University of St.Gallen

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AUTO-ID LABS

The Internet of Things in Production, Logistics, and Services

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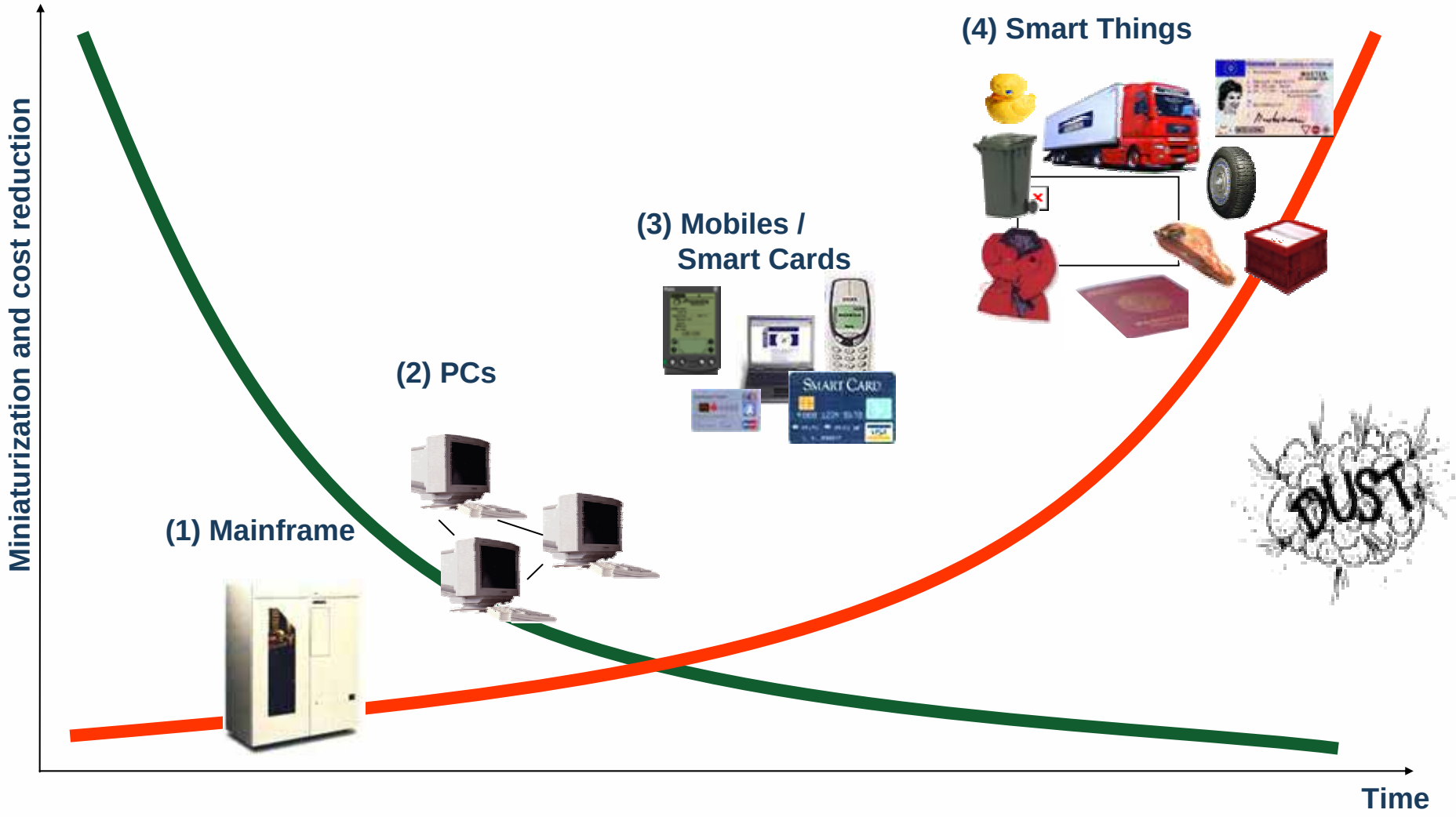
Pervasive Networked Systems: From RFID to the Internet of Things
Brussels, March 6&7, 2006

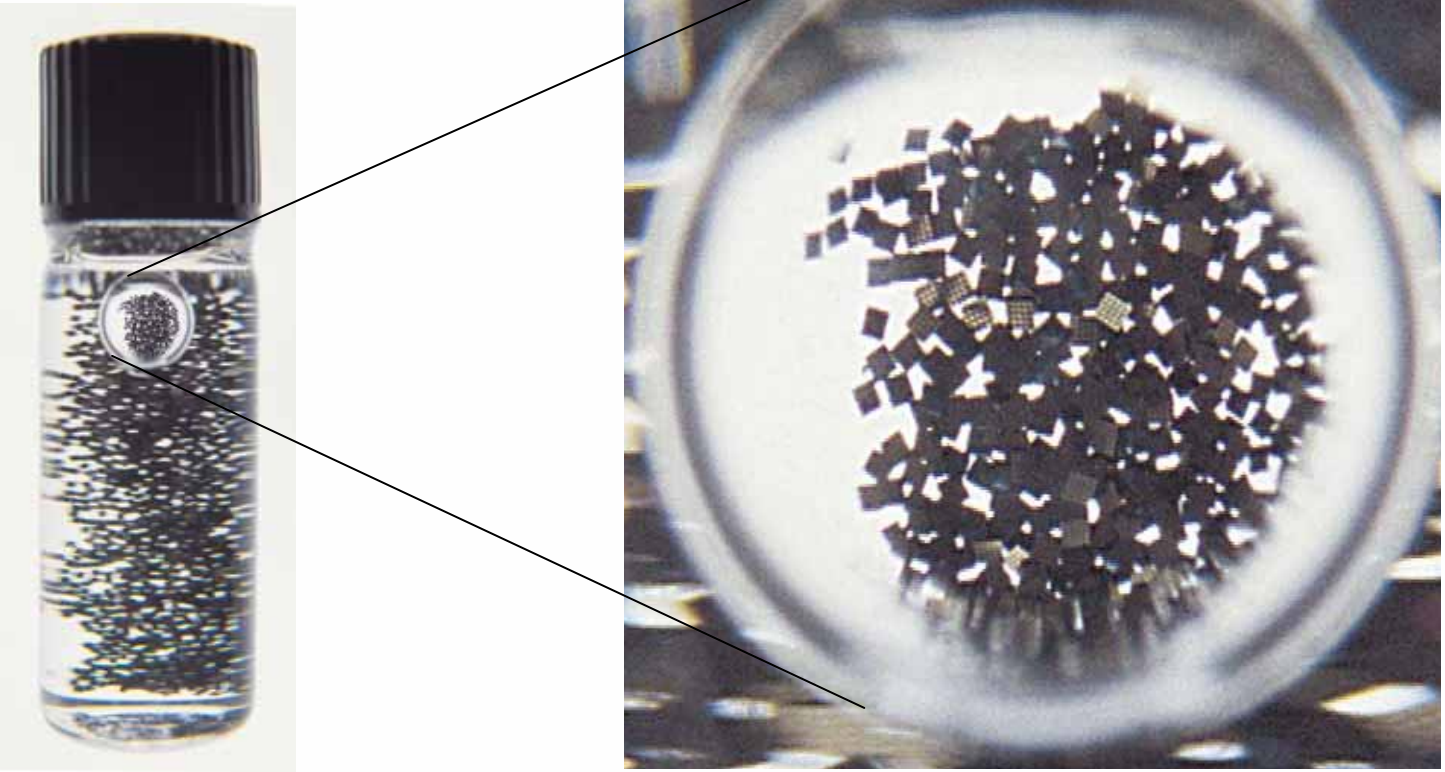
Agenda

- Technological development – Move to invisibility
- Business perspective – Tech for *High Resolution Management*
- Emerging applications – Managing „Chaos“
- Innovation Leadership – Creating competitive advantage
- Summary – Driving the future, driving growth

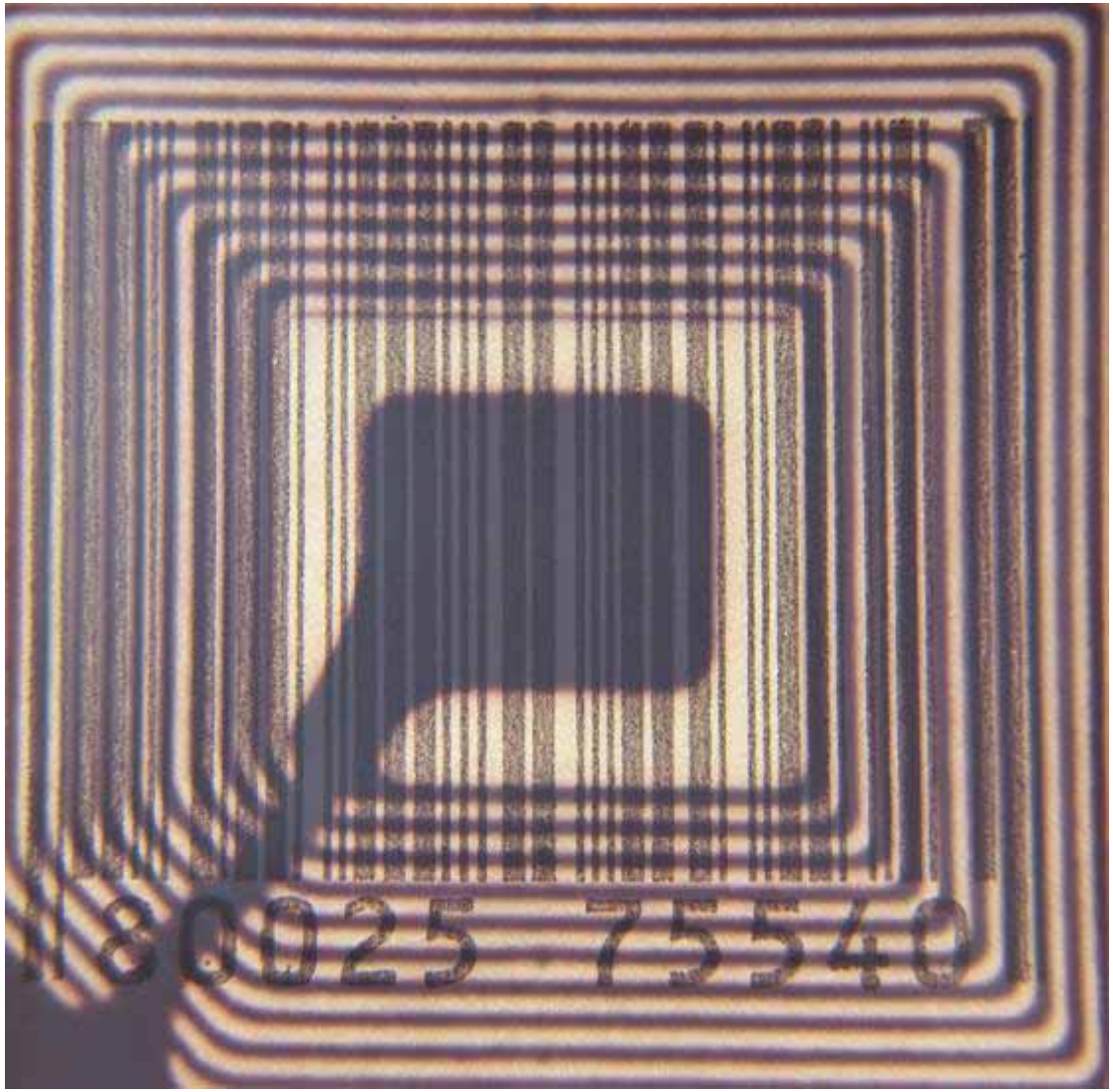
Recent advances in miniaturization, sensor & communication technology, and new materials drive for a new computing paradigm



Low cost minicomputers ...



... with mobile communication capabilities ...



… finally help to implement the vision of the Internet of Things …

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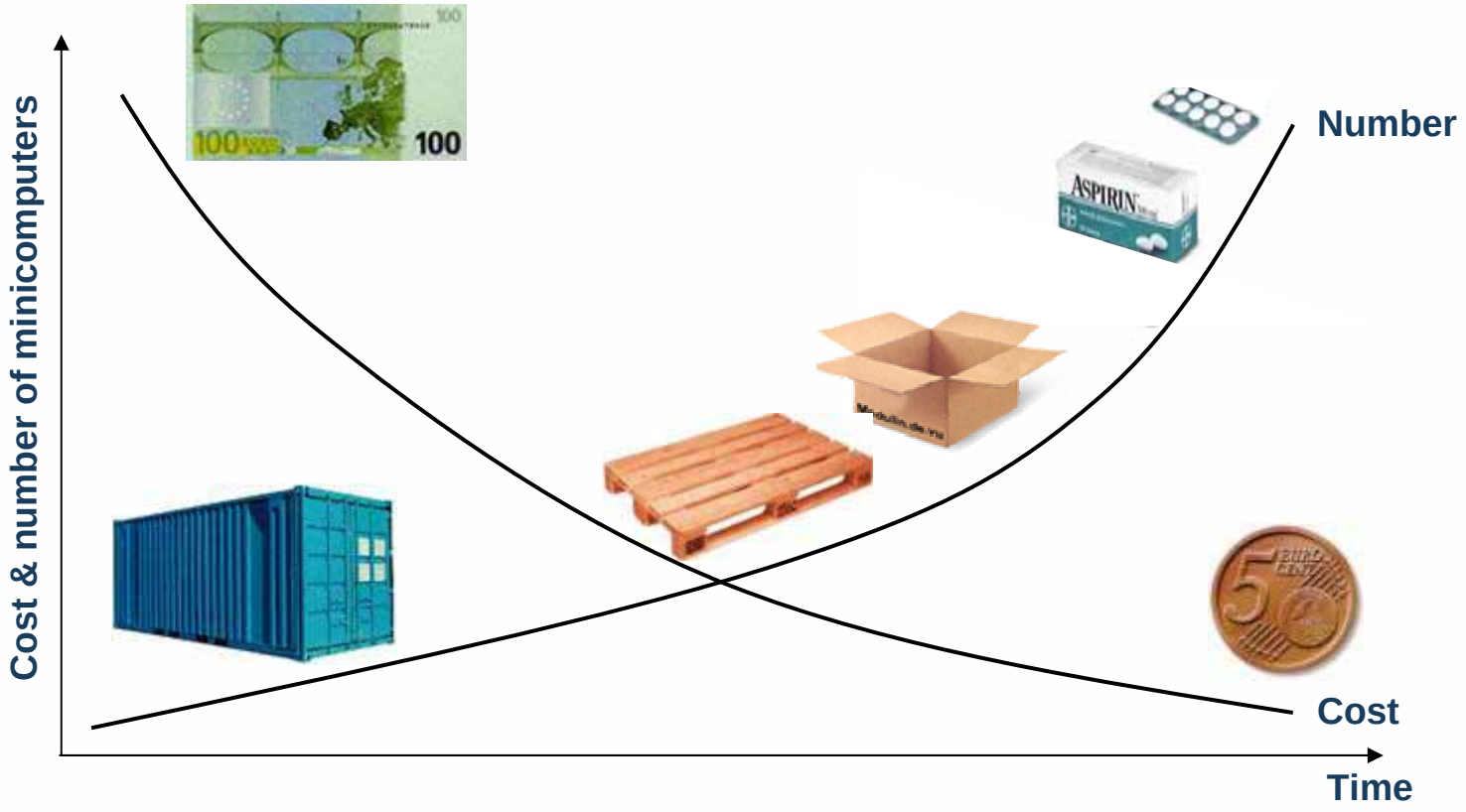
Virtual world

Real world

… where physical objects get connected automatically



RFID-adoption history: we are crossing the point of no return

- Phase 1 (<2003) – Stuck in Freedom
  - No standards
  - Closed loops
  - Niche apps
  - Low volume
  - Expensive
- Phase 2 (>2003) – Wal-Mart-Metro-Effect
  - Auto-ID Center & EPCglobal standards
  - Open loops
  - Mass apps
  - High volume
  - Cheap tech

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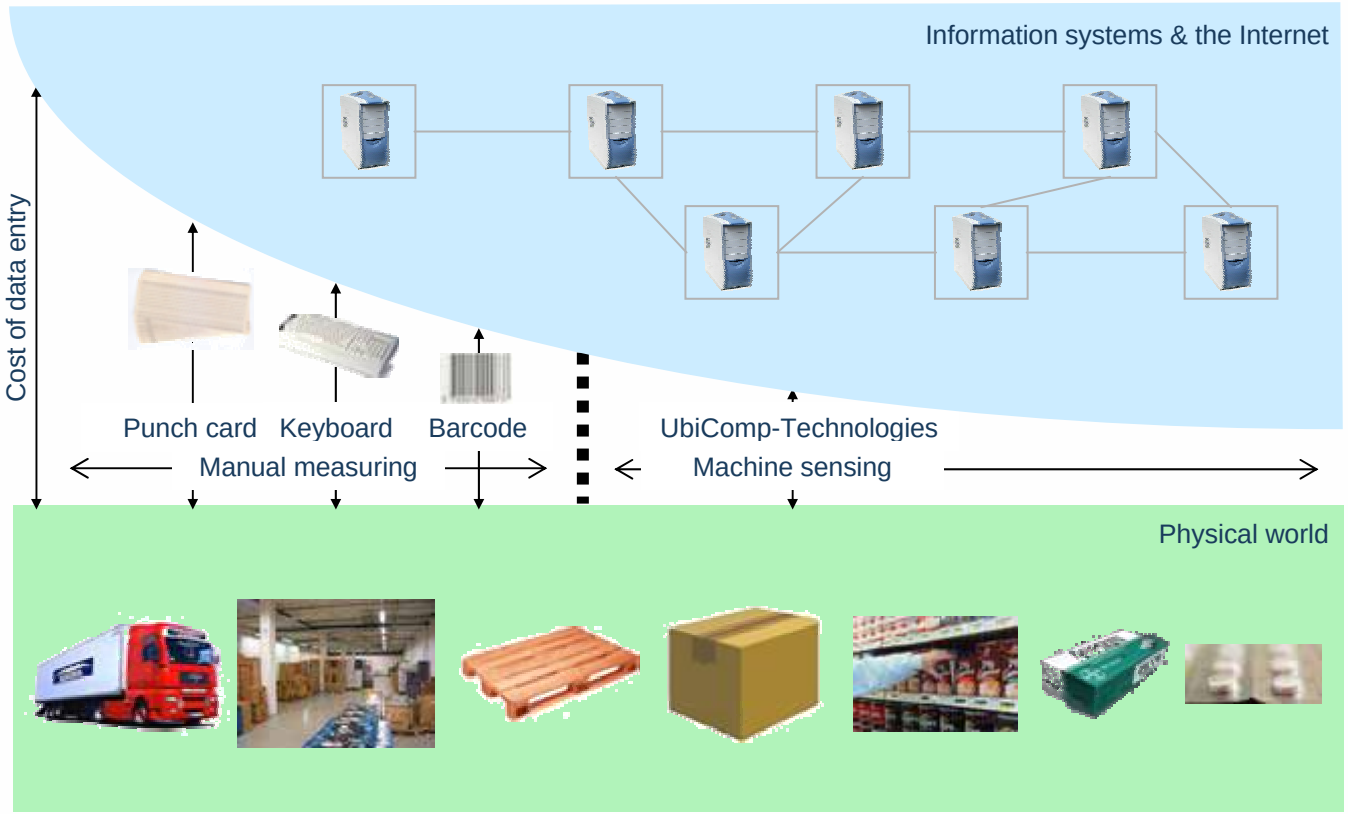
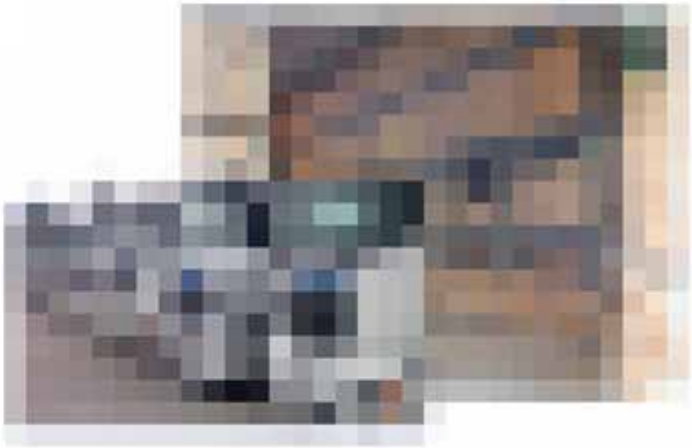
We only can manage what we can measure. The lack of automatic measurement of the real world causes many sever business problems



Today's computers have no eyes and ears and thus a rather blurred (low resolution) mapping of the physical world they are supposed to manage

Better measuring instruments change the way we see, understand and influence the world



Just as X-Rays and ultrasound advanced medicine, and as microscopes changed physics, biology, material sciences etc …

… machine sensing advances the way we do business.

ERP-systems let to BRP. E-Business-systems let to SCM etc. RFID-systems lead to High Resolution Management

Machine sensing
Smart shelf
↓
Low-cost sensing
Low cost reads
↓
Frequent sensing
1 shelf load *read* per minute
↓
Ongoing real world checks
1 shelf load *check* per minute
↓
Event-based management
If shelf load < optimal
↓
Process change
High frequency replenishment

Replenishments go up (x4)

OOS declines (0.6% of sales)

Shelf space utilization goes up

Shelf space need goes down (~50%)

Shelf safety stock goes down (~50%)

Time of “shelf in optimal load” increases

Cost

Return

Sales

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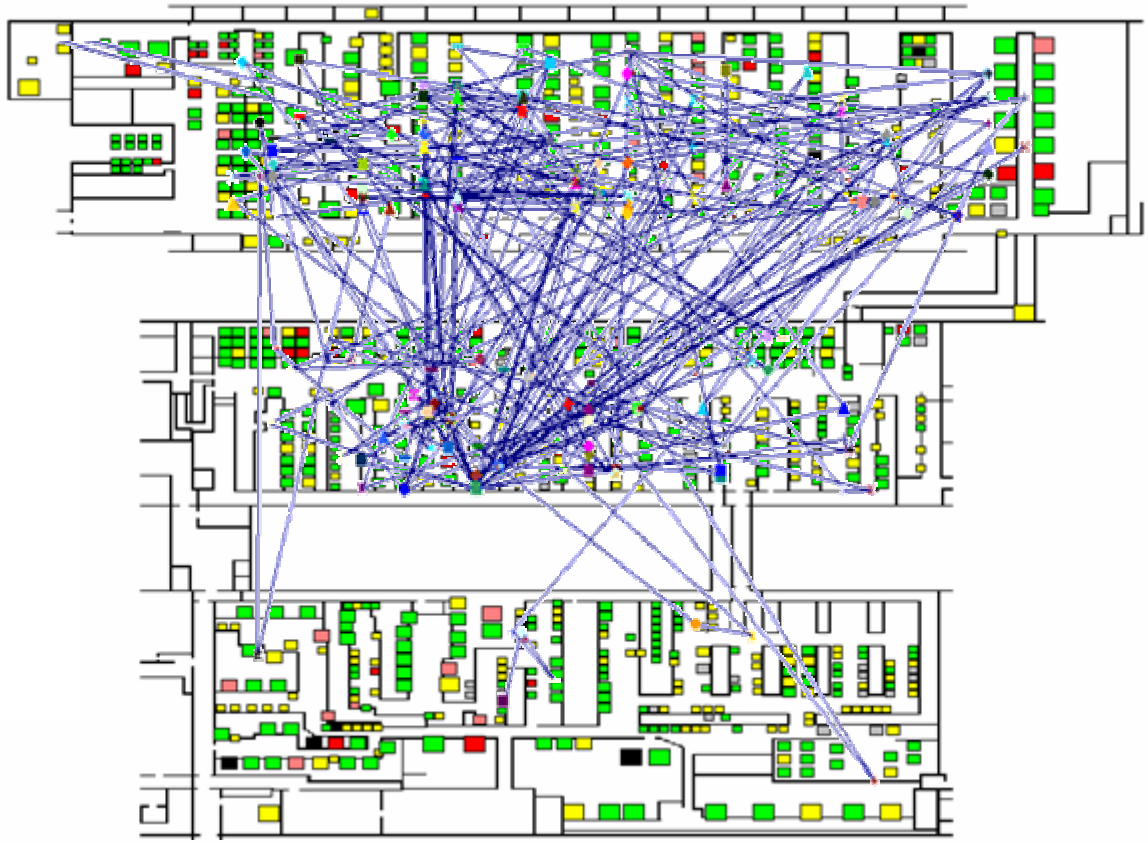
Wafer-Fab automation at Infineon: the production of logic chips …

- Investment ~1 billion €, 24x365 production, ~x000m2 clean room, ~2000 employees, ~10 billion chips per year, ~500 mio sales

Source: Courtesy of Infineon and Intellion.com

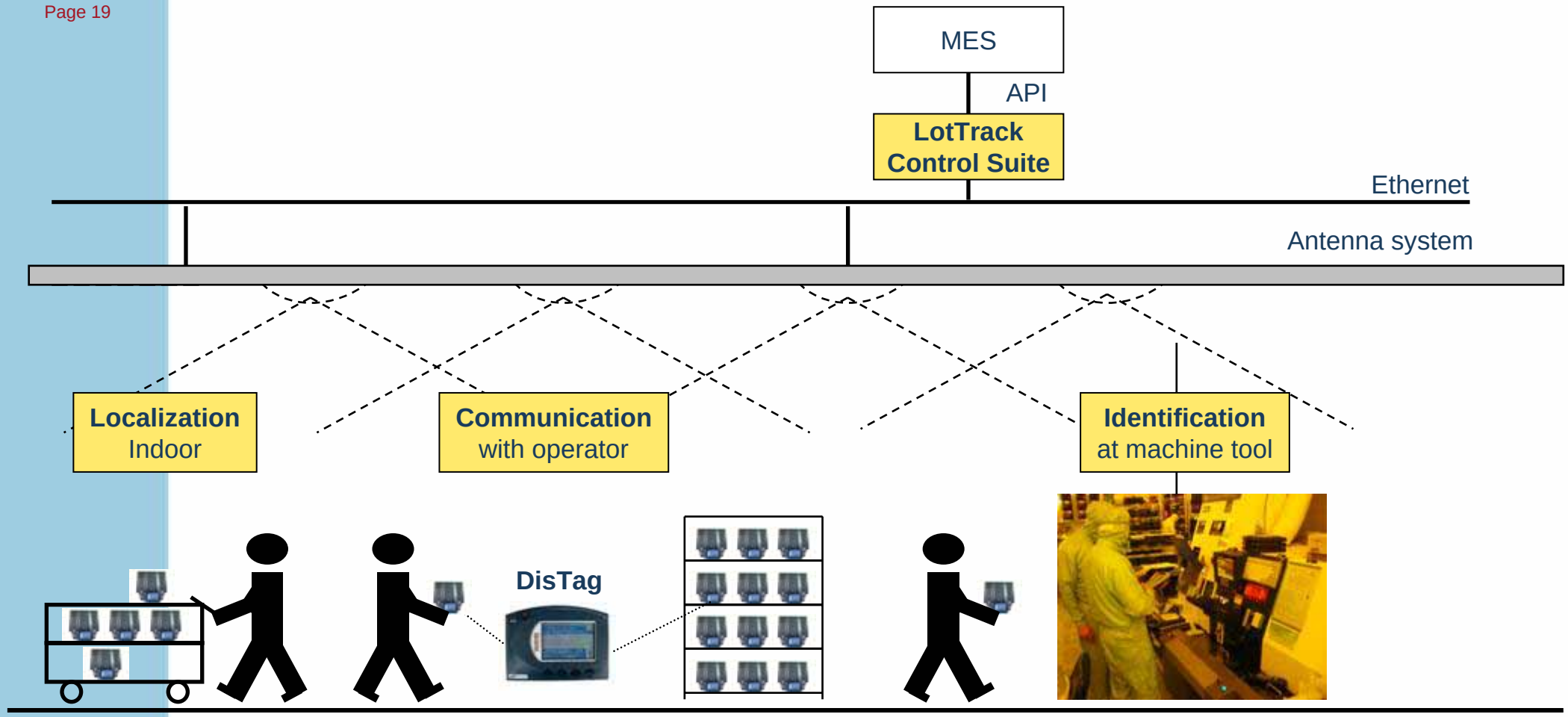
… is complex and semi-structured. A “hard” automation would not work. Instead, we went for …

- 600 machine tools, 400 process steps per lot, loops, manual transport



Source: Courtesy of Infineon

… “smart automation”, using RFID (and other technologies) for identification, location, communication, and automatic quality checks



Source: Courtesy of Intellion.com

Where to leverage this new technology in retail? Look for potentials in “weakly structured” processes (chaos), e.g. at out-of-stock, inventory reduction, order reconciliation, theft, and …

	Industry studies and trade publications									Company information			Survey results		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	∑
1. Handling efficiency	x	x	x	x		x	x	x	x	x	x	x	x	x	13
2. Out-of-stock	x		x		x	x	x	x	x	x	x	x	x	x	12
3. Inventory reduction	x	x	x				x	x	x		x*		x	x	9
3. Order reconciliation	x	x	x	x	x	x	x		x			x			9
3. Theft	x	x	x			x	x	x	x	x			x		9
6. Unsaleables		x	x				x	x	x	x					6
7. Production planning	x				x				x			x			4
7. Promotion execution					x		x	x	x						4
9. Traceability					x				x			x			3
9. Product diversion		x					x		x						3

* Improved internal inventory management

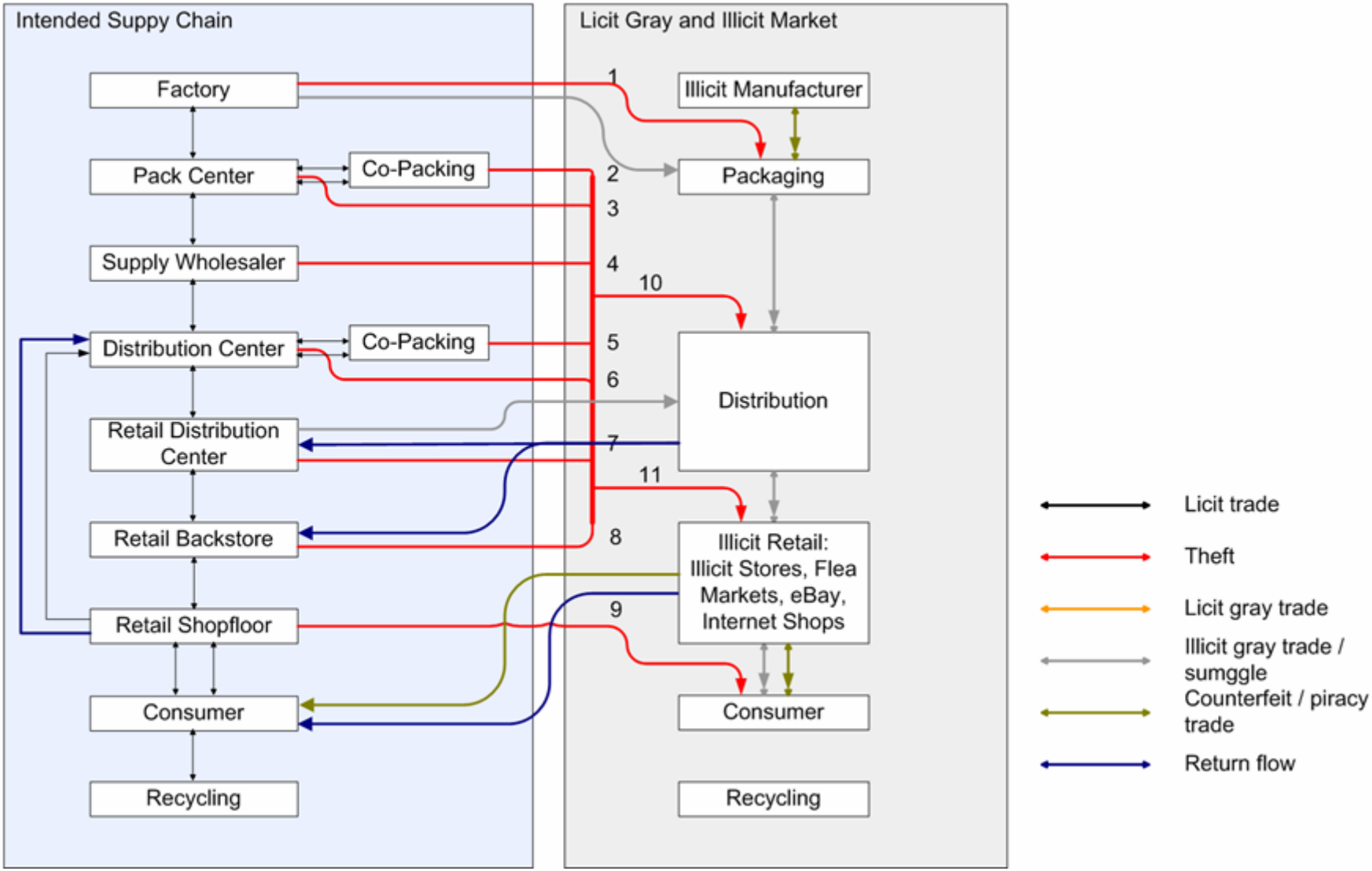
(1) Accenture 2002a; (2) A.T. Kearney 2003; (3) Behrenbeck et al. 2004; (4) CCG 2004; (5) Forrester 2004; (6) GCI 2003a; (7) GMA 2004; (8) IBM 2002a; (9) Lee et al. 2005; 1(0) Clarke, Palinkas 2003 [Tesco]; (11) Langford 2004 [Wal-Mart]; (12) Metro 2005; Ebling, Scharr 2004 [Metro]; (13) Accenture 2003b [Survey results EPC Symposium 2003; top-5 benefits retailers]; (14) Accenture 2003b [Survey results EPC Symposium 2003; top-5 benefits manufacturers]

Source: C. Tellkamp, HSG; Gartner

… sales

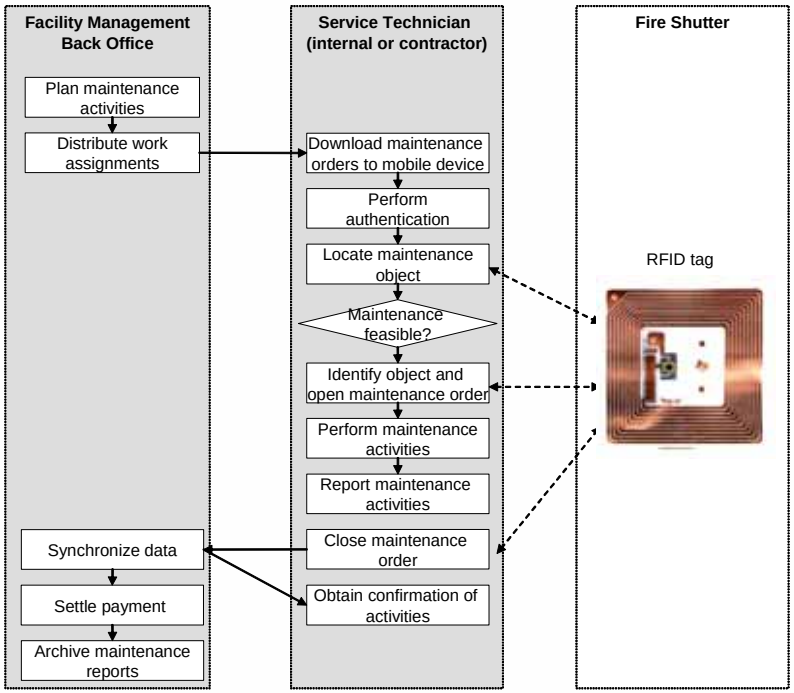
In the health care industry dabbers are automatically checked for completeness, beds for location, and patients for room access and “match” with medication

Preventing counterfeiting products, grey markets and parallel trades would help securing R&D investments, revenues and brand value



Today, customs and customers need special know-how to measure product authentication: the detection rate is humble. RFID can help here a great deal

RFID in after sales and field force automation helps to monitor products and service providers

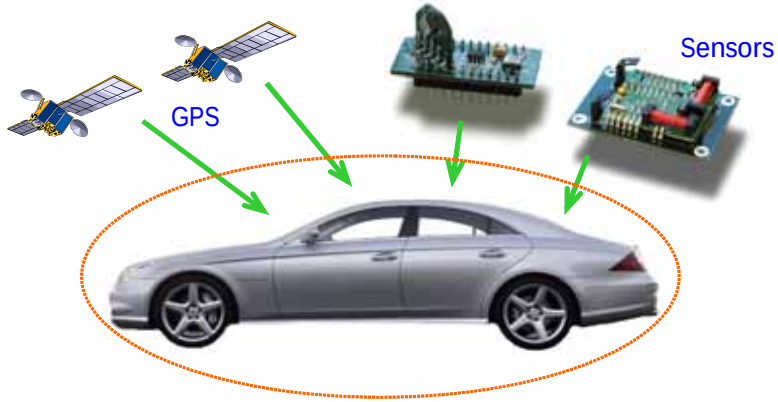


Fire shutters
Fire door
Smoke alarms (tubes, rooms)
Conveyor systems
Escape routes
Quality assurance cleaning services

Low cost sensing enables individual & dynamic risk patterns (Pay-as-you-risk), and is the basis for preventive insurance (Reduce risk)

Risk-based-pricing

Source: Courtesy of F. Mattern, ETH Zürich



Smoke detector

Water detector

Weather sensor

RFID tags in skis speed up the rental and service process, helps preventing theft and generates some red ears

Privacy concerns end where perceived benefit begins. Smart collectibles add positive emotions at home and drive sales in outlets

RFID helps to train you on a new card game, adds up scores, and detects cheating. RFID is convenient and fun

Smart playing cards

Source: Courtesy of Prof. F. Mattern, ETH Zurich

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What take the first mover risk? Why are hard benefits so hard to calculate? Gaining competitive advantage must not be easy

	Savings as % of sales		
	1975	1997	Factor
Hard benefits*	3.13	3.45	1.1 x
Soft benefits**	0.29	3.44	12 x
Cost	2.50	1.25	0.5 x
Net benefit	**0.92**	**5.64**	**6 x**

* Main benefits: Faster check-outs, reduced check-out errors / loss prevention, elimination of price marking

** Main benefits: Automatic reorder, shrink control, improved warehouse operations, improved DSD control; inventory reduction and sales increase

Table III-1: Estimated benefits of the barcode 1975 and 1997[5]

Source: C. Tellkamp, HSG; Gartner

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Still, we are only a the very beginning of computerizing this very world

- Industrial robot
  - In production environment since 1960
  - Today 800.000 robots world wide; market 5.6 bio USD with 7% average growth rate
  - Growth 2002 -> 2003: 26%
  - Cost decline 2002:1990 -> 1:5
  - Surveillance

- Home robotic
  - 2006 home robotic market > industrial market
  - Vacuum cleaner: iRobot`s Roomba (sold 200.000 times), Electrolux, Karcher
  - Lawn mower: Husqvarna
  - Toys / Surveillance: Sony's Aibo

Progress has no alternative

- The Internet of Things for the first time connects the physical world with computers
- It is the logical next step in enterprise computing
- It generates massive business potentials
- *Innovators* have to deal with the Internet of Things *today* to secure their competitive advantage (and work) *tomorrow*
- *European First Movers* are key for building a truly global infrastructure for the Internet of Things (EPC-network), not an US-centric

Many Thanks

- Literature
  - Fleisch, E., Mattern, F., Das Internet der Dinge, Springer, 2005
- Further information
  - www.m-lab.ch
  - www.autoidlabs.org
- Contact
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