Prima Giornata del Triveneto
5 ottobre 2018

GIORNATE del TRIVENETO

Associazione dei Dottori Commercialisti e degli Esperti Contabili delle Tre Venezie

POLITECNICO MILANO 1863

SCHOOL OF MANAGEMENT

OSSERVATORI.NET digital innovation

Data Economy and the Fourth Industrial Revolution

Giovanni Miragliotta

Osservatorio Industria 4.0
Osservatorio Internet of Things
Osservatorio Artificial Intelligence

Vicenza 05.10.18

#OI40

Agenda

- Data Economy and the Fourth Industrial Revolution
- The leading actor: the Internet of Things
- The value of data: tactical perspective
- The value of data: strategic perspective
- The world upside down
- New world, new skills, new roles

Data Economy

"Data are to this century what oil was to the last one: a driver of growth and change. Flows of data have created new infrastructures, new businesses, new monopolies, new politics and —crucially—new economics.

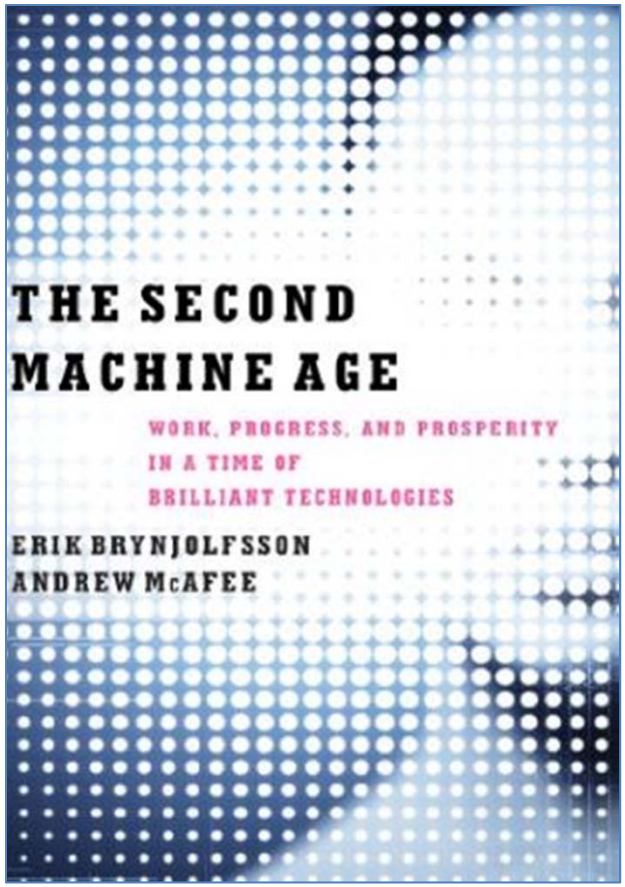
Digital information is unlike any previous resource; it is extracted, refined, valued, bought and sold in different ways.
It changes the rules for markets and it demands new approaches from regulators.

Many a battle will be fought over who should own, and benefit from, data."

May, 2017

Data Economy

"Instant, perfect, free" →



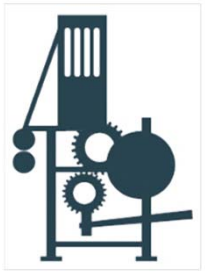
"Winner takes it all" ←

Data Economy so far….

Fonte: Cumulus Media, Ott 2017

…and now enter The Fourth Industrial Revolution

First Industrial Revolution	Second Industrial Revolution	Third Industrial Revolution	Fourth Industrial Revolution
Steam power, machines in factories	Labor organization, mass production, use of electricity	Automation / robots in factories, computers / SW in business processes	Interconnected digital and physical world thanks to new digital technologies



1780	1870	1970	2011	TIME
First loom powered by steam	First assembly line (1870)	First PLC (1969)	First appearance of "Industrie 4.0"	

The Fourth Industrial Revolution

Industry 4.0

Smart Connected Product

The Fourth Industrial Revolution

Definition

Industry 4.0 is a vision of the future of Industry and Manufacturing in which Digital Technologies are going to boost competitiveness and efficiency by interconnecting every resource (**data, people and machinery**) in the Value Chain

SMART MANUFACTURING TECHNOLOGIES

Industrial Internet of Things

Advanced Human-Machine Interface

Industrial Analytics

Advanced Automation

Cloud Manufacturing

Additive Manufacturing

Operational Technology

Information Technology

The Fourth Industrial Revolution

The playground

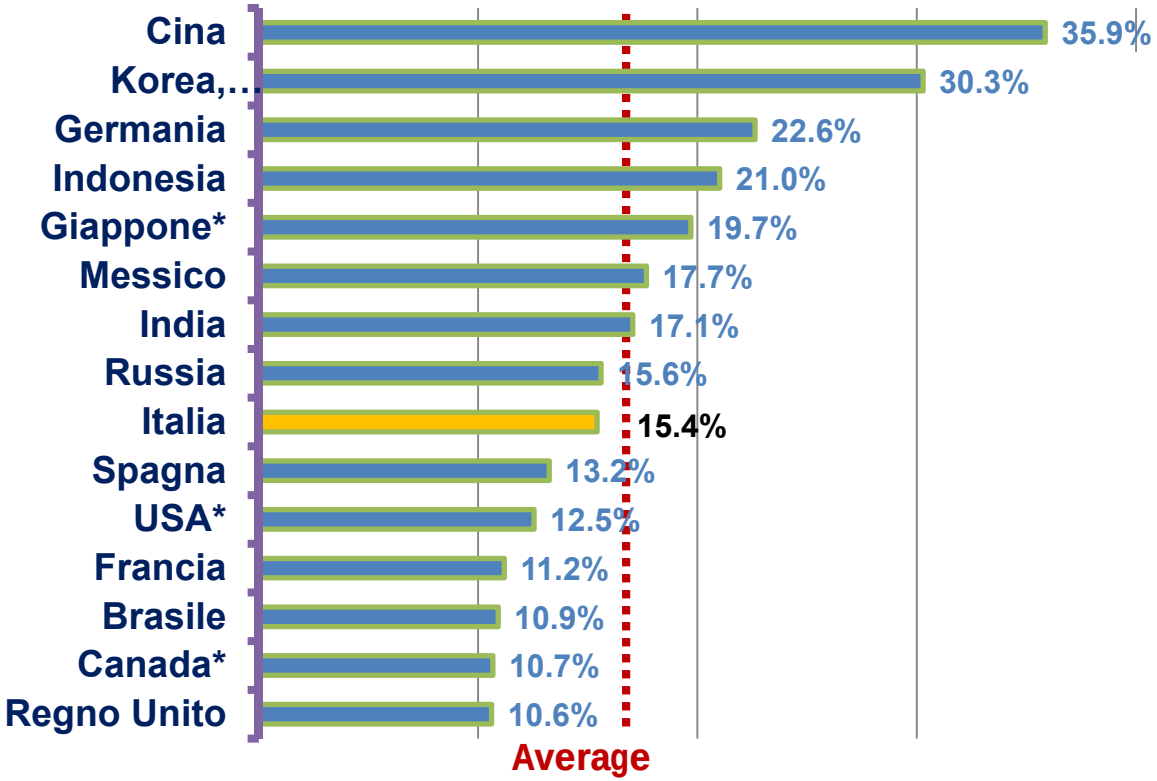
PROCESSES

	Smart Lifecycle	Smart Supply Chain	Smart Factory
SMART TECHNOLOGIES			
Cloud Manufacturing	• New Product Development • Product Lifecycle management • Suppliers Relationship Management	• Production & Distribution Planning • Supply Chain Event Management • Suppliers Relationship Management	• Production Management • Logistics Management • Maintenance Management • Quality Management • Safety & Compliance
Industrial Analytics			
Industrial IoT			
Advanced HMI			
Advanced Automation			
Additive Manufacturing			

Why Manufacturing is so important?

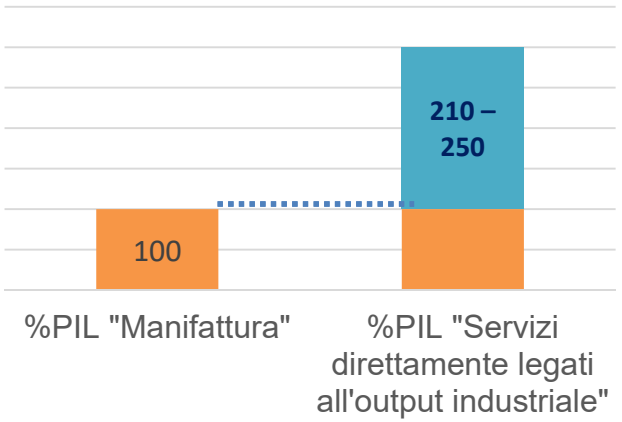
1 – Economic reasons

Manufacturing as a % of GDP – 2014



Source: The World Bank (2013)

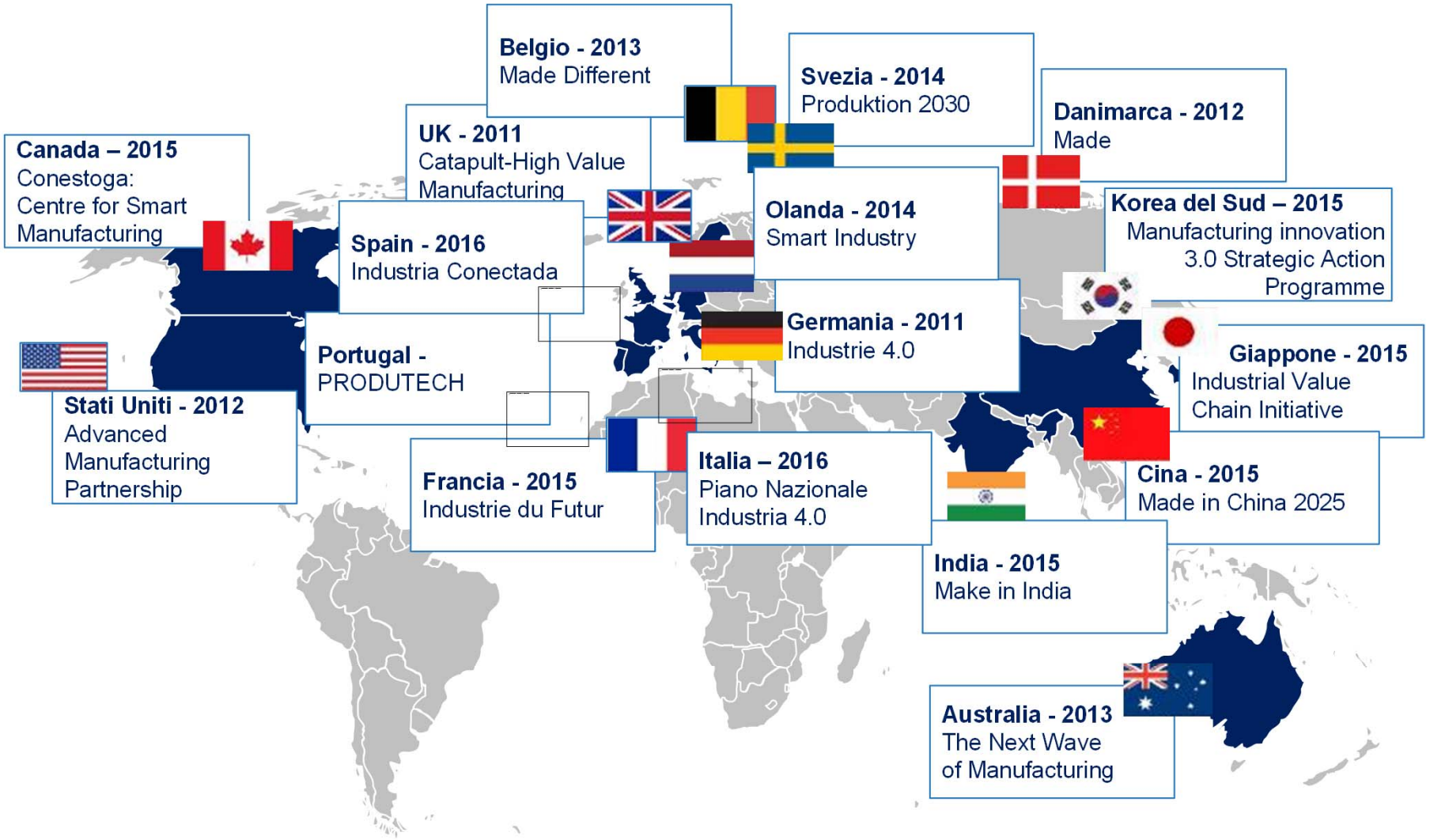
Services for manufacturing (Italy, 2014)



Source: ISTAT, Rapporto di competitività 2014

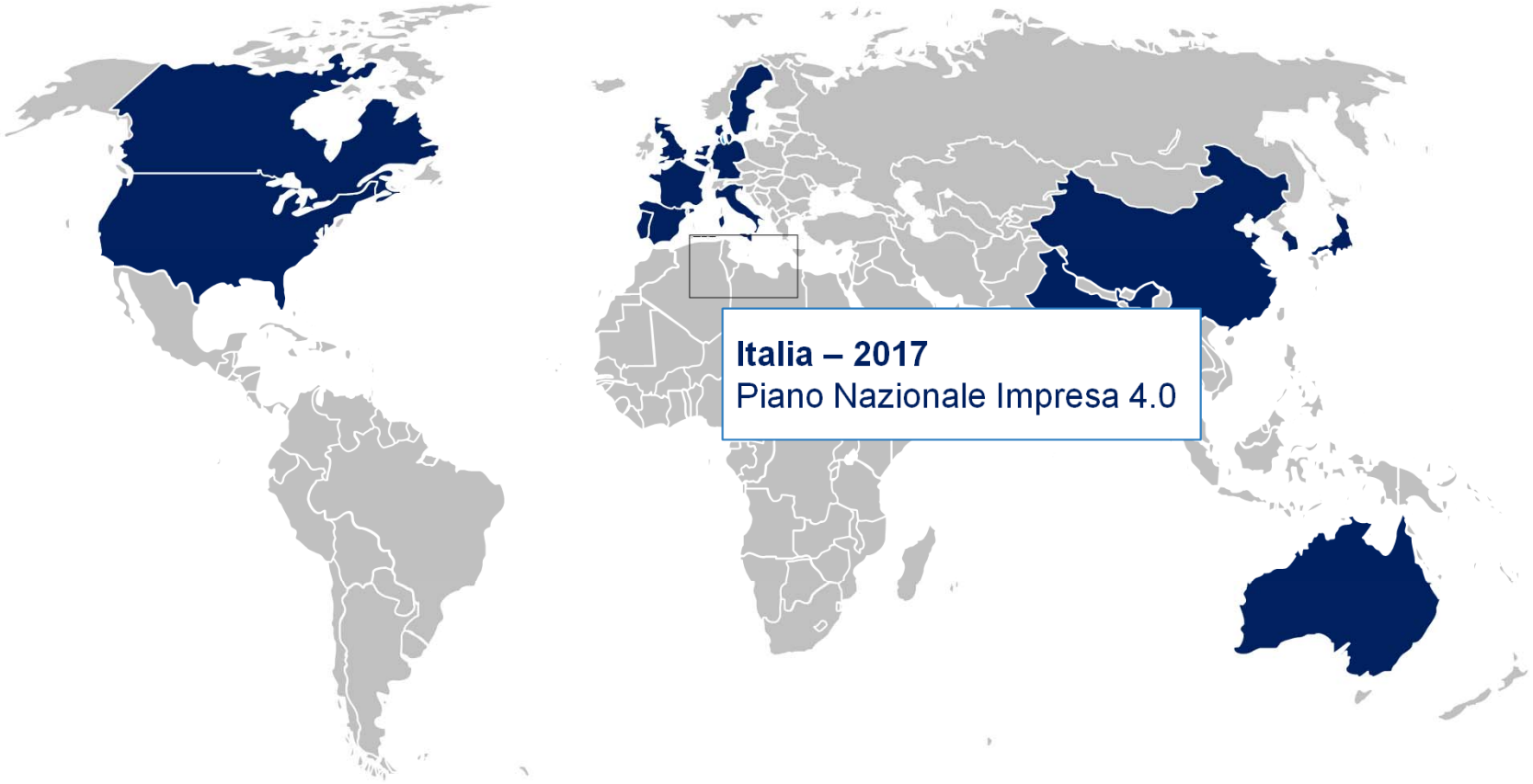
The Fourth Industrial Revolution

Governments' programs



The Fourth Industrial Revolution

Governments' programs



14

Agenda

- Data Economy and the Fourth Industrial Revolution
- The leading actor: the Internet of Things
- The value of data: tactical perspective
- The value of data: strategic perspective
- The world upside down
- New world, new skills, new roles

The leading actor: the Internet of Things

Back to where it all began: RFId

The baby IoT

RFId (Radio Frequency Identification) is a technology for the automatic identification of objects (animals and/or people) through RF communication, by using smart tags(*)

(*) autonomous power supply, embedded software

Back to where it all began: RFId

The Walmart mandate (2003)

Wal-Mart Expands RFID Mandate

The world's largest retailer says that it will ask *all* suppliers to tag pallets and cases by the end of 2006.

By Bob Violino

Tags: Manufacturing, Retail, Standards

PDF | Email | Print | Definitions | Save Article

Like 1 | Tweet 0 | Google +1 0 | Share 0

Aug 17, 2003—Aug. 18, 2003 – If anyone still has any doubts that Wal-Mart is serious about deploying RFID technology in its supply chain, they should be dispelled by its latest revelation. The world's largest retailer says it will require all suppliers to put RFID tags carrying Electronic Product Codes on pallets and cases by the end of 2006.

"We have asked our 100 top suppliers to have product on pallets employing RFID chips and in cases with RFID chips," says Wal-Mart spokesman Tom Williams. "By 2006, we will roll it out with all suppliers."

Back to where it all began: RFId

The Walmart mandate (2007-2009)

October 2007: Wal-Mart announces a major change in its RFID strategy, largely abandoning the initial pallet/case focus on shipments going to Wal-Mart stores in favor of three focus areas: (1) shipments going to Sam's Club; (2) promotional displays and products going to Wal-Mart stores; (3) tests to see RFID's impact in improving category management in select areas. "We're coming at RFID from a different angle," Wal-Mart's VP of Information Technology, **Carolyn Walton**, says at the EPC Global conference.

January 2008: Wal-Mart announces its first real compliances "penalties" for failure to tag products, specifically for shipments to its Sam's Club chain. Wal-Mart says in letter to suppliers that a failure to tag pallets sent to its distribution center in DeSoto, Texas, or directly to one of its stores served by that DC after January 31 will be charged a service fee, starting at $2 per untagged pallet on Feb. 1, and capping at $3 per pallet on Jan. 1, 2009.

Wal-Mart also announced its plans for the Sam's Club rollout (later changed):

- Jan 30, 2008: pallet-level tagging for DeSoto, Tex., distribution center.
- Oct. 31, 2008: pallet-level tagging for an additional four distribution centers, case- and mixed-pallet level tagging for Texas distribution center.
- Jan. 30, 2009: pallet-level tagging for remaining 17 distribution centers, case- and mixed-pallet level tagging for an additional four distribution centers.
- Oct. 31, 2009: case- and mixed-pallet level tagging for the remaining 17 distribution centers; selling-unit -level tagging for Texas distribution center.
- Jan. 30, 2010: selling-unit-tagging for an additional four distribution centers.
- Oct. 31, 2010: selling-unit-tagging for remaining 17 distribution centers

January 2009: Sam's Club dramatically lowers penalties for failure to tag pallets from $2-3 dollars per pallet to just 12 cents – what Wal-Mart estimates it will cost Sam's to do the tagging itself. It also pushes back the rollout schedule announced the previous January, saying the tagging requirement will apply only to pallets sent to the DeSoto DC or stores served by that DC in 2009. DC. Pallet-level tagging is expected to be rolled out chain-wide in 2010, while the deadline for tagging sellable units is "under review."

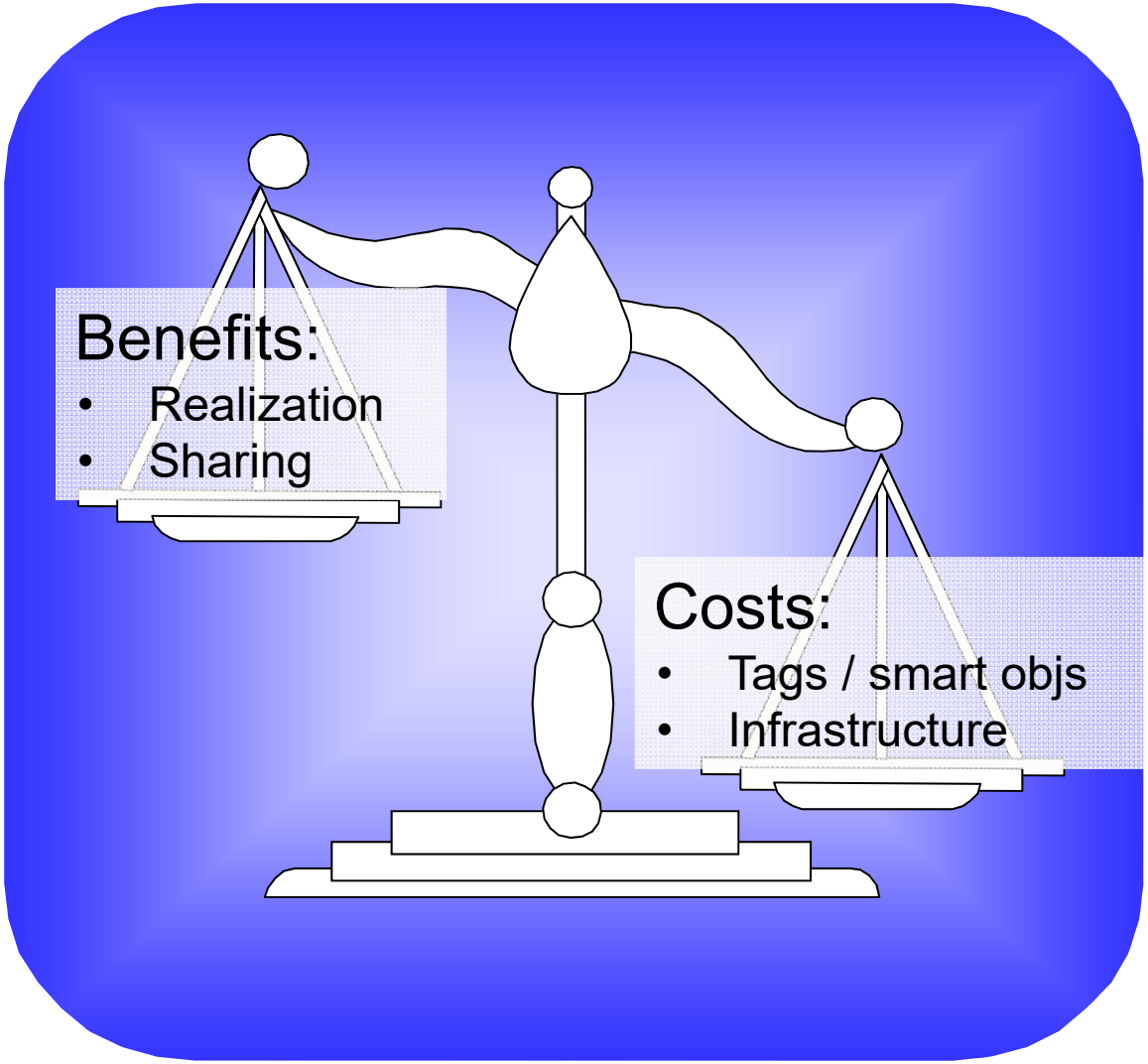
February 2009: Procter & Gamble says that after "validating" the benefits of RFID in merchandising and promotional displays, it is ending its pilot program with Wal-Mart for those displays, implying Wal-Mart is not acting on the information to improve store execution.

Why these failures?

The technology performances

Why these failures?

The business reasons



Why these failures?

The technology architecture

Level 3

Data center and application

- Network management platforms
- Data storage and elaboration

Level 2

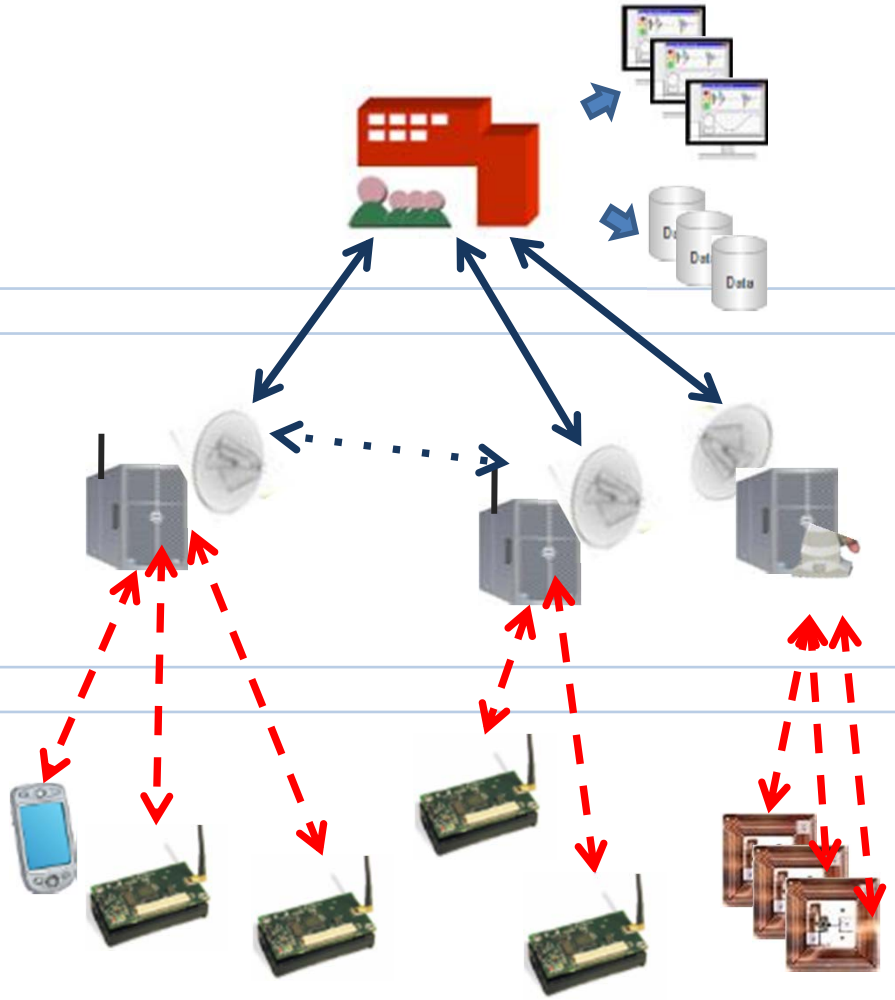
Mediation

- Gateway, repeaters

Level 1

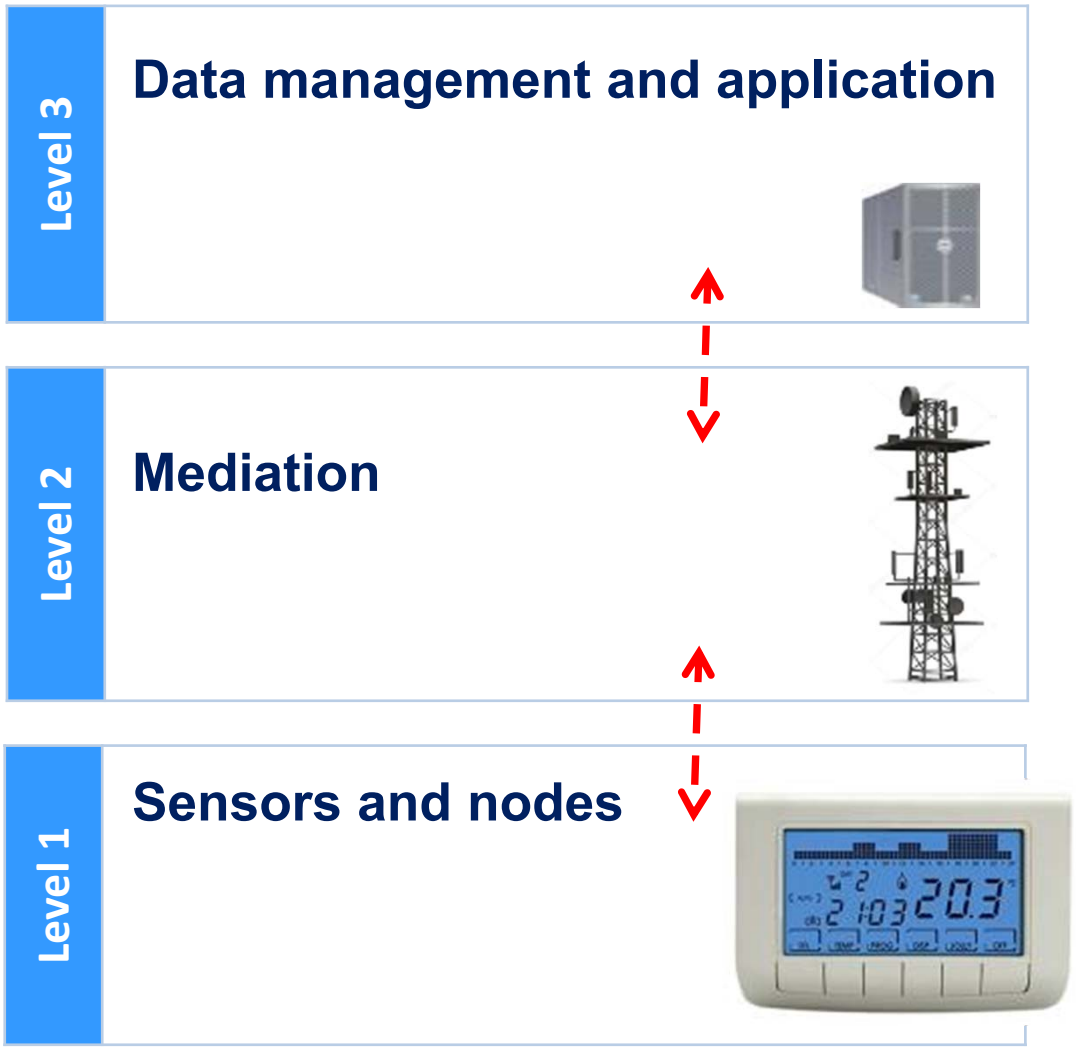
Sensors and nodes

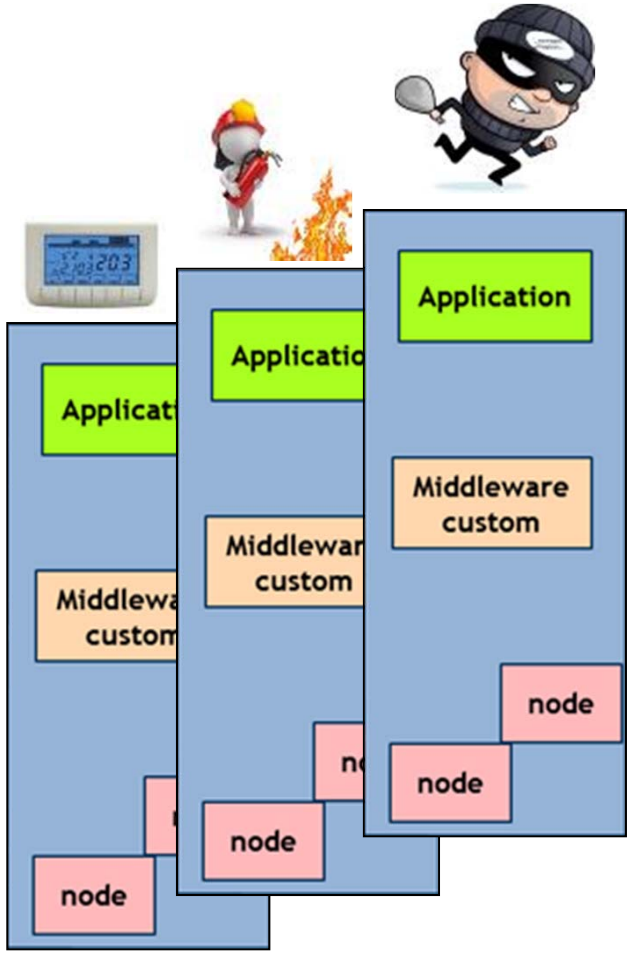
- Smart objects
- Widespread and pervasive
- Energy and/or band limitations



Why these failures?

The technology architecture

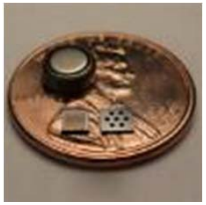




What has changed in 15 (exciting!) years

HW & Technology – New Sensors and New Sensing

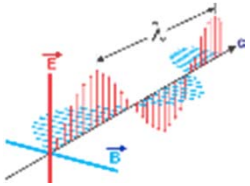
New Sensors




New Sensing

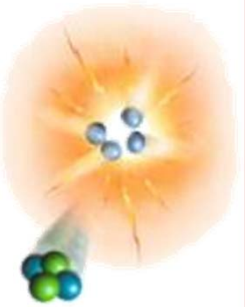
Video analysis

Electromagnetic field



Network devices

Sensing fusion



Sound and vibrations

Smart meters

Connected appliances

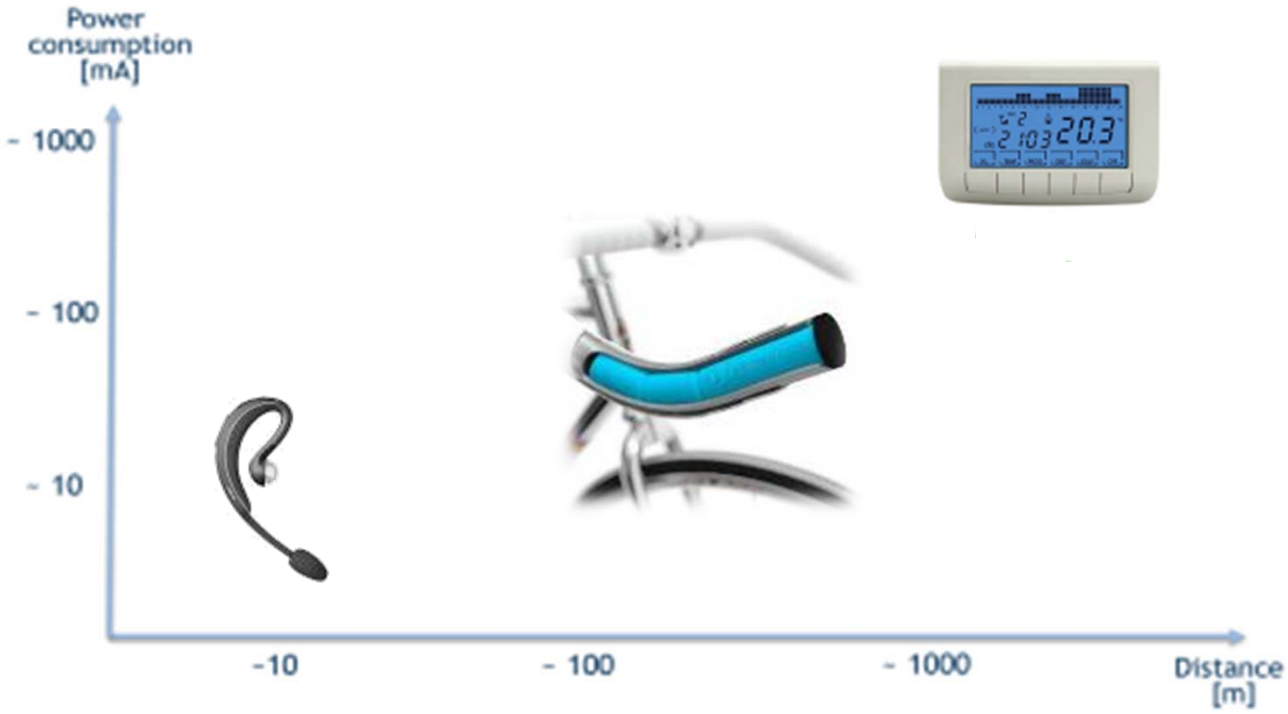
What has changed in 15 (exciting!) years

HW & Technology – New Sensors

- What does "sensors" mean?

What has changed in 15 (exciting!) years

New Networks



What has changed in 15 (exciting!) years

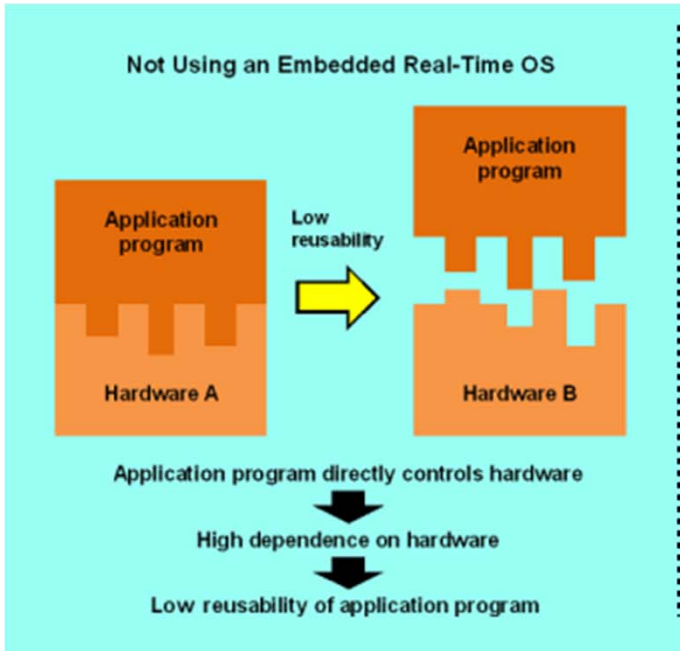
New processors

Computing power

What has changed in 15 (exciting!) years

The advent of real time OS

- End-devices/sensors become capable to run Operating Systems
- Why is this important?

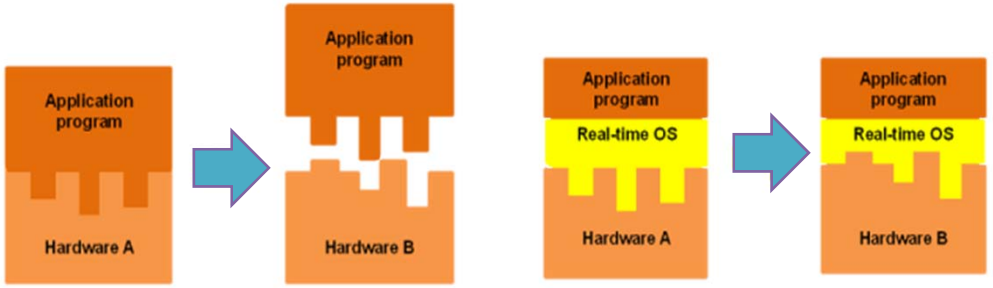


"Outsource" generic tasks to the OS (ex: connectivity, security, sensors, ...)

Focus on the **application**!

What has changed in 15 (exciting!) years

The advent of real time-OS



The battle for Real Time-OS

Open Source (RT)OS

RIOT OS

Linux

freeRTOS

ARMmbed

Offerte dei big players

Embedded Apple iOS

Windows 10 IoT

Google Brillo OS

Weave

RTOS Commerciali

Nucleus RTOS

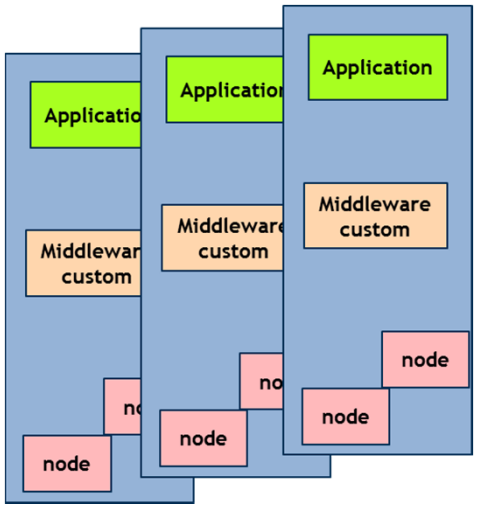
WindRiver VxWorks

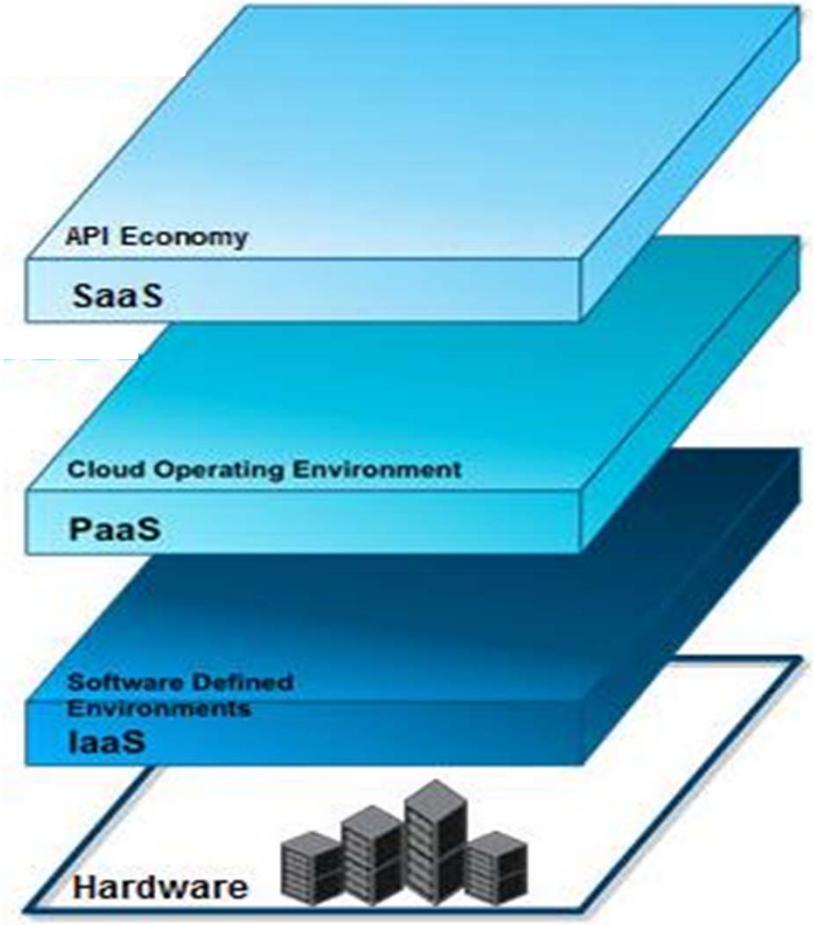
Green Hills Integrity

What has changed in 15 (exciting!) years

IoT Platforms (special thanks to cloud!)

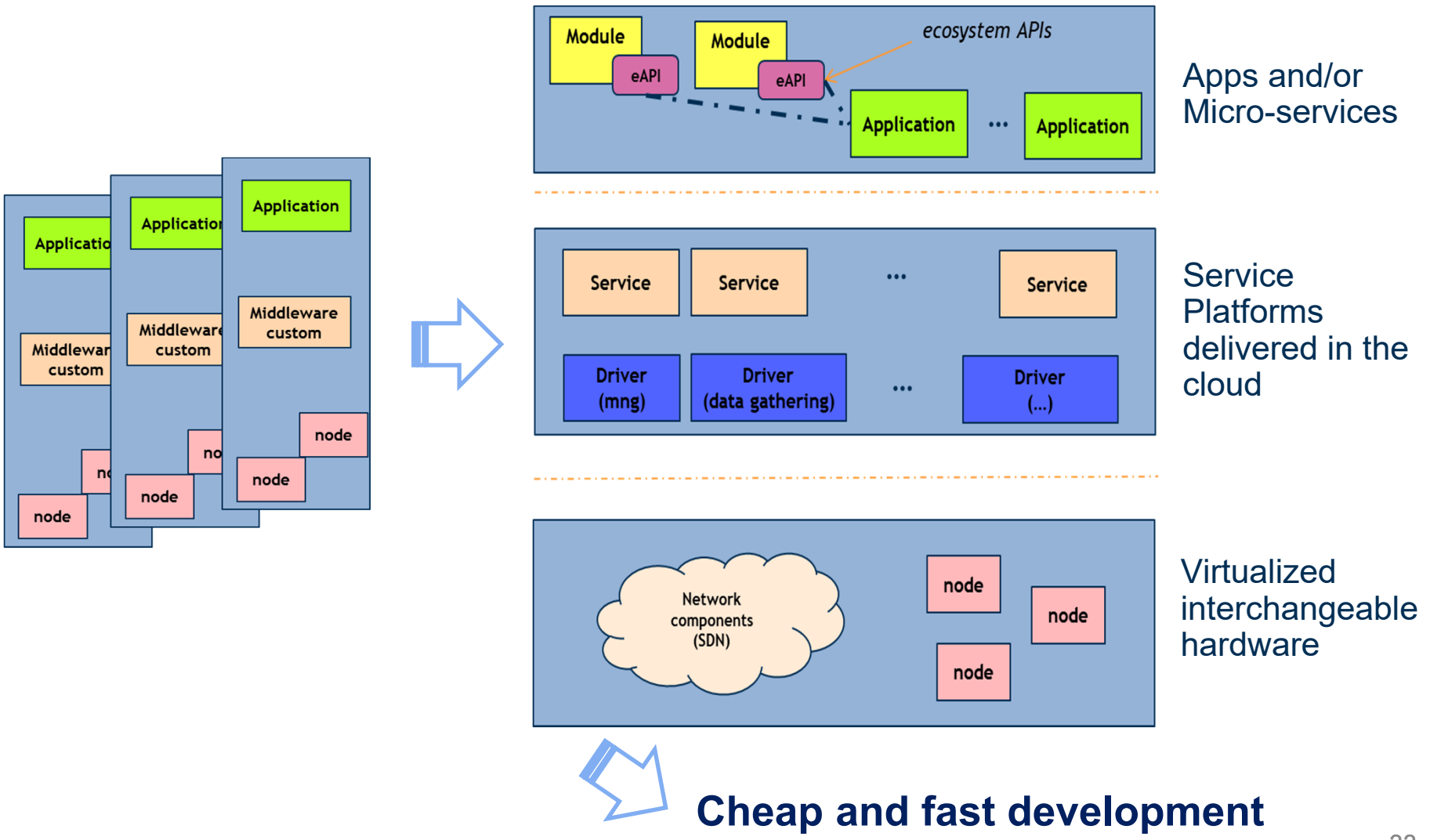
From a *vertical* to a *horizontal approach*





What has changed in 15 (exciting!) years

IoT Platforms (special thanks to cloud!)



Now IoT means business…

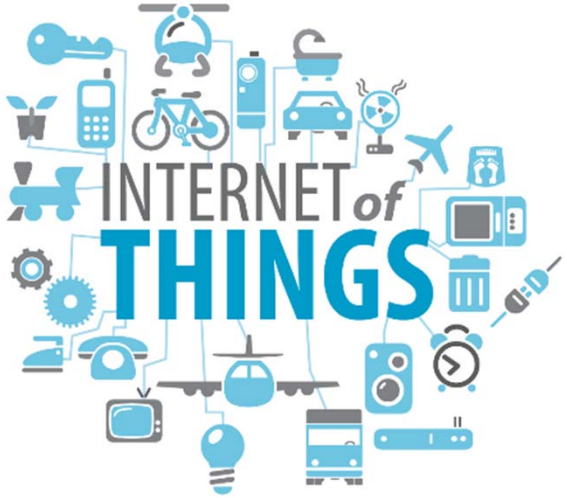
Now IoT means business…

Agenda

- Data Economy and the Fourth Industrial Revolution
- The leading actor: the Internet of Things
- The value of data: tactical perspective
- The value of data: strategic perspective
- The world upside down
- New world, new skills, new roles

Value from data: a generalised picture

A
Processes optimisation



E
Business Enlargement

B
New generation of product / service

D
Data Reselling

C
Customised product / service

A) Processes optimisation

Examples

Products location on shelves

Counting visitors

Cleaning services

Beacons / Cameras to collect data on customers path

RFId tags / Cameras to monitor products

Stock replenishment

Sale assistant (e.g. availability)

B) New generation of product / service

Using data regarding the usage of IoT objects to develop product / service improved versions

USE CASE

Development of a new video-door phone characterised by better usability

C) Customised product / service

Examples

Customised product / service

A

B

C

Grasp the needs of the individual, and go with a tailor-made offer

Example: utility

On the basis of energy consumption of the home you can give advice to users to reduce waste and/or define custom contracts

D) Data reselling

Examples

Beacons to collect data about how much time customers spend looking for items, data which are then sold to third parties

Fashion retailer

Selling to manufacturers information regarding customers behaviour (e.g. most tried on clothes for the development of future collections)

E) Business Enlargement

Examples

Business Enlargement

A

B

C

D

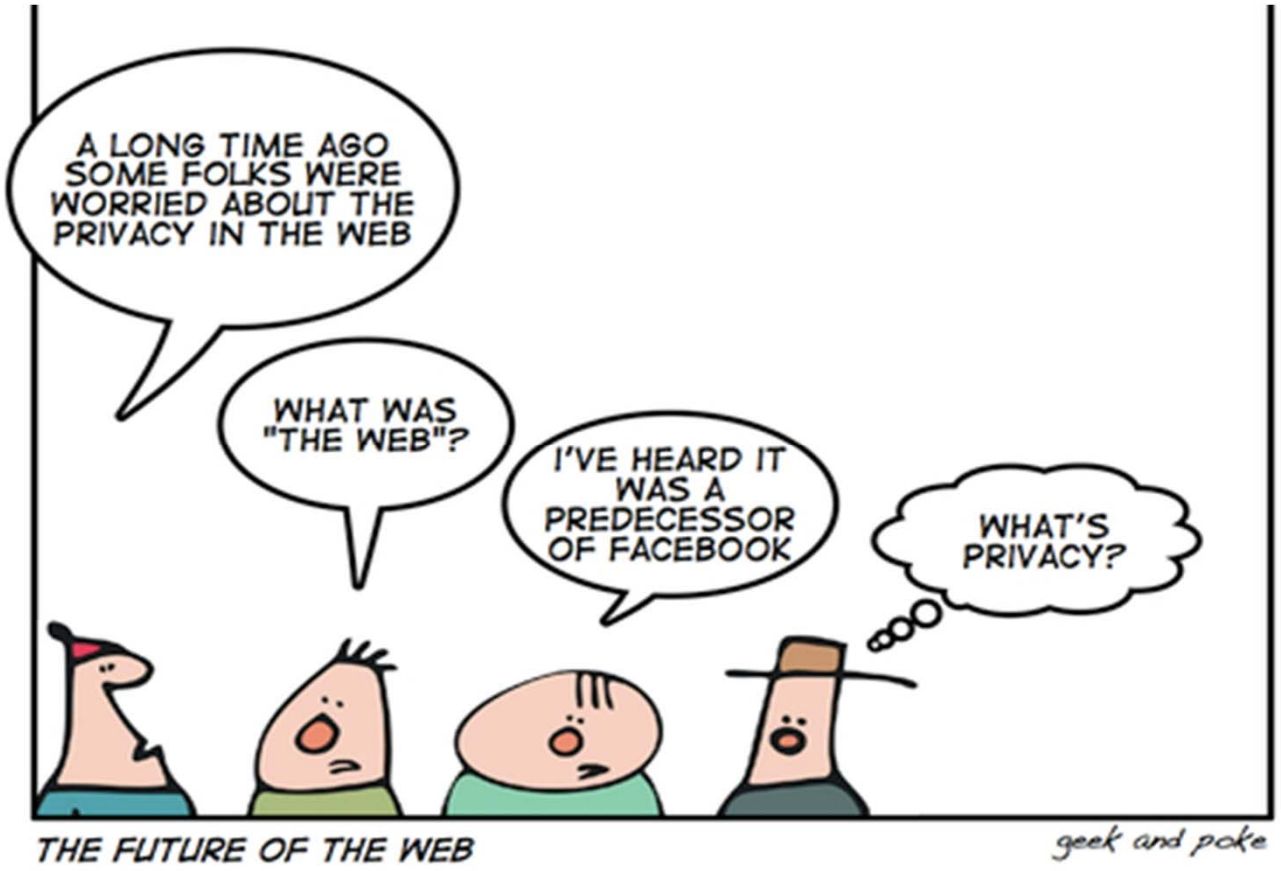
E

Cross Selling and In-thing purchases

The dishwasher checks the consumption of detergent and manages automatic re-orders

The refrigerator detects a problem and has a premium feature to self-fix it.

What about consumers privacy?



Agenda

- Data Economy and the Fourth Industrial Revolution
- The leading actor: the Internet of Things
- The value of data: tactical perspective
- The value of data: strategic perspective
- The world upside down
- New world, new skills, new roles

Smart Connected Products

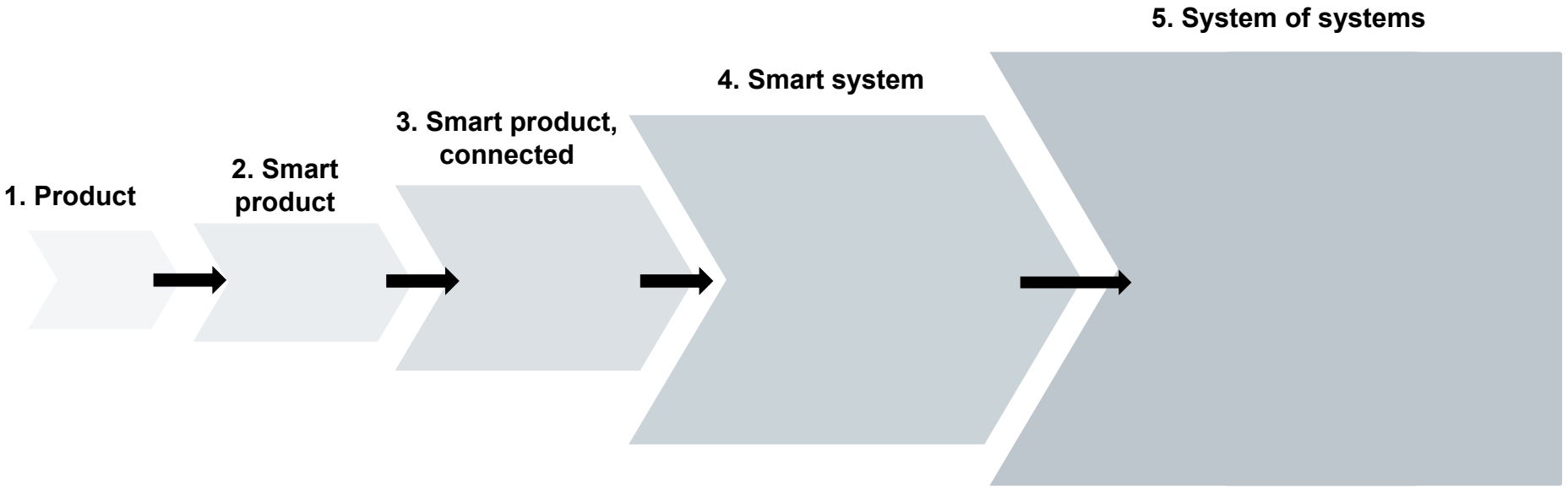
Porter M. E., Heppelmann J.E., "How Smart Connected Products Are Transforming Competition, HBR, November 2014

"Now IT is becoming an integral part of the product itself. Embedded sensors, processors, software, and connectivity … coupled with a **product cloud** in which product data is stored and analyzed and some applications are run, are driving dramatic improvements in product functionality and performance. …

… this **will reshape the value chain yet again**, by changing product design, marketing, manufacturing, and after-sale service and by creating the need for new activities…."

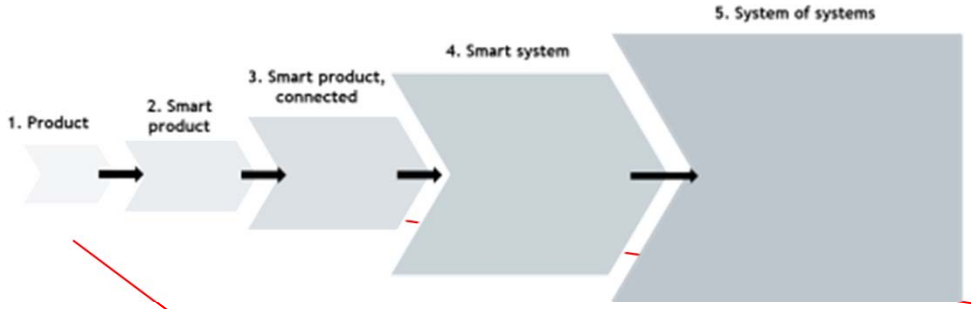
Smart Connected Products

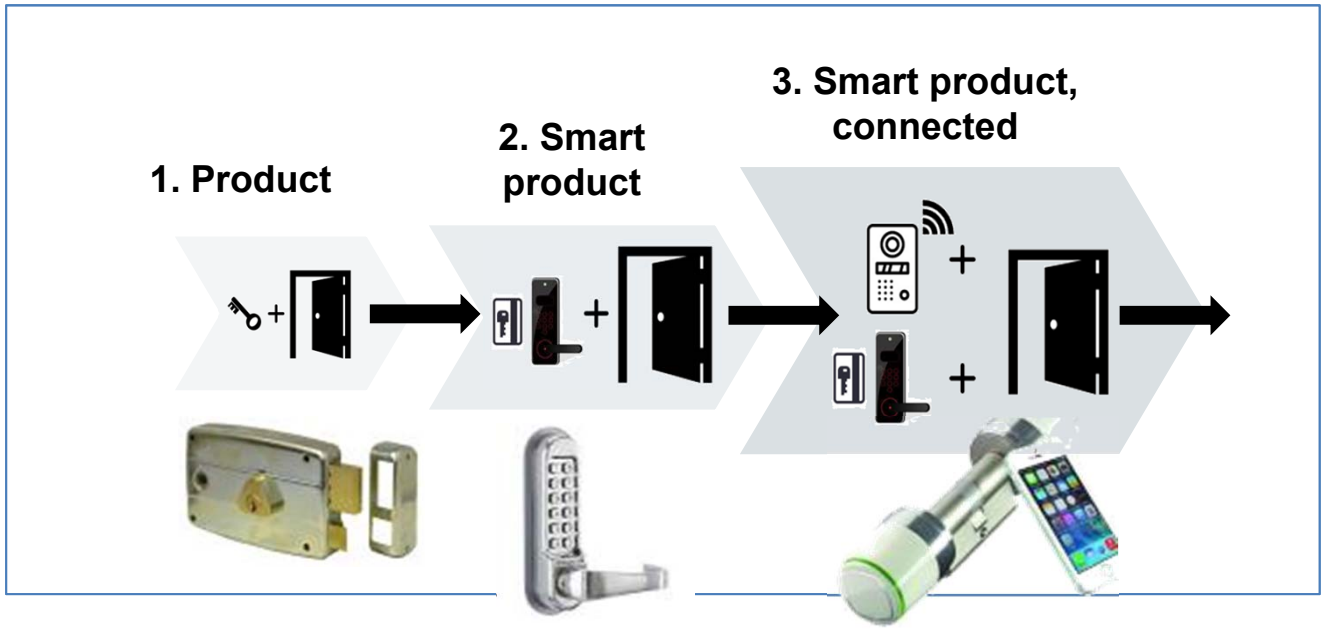
Redefining Industry Boundaries



Smart Connected Products

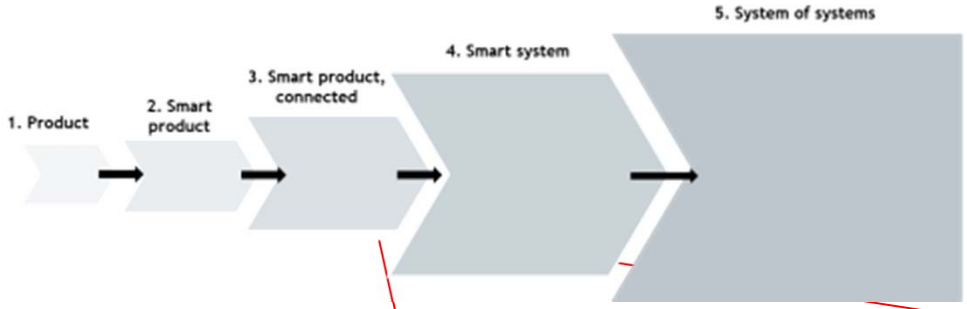
Redefining Industry Boundaries





Smart Connected Products

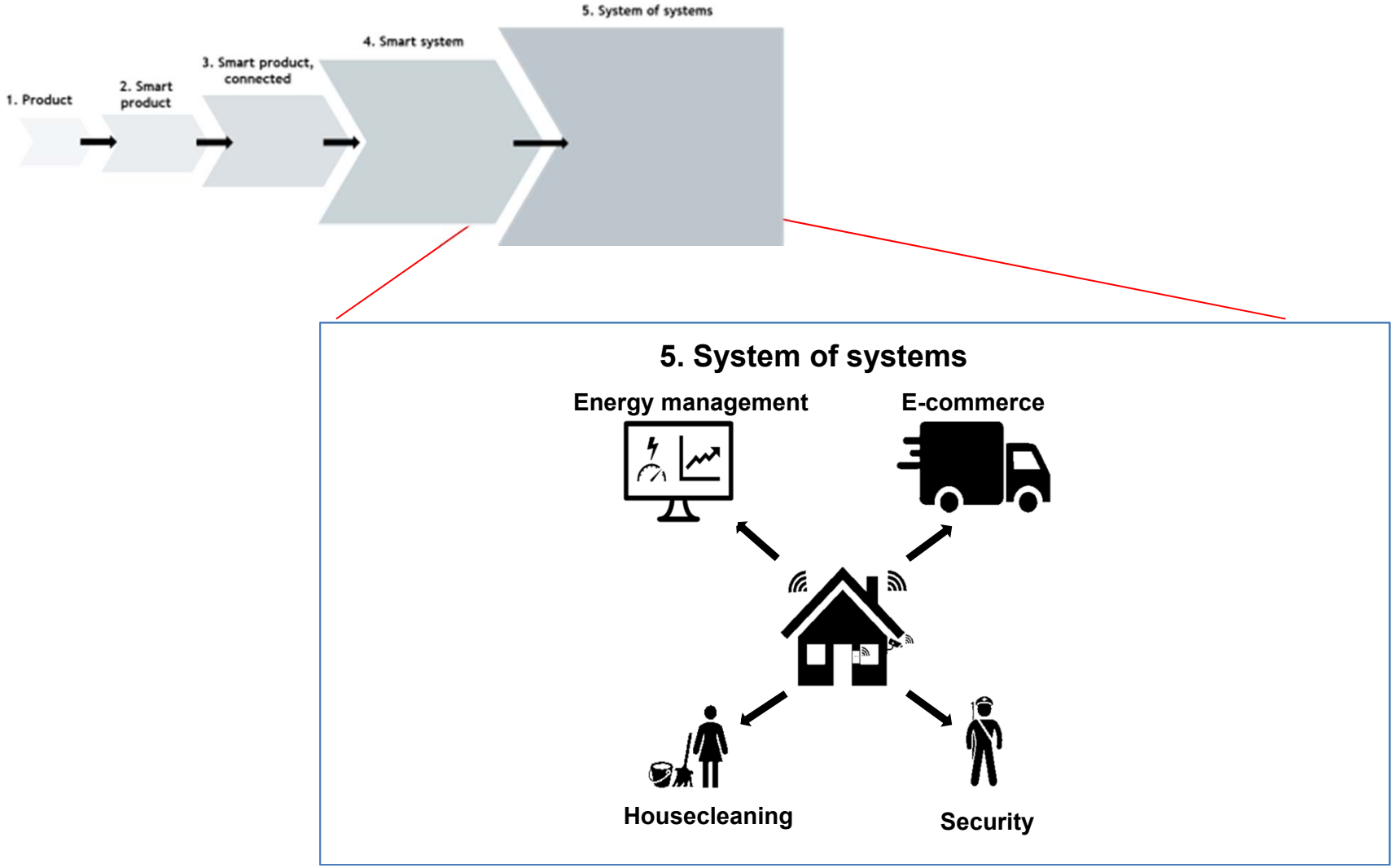
Redefining Industry Boundaries



4. Smart system

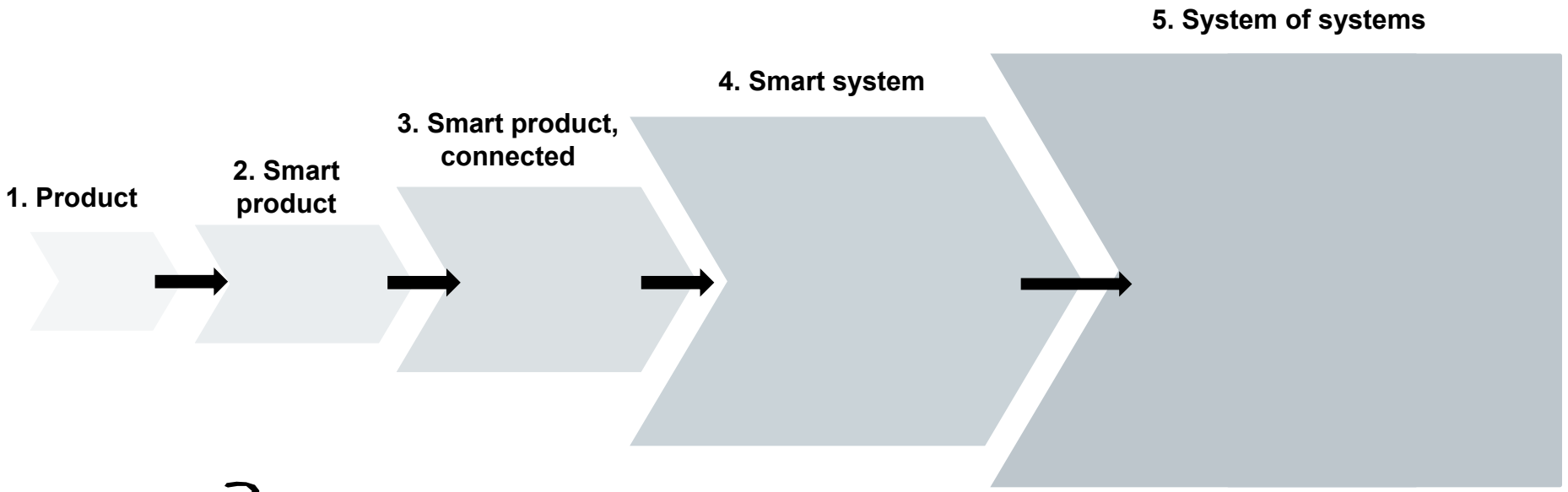
Smart Connected Products

Redefining Industry Boundaries



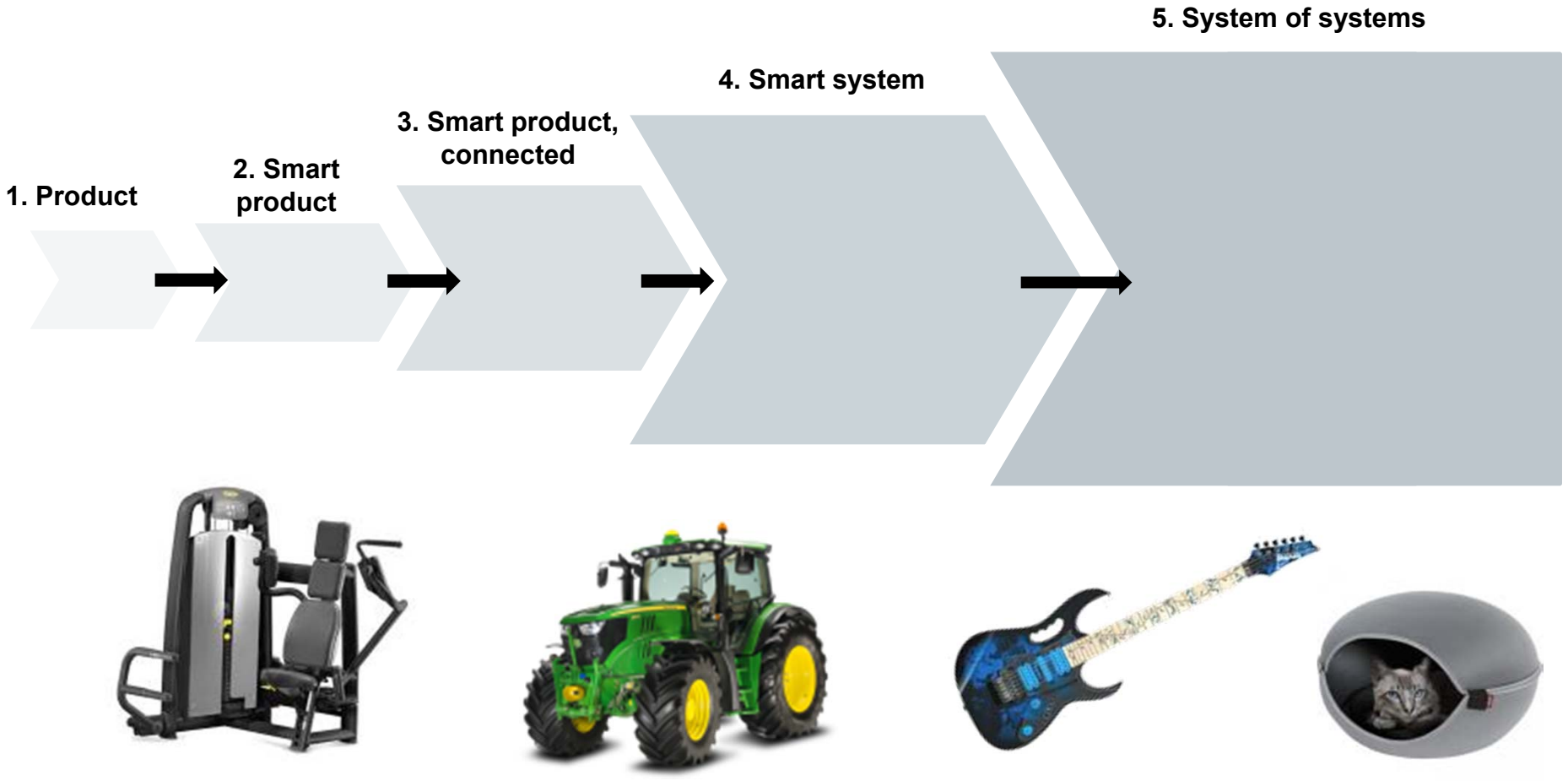
Smart Connected Products

Redefining Industry Boundaries



Smart Connected Products

Redefining Industry Boundaries



Smart Connected Products

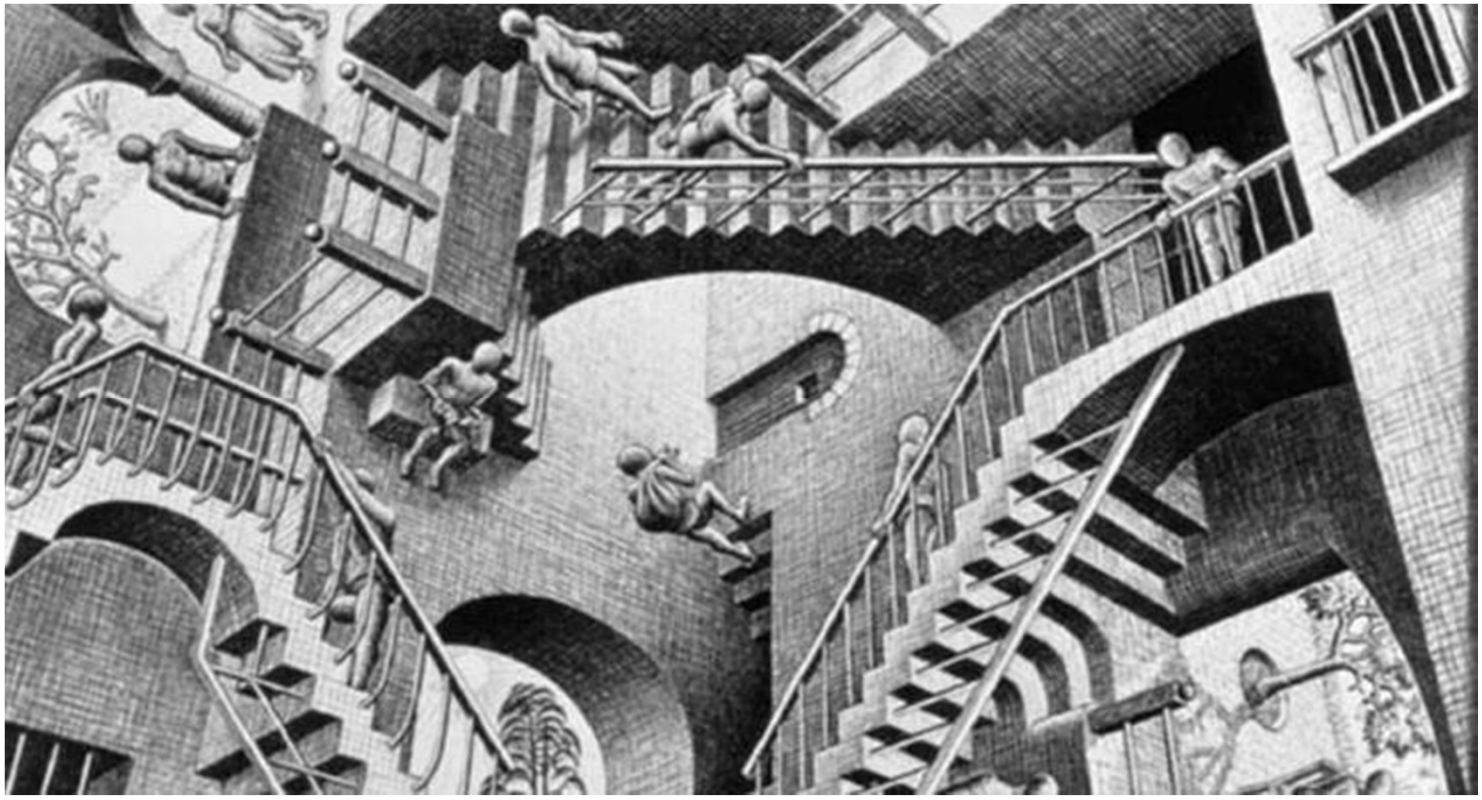
Redefining Industry Boundaries

amazon

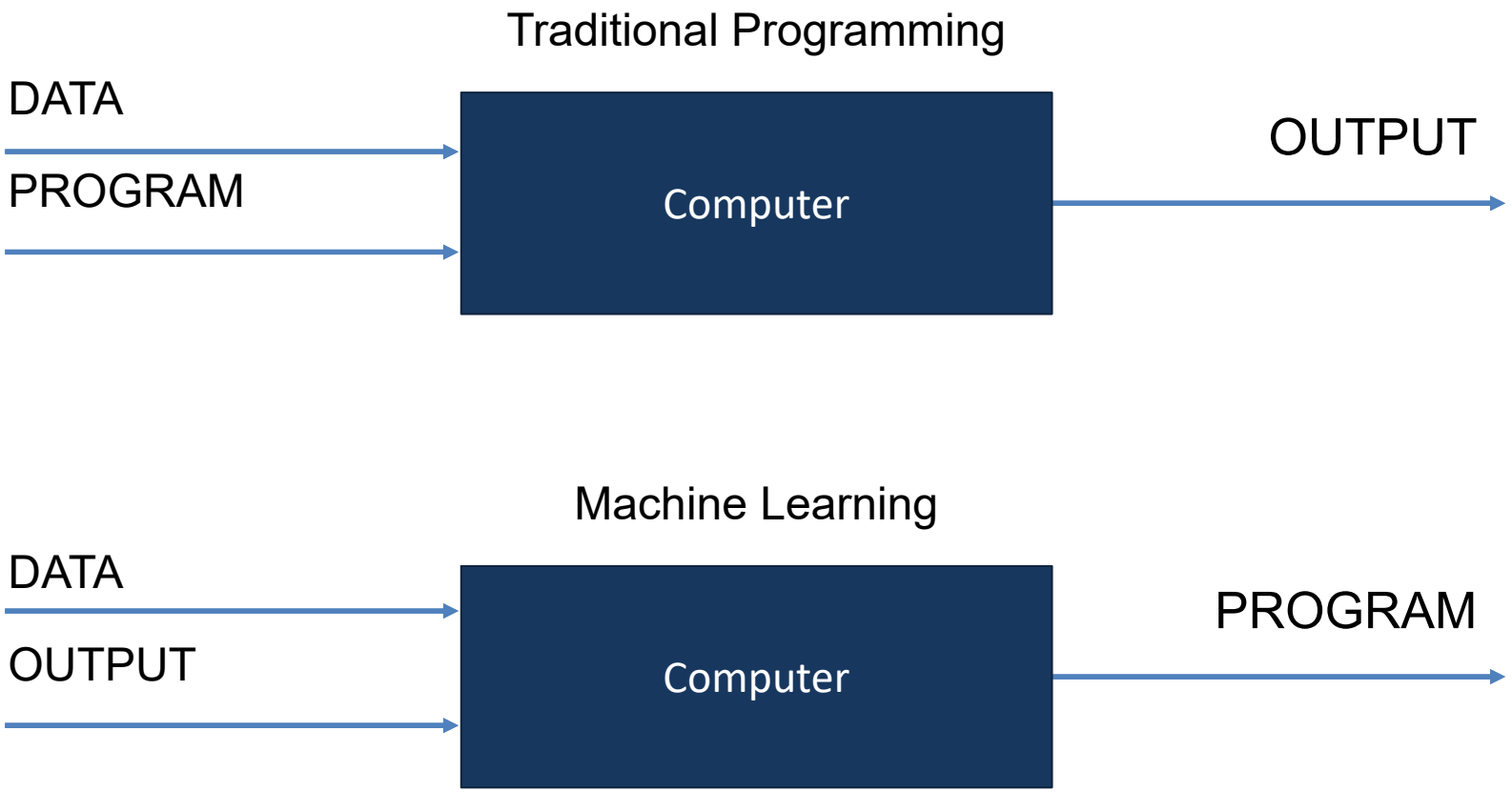
Agenda

- Data Economy and the Fourth Industrial Revolution
- The leading actor: the Internet of Things
- The value of data: tactical perspective
- The value of data: strategic perspective
- The world upside down
- New world, new skills, new roles

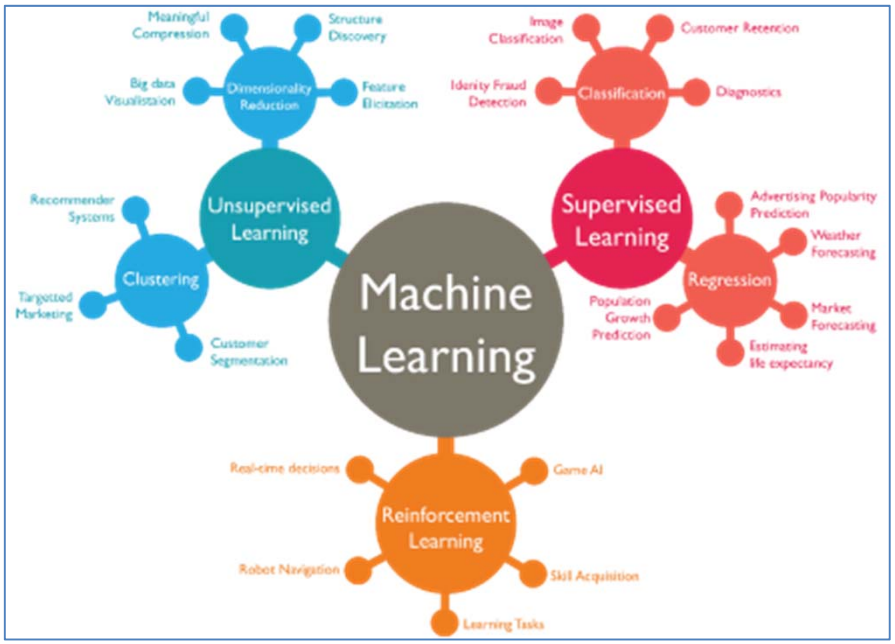
The world upside down

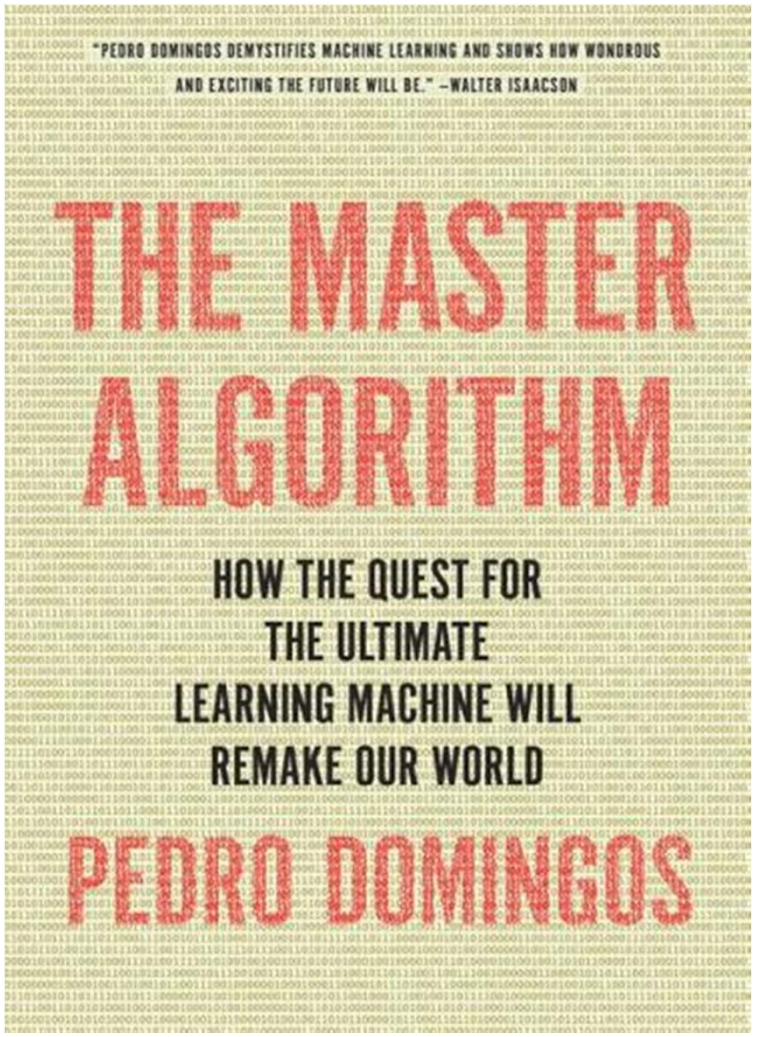


The world upside down



Welcome to machine learning!





From Machine Learning to Artificial Intelligence

INPUT

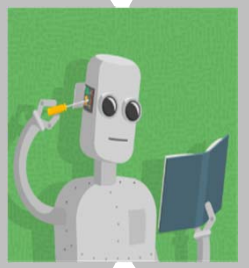
PROCESSING

OUTPUT

Natural Language Processing

Image Processing

Learning



Reasoning and Planning

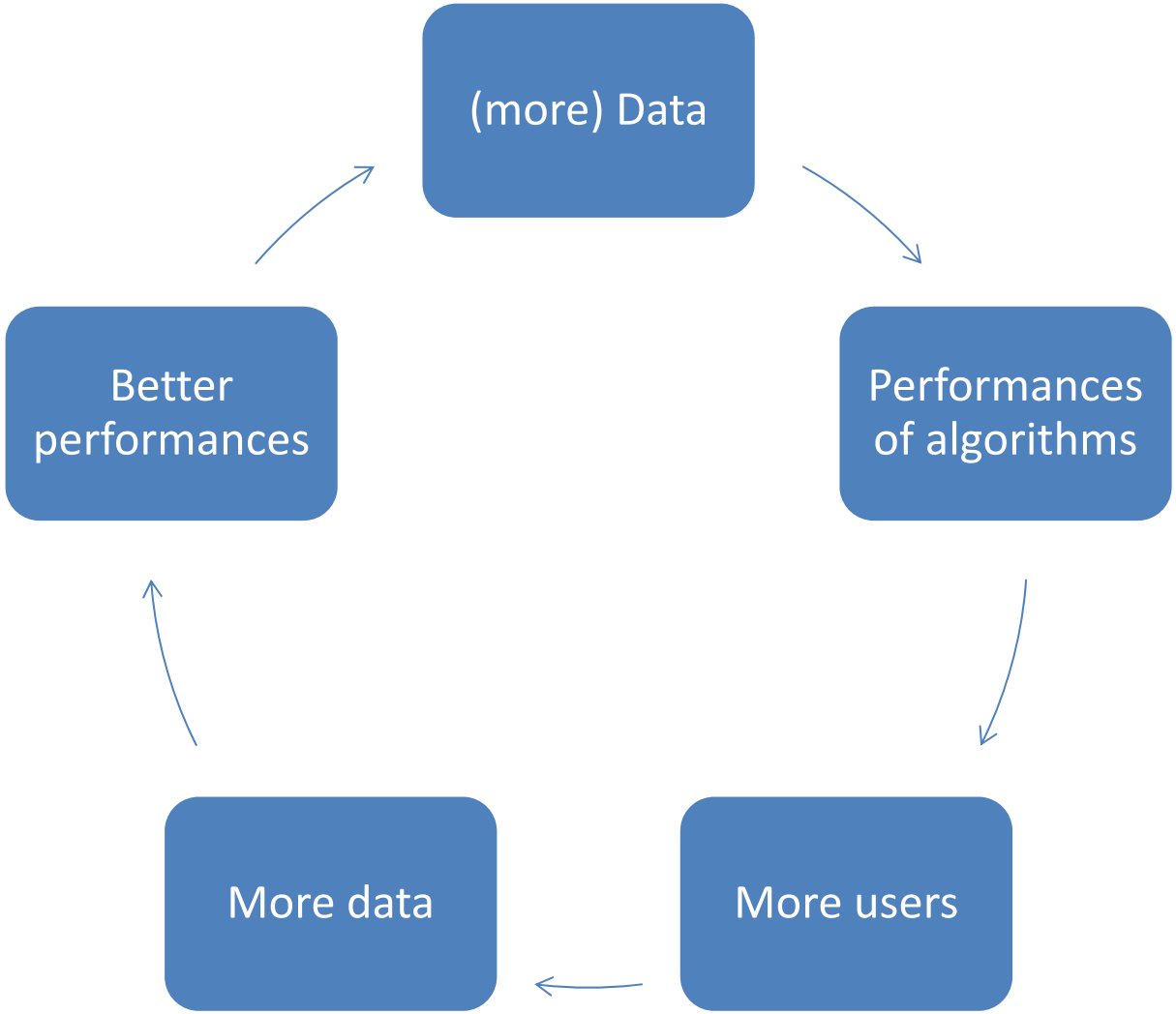
Interacting Physically

Interacting Socially

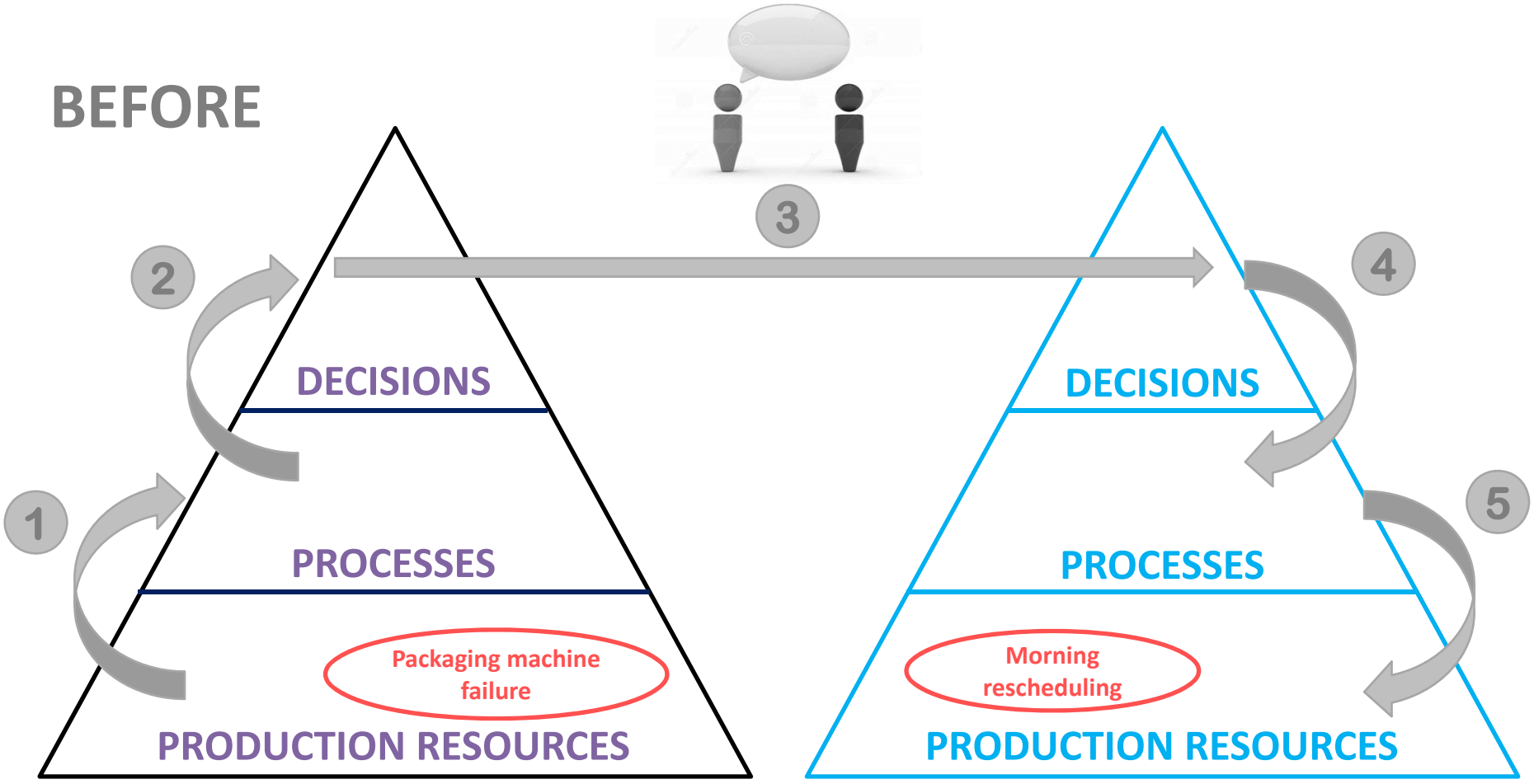
Artificial Intelligence

"L' Artificial Intelligence è il ramo della computer science che studia lo sviluppo di **sistemi hardware e software** dotati di **capacità tipiche dell'essere umano** ed in grado di **perseguire autonomamente** una finalità definita **prendendo delle decisioni** che, **fino a quel momento**, erano solitamente affidate agli esseri umani"

Artificial Intelligence and Data



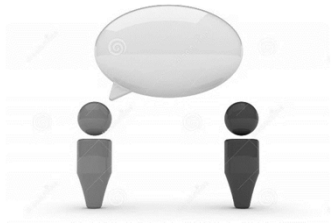
Artificial Intelligence and Decision making



Company 1

Company 2

Artificial Intelligence and Decision making



AFTER

Target Cost Deviation

DECISIONS

Extra defects

PROCESSES

Packaging machine failure

PRODUCTION RESOURCES

Corrective actions

DECISIONS

No free pass today!

PROCESSES

Morning rescheduling

PRODUCTION RESOURCES

Company 1

Company 2

Agenda

- Data Economy and the Fourth Industrial Revolution
- The leading actor: the Internet of Things
- The value of data: tactical perspective
- The value of data: strategic perspective
- The world upside down
- New world, new skills, new roles

New World, news skills

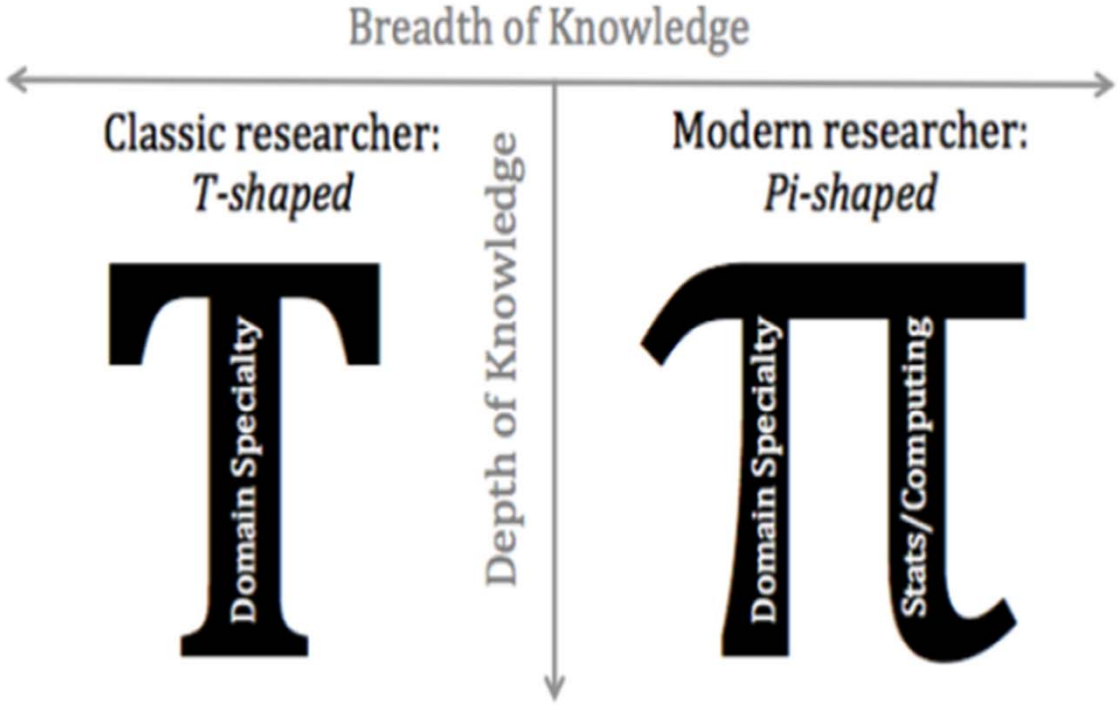


Figure 1: Representations of T vs Pi-shaped education.

Cited in S. Ceri, "On the role of statistics in the era of big data: a computer science perspective", Politecnico di Milano, 2017, White Paper

References

Must read:

- Erik Brynjolfsson, Andrew McAfee, 2014, "The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies", W&W Norton & Company (Italian edition available)
- Michael E. Porter, James E. Heppelmann, 2014, "How Smart, Connected Products Are Transforming Competition", HBR, November issue (Italian edition available)
- Pedro Domings, 2015, "The Master Algorithm: How the Quest for the Ultimate Learning Machine Will Remake Our World ", Basic Book (Italian edition available)

(Near) Must read:

- Nicholas Carr, 2014, The Glass Cage: Automation and Us, W&W Norton & Company
- *Thomas H. Davenport, Julia Kirby, 2015,* Beyond Automation: Strategies for remaining gainfully employed in an era of very smart machines, HBR, June issue
- Erik Brynjolfsson, Andrew McAfee, 2017, "Machine, Platform, Crowd: harnessing our digital future", W&W Norton & Company
- Daron Acemoglu, Pascual Restrepo, 2017, Robots and Jobs: Evidence from US Labor Markets, NBER Working Paper No. 23285 (introduction only)

Into the future:

- Tim Urban, The Road to SuperIntelligence, https://waitbutwhy.com/2015/01/artificial-intelligence-revolution-1.html (part 2 also)

Who am I?

- Professor of Advanced Supply Chain Planning @ Politecnico di Milano

- Senior director at Osservatori.net, 100-people research group on Digital Innovation:
  - Internet of Things
  - Industry 4.0
  - Artificial Intelligence

- Responsible of the Internet of Things Lab, the applied research lab of Politecnico di Milano (www.iotlab.it)

- More than 100 cooperation projects with leading Italian and International companies

- To contact me:
  - giovanni.miragliotta@polimi.it
  - +39 02 2399 2785
  - linkedin.com/in/giovanni-miragliotta-4617a0