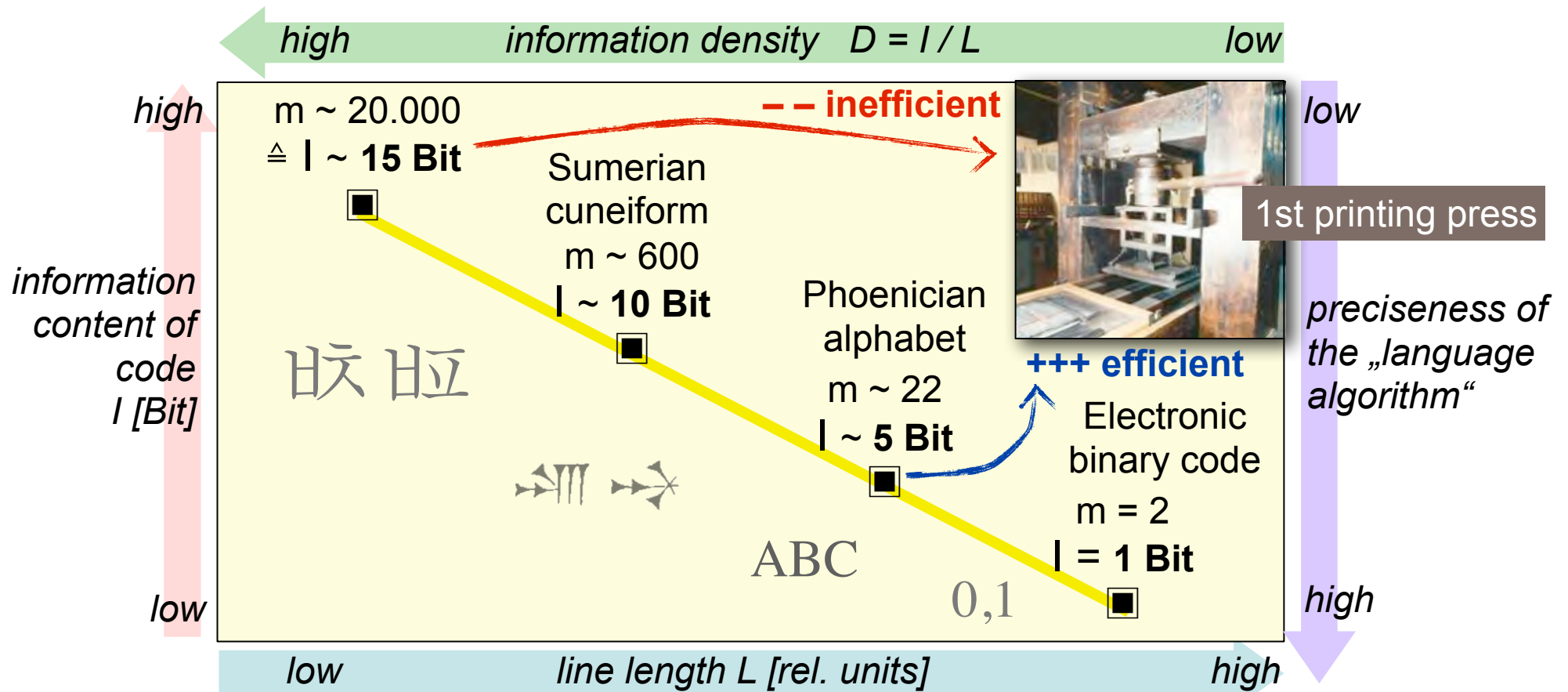## Why Gutenberg initiated the information revolution of printing?

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languages = coding systems

high ← information density $D = I / L$ → low

high
information content of code I [Bit]
low

m ~ 20.000
≙ I ~ **15 Bit**

– – **inefficient**

Sumerian cuneiform
m ~ 600
I ~ **10 Bit**

Phoenician alphabet
m ~ 22
I ~ **5 Bit**

1st printing press

+++ **efficient**

Electronic binary code
m = 2
I = **1 Bit**

ABC

0,1

low ← line length L [rel. units] → high

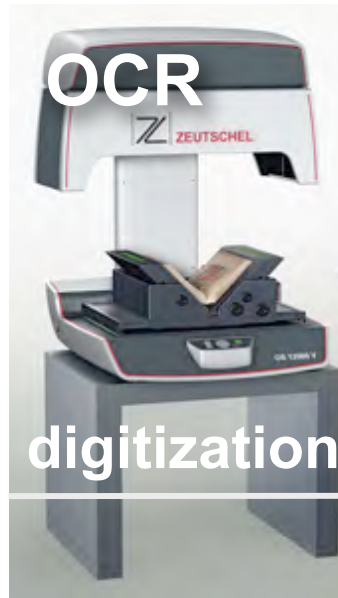low ← preciseness of the „language algorithm" → high

In ancient times, storage space (stone, papyri, …) was very expensive, coding was optimised to save space.

Later, storage space becomes commodity, focus shifted to technical process-ability:

– 2.800, Sumerian: quick writing
1450, Gutenberg: easy printing
1703, Leibniz: digital numbers (0/1)
1941, Zuse: programable processing

© 31.Mar.2010

printing & OCR

digital documents

NCI-document → **OCR** → CI-document

CI-document → RIP → NCI-document

paper document

digitization
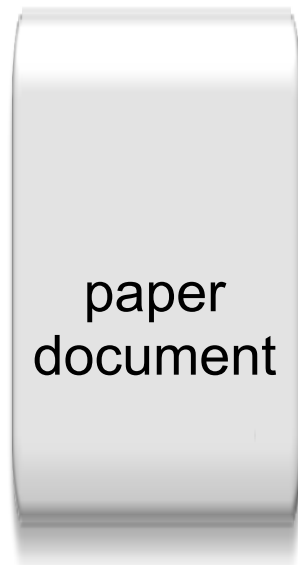
print
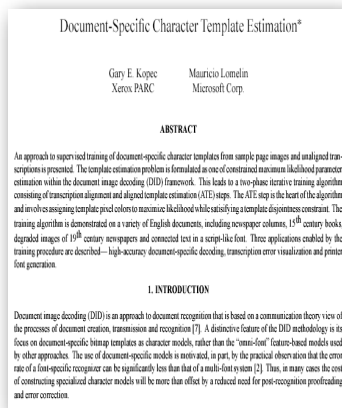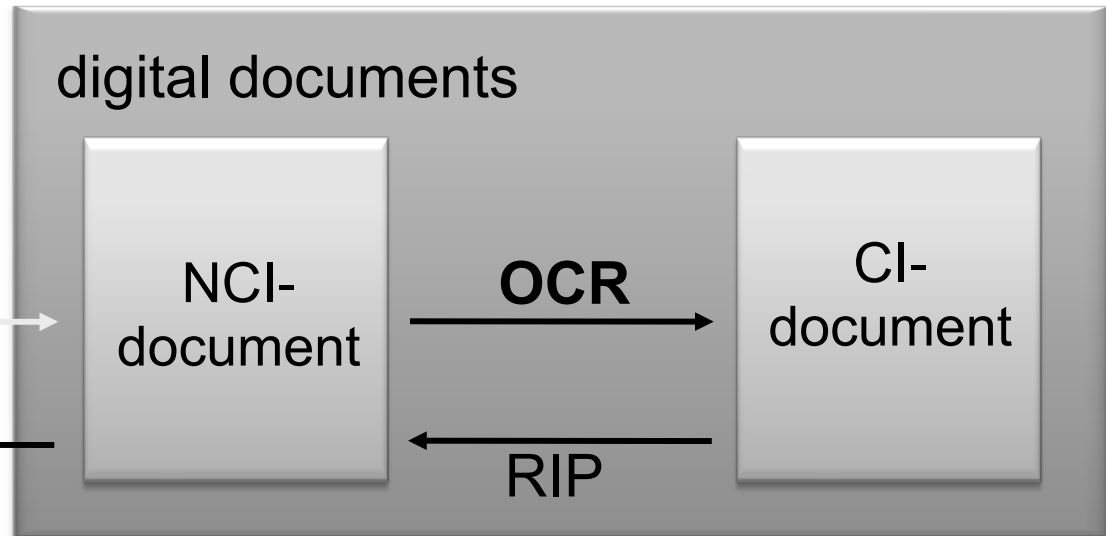
41 hex

NCI: non coded information
Bitmap image
(TIFF, BMP)

CI: coded information
(e.g. ASCII, Unicode)

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restrictions of traditional OCR processes
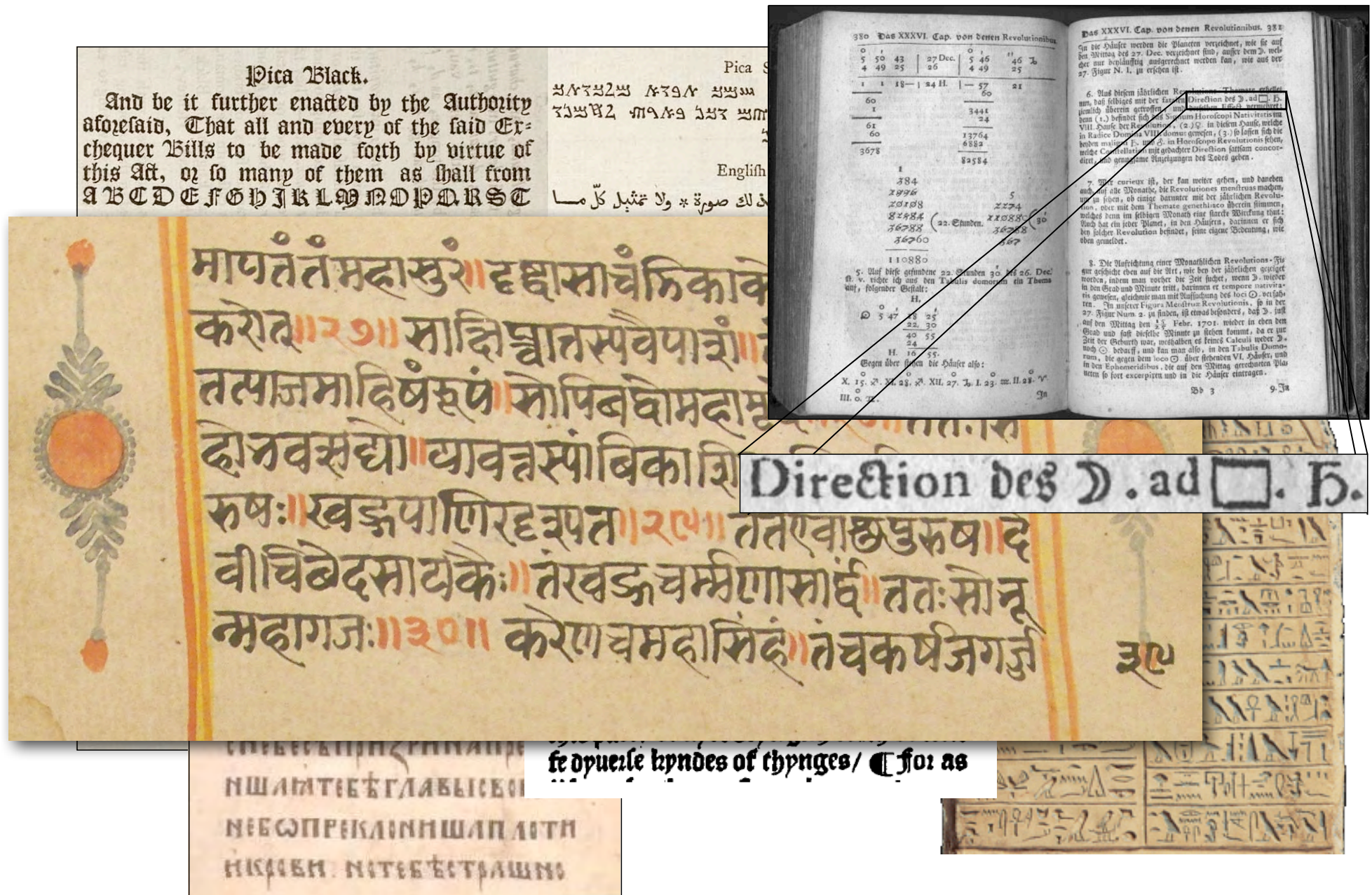
OCR methodology

The final document is a code sequence, readable in a normal RFT-editor like Word. If our special font is selected, the document shows the original apperance, but with individual layout.

world of pattern

world of meaning

VENOD

with linguistic background

- final document
- specific font
- outline glyphs
- vectorization
- **generalized glyphs**
- clustering

- glyph database
- Unicode

layout analysis

Layout information & pictures

- character sequence

- language, dictionaries (orthographic, syntax, semantic)

- character correction

- Scan
- preparation & segmentation
- individual glyphs
- **traditional OCR**
- recognition
- final document

preparation → **recognition** → **post processing**

traditional OCR

Our status-quo

clustering

font generation


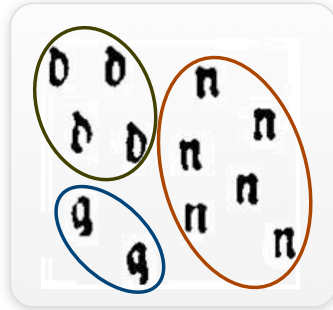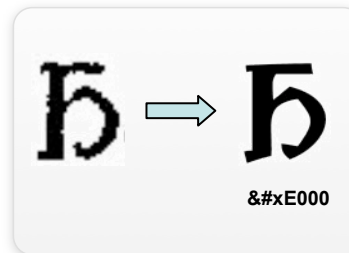
original scan

generated glyphs

different layout arrangements

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smart media of the future**

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advanced code handling   **…AR**

optical coding: developments

the link to augmented reality «AR»

object as code: 3D object recognition

free form codes: pattern recognition

code as an object

code in an object

object with unique code

OCR: optical character recognition

1D   2D   3D   4D

data codes   barcode

01330 801

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AR & magazines: example

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AR & books: example

AR & packaging: example cereal box

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AR & packaging: example LEGO digital box

1st AR in India: November 7th, 2011
technology by Junaio, Munich

augmented reality: onsite translation

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colloquium at
International School of Information Management, University of Mysore
March 7th, 2012 in Mysore, India

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thank you for your attention!

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iarigai
print and media research
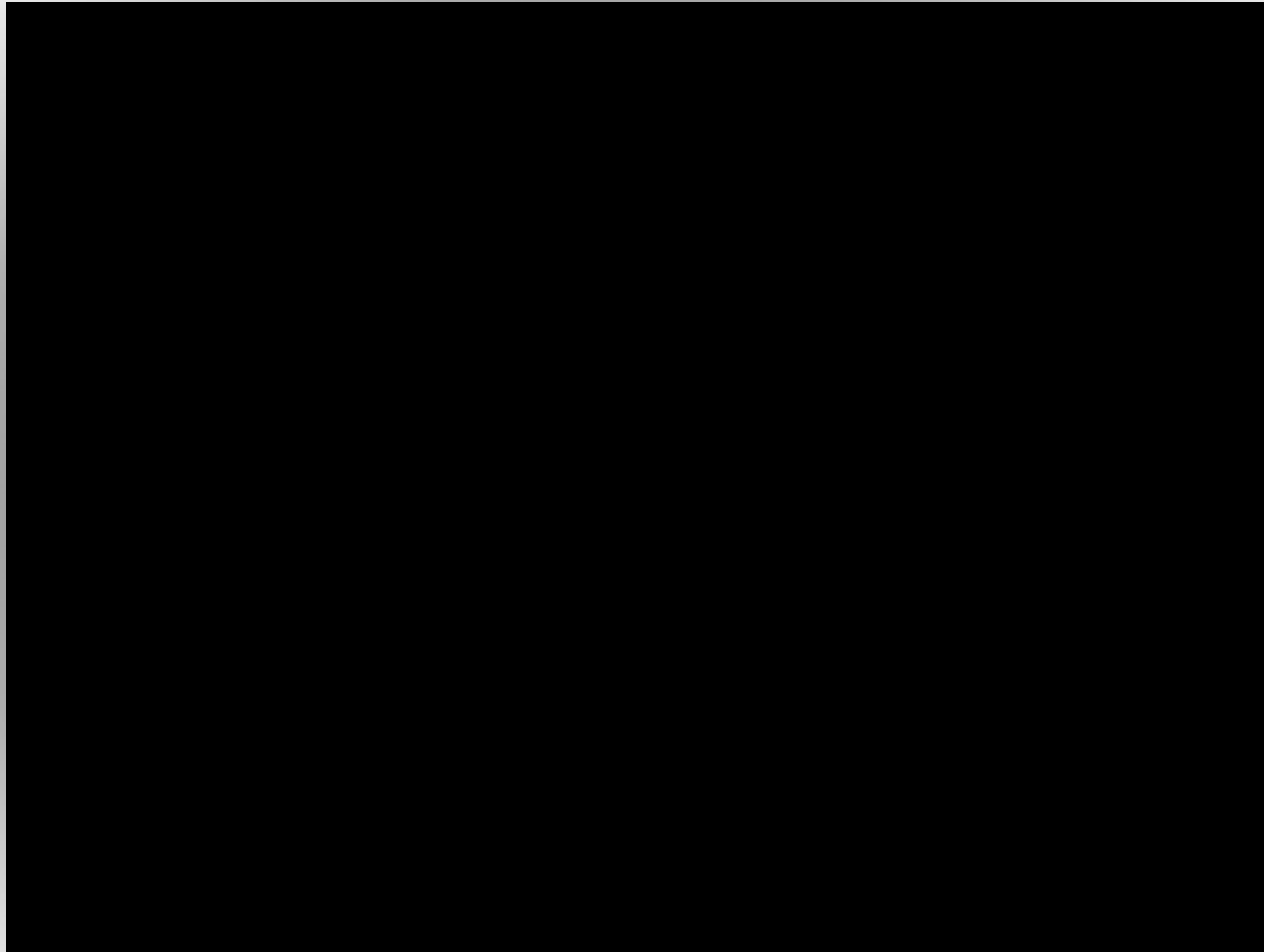
Institut für Print- und Medientechnik der TU Chemnitz
[Institute for Print and Media Technology at Chemnitz University of Technology]
Prof. Dr. Arved C. Hübler • Reichenhainer Str. 70 • 09126 Chemnitz • Germany
http://www.tu-chemnitz.de/pm • pmhuebler@mb.tu-chemnitz.de • Phone: +49-371-531-23610 • Fax: -23619
representative India: Kiran Prayagi, Akurli Road, Kandivali, East Mumbai - 400 101 / India • Phone: +91 9820441799 • **http://pm-india.in**

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new technologies: 3PV

new opportunities: entrepreneurship

3PV vision

new markets and applications

M.Sc./M.Tech. Print & Media Technology at TU Chemnitz

foreign students back home/US/…
Indian students back to India/US/…

double degree with Manipal University

2. Semester   3.Semester

job at
- German company in Germany
- German company in India
- Indian company in Germany

German and international Bachelors

pmTUC Bachelor project seminar

Master program
4 Sem. in English

60% technical subjects

Research project seminar   20%   Research project seminar

Master thesis

20%

media manage-ment

media entrepreneurship
LV + Ex + Sem

one year Entrepreneurship development program

start-ups

pre-incubator
ADVANCED MEDIA

prototype & demo center technology development support

founders:
1 year small job at pmTUC, supervision & business support

soft landing cooperation
with Manipal University Incubator

research at pmTUC
PhD thesis

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