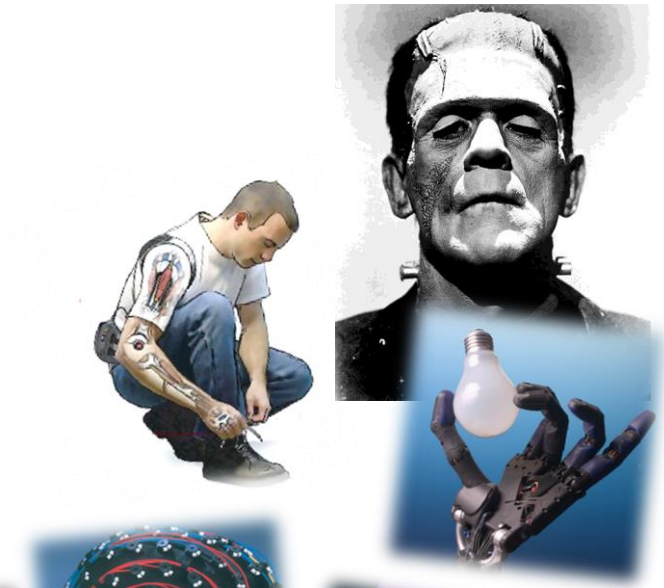
Europeans Do It Better(?): Key Digital Technologies and the role of Europe

Alberto Sangiovanni-Vincentelli,

The Edgar L. and Harold H. Buttner Chair Department of EECS,

University of California, Berkeley

Co-founder, Member of the Board, Cadence Design Systems



Digit(al)ization:
What is digital and what is it not, and why do businesses have such trouble defining it?

Digital is not just about ***more***; it's about **different**.

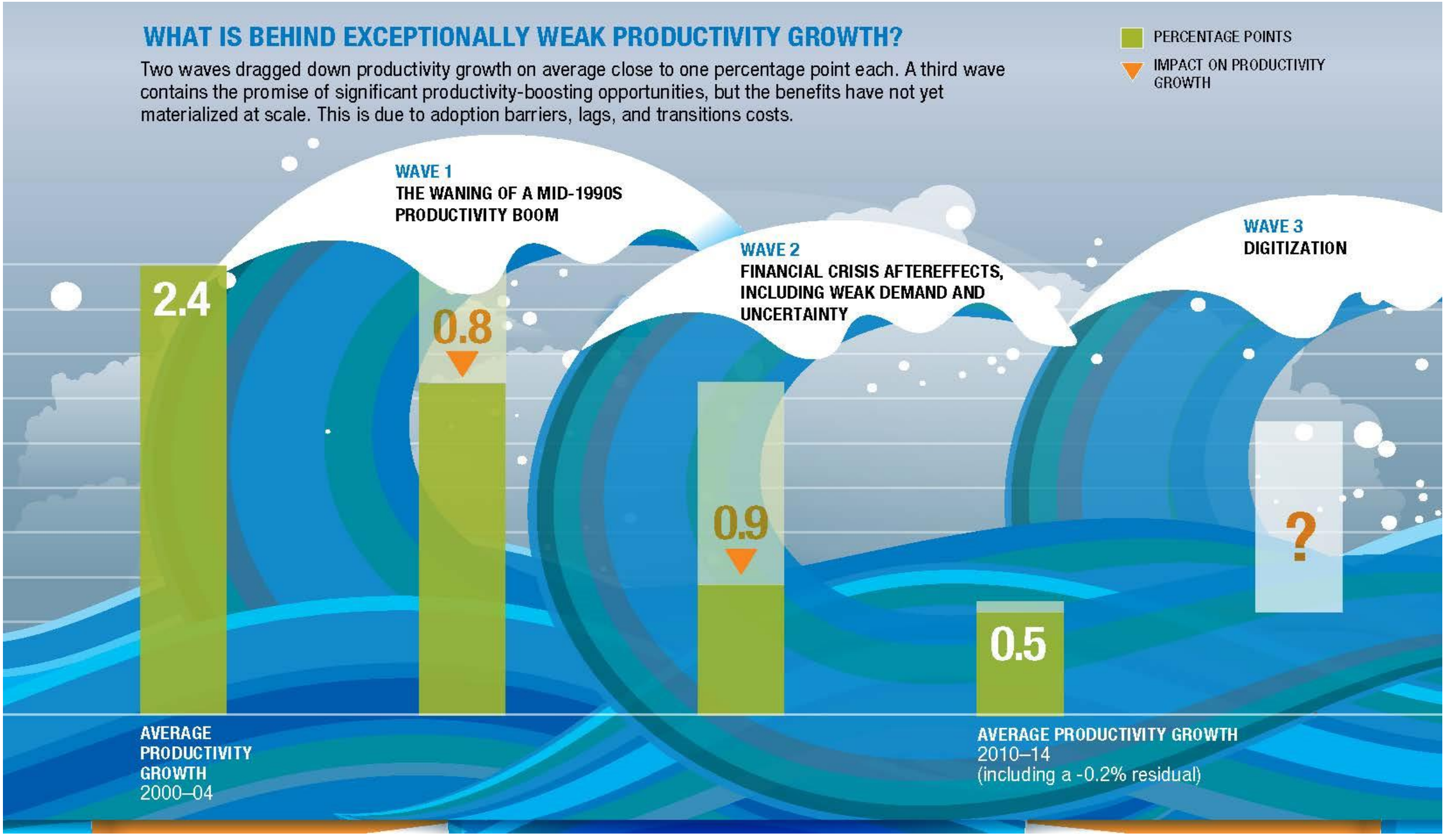
- Rethink the **overall business model**, the way one makes money, the way one delivers a value proposition overall.
- New way to interact **with customers** to take a value proposition and bring it to market.
- A different way of operating **within a company**, and within a broader ecosystem, to actually make those products and services happen.

Provocative Statement

- We are in the midst of the **fourth industrial revolution**.
- It is an extraordinary time but **something is not quite working as intended**.
- Given the technological breakthrough and the advent of robotics and AI, **why is productivity stalling in the most advanced economies**?

WHAT IS BEHIND EXCEPTIONALLY WEAK PRODUCTIVITY GROWTH?

Two waves dragged down productivity growth on average close to one percentage point each. A third wave contains the promise of significant productivity-boosting opportunities, but the benefits have not yet materialized at scale. This is due to adoption barriers, lags, and transitions costs.



Economic Potential

	**The Internet of Things**	**300%** Increase in connected machine-to-machine devices over past 5 years **80–90%** Price decline in MEMS (microelectromechanical systems) sensors in past 5 years	**1 trillion** Things that could be connected to the Internet across industries such as manufacturing, health care, and mining **100 million** Global machine to machine (M2M) device connections across sectors like transportation, security, health care, and utilities	**$36 trillion** Operating costs of key affected industries (manufacturing, health care, and mining)
	**Cloud technology**	**18 months** Time to double server performance per dollar **3x** Monthly cost of owning a server vs. renting in the cloud	**2 billion** Global users of cloud-based email services like Gmail, Yahoo, and Hotmail **80%** North American institutions hosting or planning to host critical applications on the cloud	**$1.7 trillion** GDP related to the Internet **$3 trillion** Enterprise IT spend
	**Advanced robotics**	**75–85%** Lower price for Baxter[3] than a typical industrial robot **170%** Growth in sales of industrial robots, 2009–11	**320 million** Manufacturing workers, 12% of global workforce **250 million** Annual major surgeries	**$6 trillion** Manufacturing worker employment costs, 19% of global employment costs **$2–3 trillion** Cost of major surgeries
	**Autonomous and near-autonomous vehicles**	***7*** Miles driven by top-performing driverless car in 2004 DARPA Grand Challenge along a 150-mile route **1,540** Miles cumulatively driven by cars competing in 2005 Grand Challenge **300,000+** Miles driven by Google's autonomous cars with only 1 accident (which was human-caused)	**1 billion** Cars and trucks globally **450,000** Civilian, military, and general aviation aircraft in the world	**$4 trillion** Automobile industry revenue **$155 billion** Revenue from sales of civilian, military, and general aviation aircraft

Source: McKinsey

Technology Trends

The Emerging Technology Scene:

IoT, Mobile Devices, Cloud

Computers and mobiles to disappear: Augmented Reality

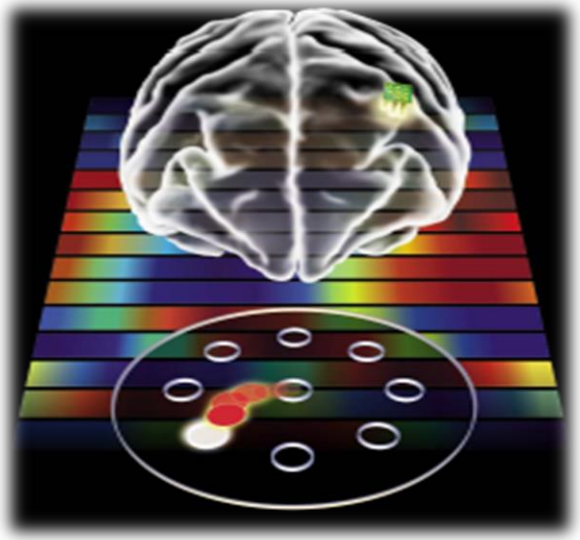
7 trillions devices for **7** billion persons, Devices per person by 2025

The Immersed Human

Real-life interaction between humans and cyberspace, enabled by enriched input and output devices on and in the body and in the surrounding environment

Another One: BioCyber (?) Systems

Linking the cyber and Biological Words: Examples Brain-Machine Interfaces and Body-Area Networks



Enabling Technologies

Simulation

Cyber Security

Big Data & Analytics

Software Integration

Robotics

Artificial Intelligence

Industrial Internet Internet of things

Micro - Nano - Electronics

Photonics

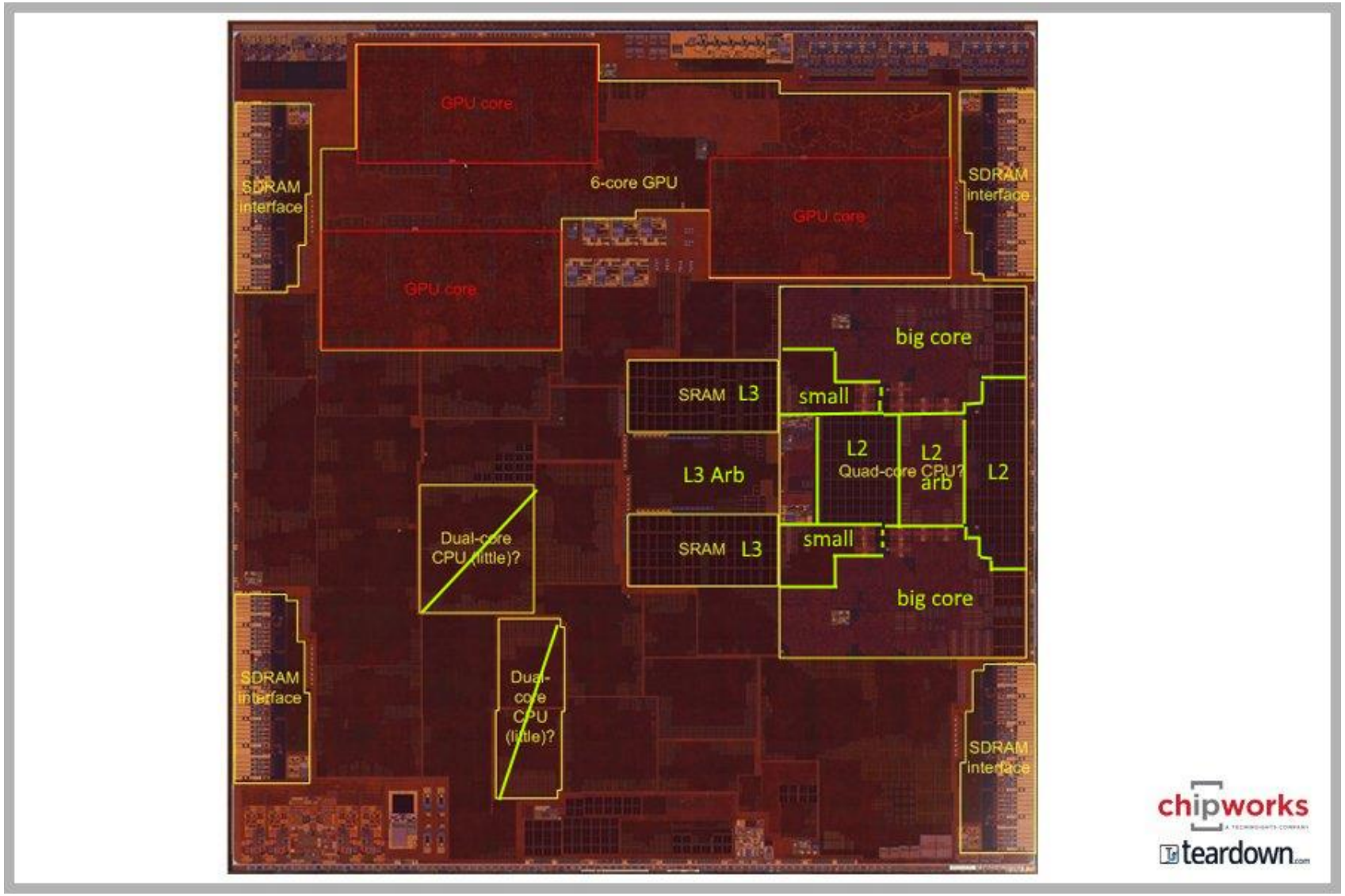
Additive Manufacturing

Materials

Big Data + Processing Power
=
New Age for Artificial Intelligence

Today’s Monster Chips:

A11 4.3Billion transistors

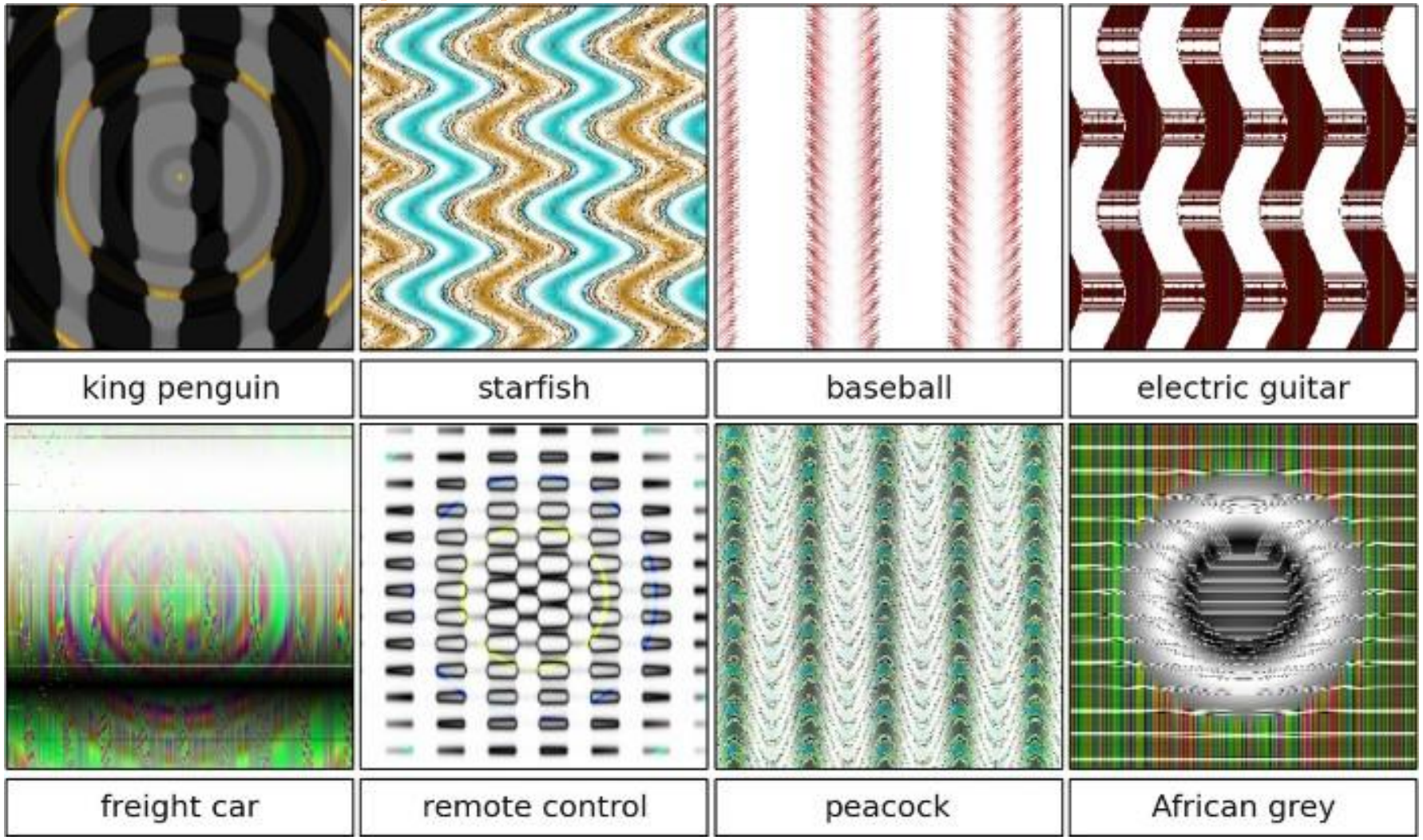


AI Chips: the race is ON!

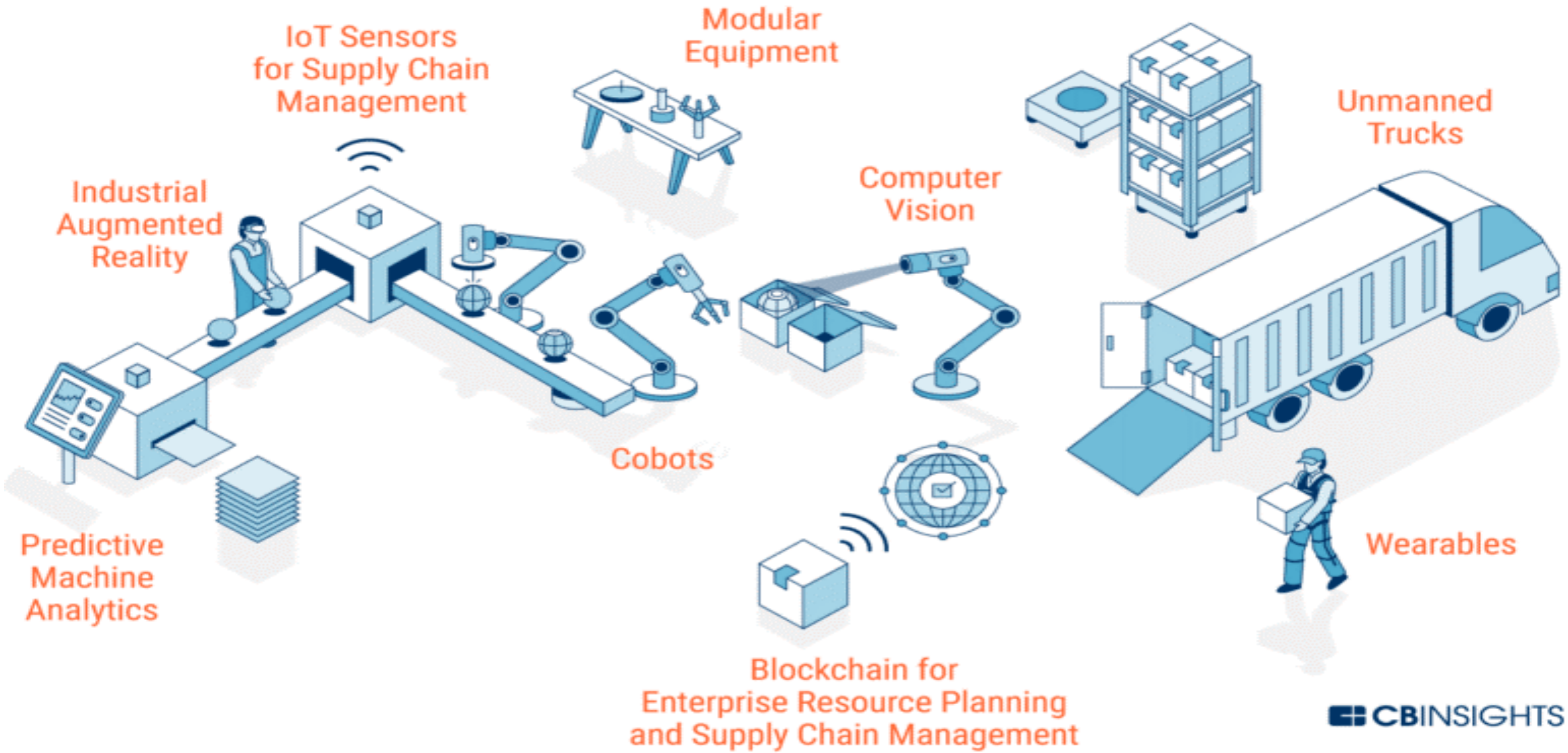
IC Vendors	Intel, Qualcomm, Nvidia, Samsung, AMD, Xilinx, IBM, STMicroelectronics, NXP, MediaTek, HiSilicon, Rockchip
Tech Giants & HPC Vendors	Google, Amazon_AWS, Microsoft, Apple, Aliyun, Alibaba Group, Tencent Cloud, Baidu, Baidu Cloud, HUAWEI Cloud, Fujitsu, Nokia, Facebook
IP Vendors	ARM, Synopsys, Imagination, CEVA, Cadence, VeriSilicon, Videantis
Startups in China	Cambricon, Horizon Robotics, DeePhi, Bitmain, Chipintelli, Thinkforce
Startups Worldwide	Cerebras, Wave Computing, Graphcore, PEZY, KnuEdge, Tenstorrent, ThinCI, Koniku, Adapteva, Knowm, Mythic, Kalray, BrainChip, AImotive, DeepScale, Leepmind, Krtkl, NovuMind, REM, TERADEEP, DEEP VISION, Groq, KAIST DNPU, Kneron, Esperanto Technologies, Gyrfalcon Technology, SambaNova Systems, GreenWaves Technology

CAVEAT:
Deep neural networks are easily fooled

(Nguyen,Yosinki & Clune 2014)

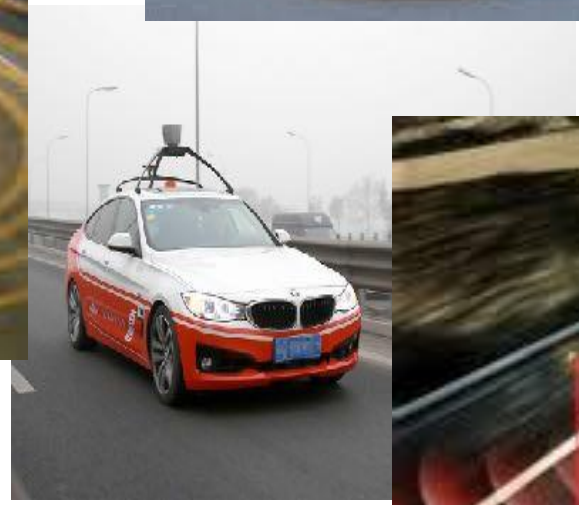


FACTORY OF THE FUTURE



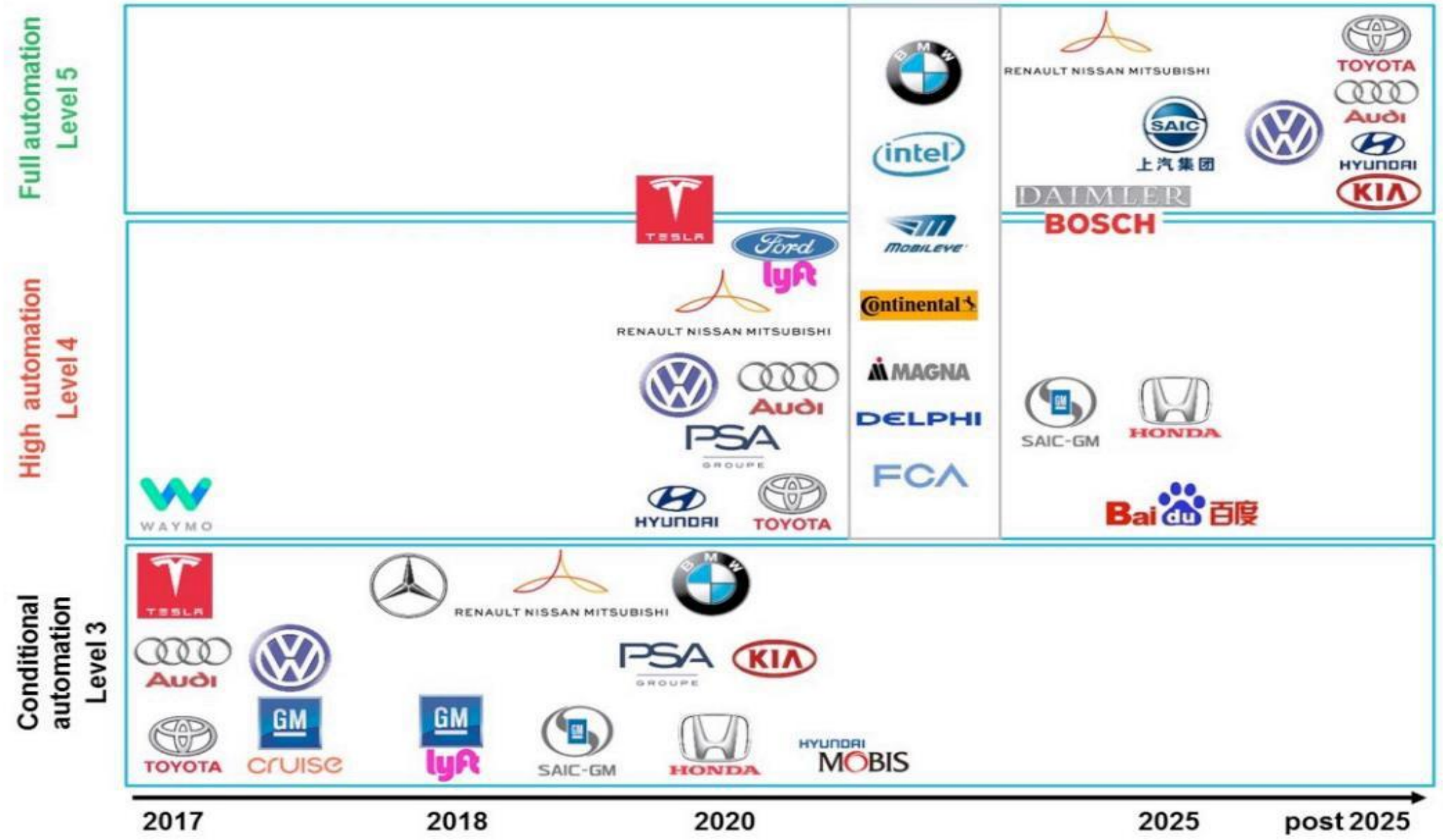
CBINSIGHTS

Disruption in Consolidated Business Sectors: Automobiles



Launch timelines all over the board

Figure 16: Autonomous vehicle launch timelines based on public announcements



MARCH 21, 2017

21 Industries Other Than Auto That Driverless Cars Could Turn Upside Down

Four Fundamental Questions

1. Where Am I?

- **Sensing technology: GPS, Inertial,… (mapping technology)**

2. What's Around Me?

- **«Vision» systems: Radars, Lidars, Camera systems (neural networks for image recognition)**

3. What Will Happen Next?

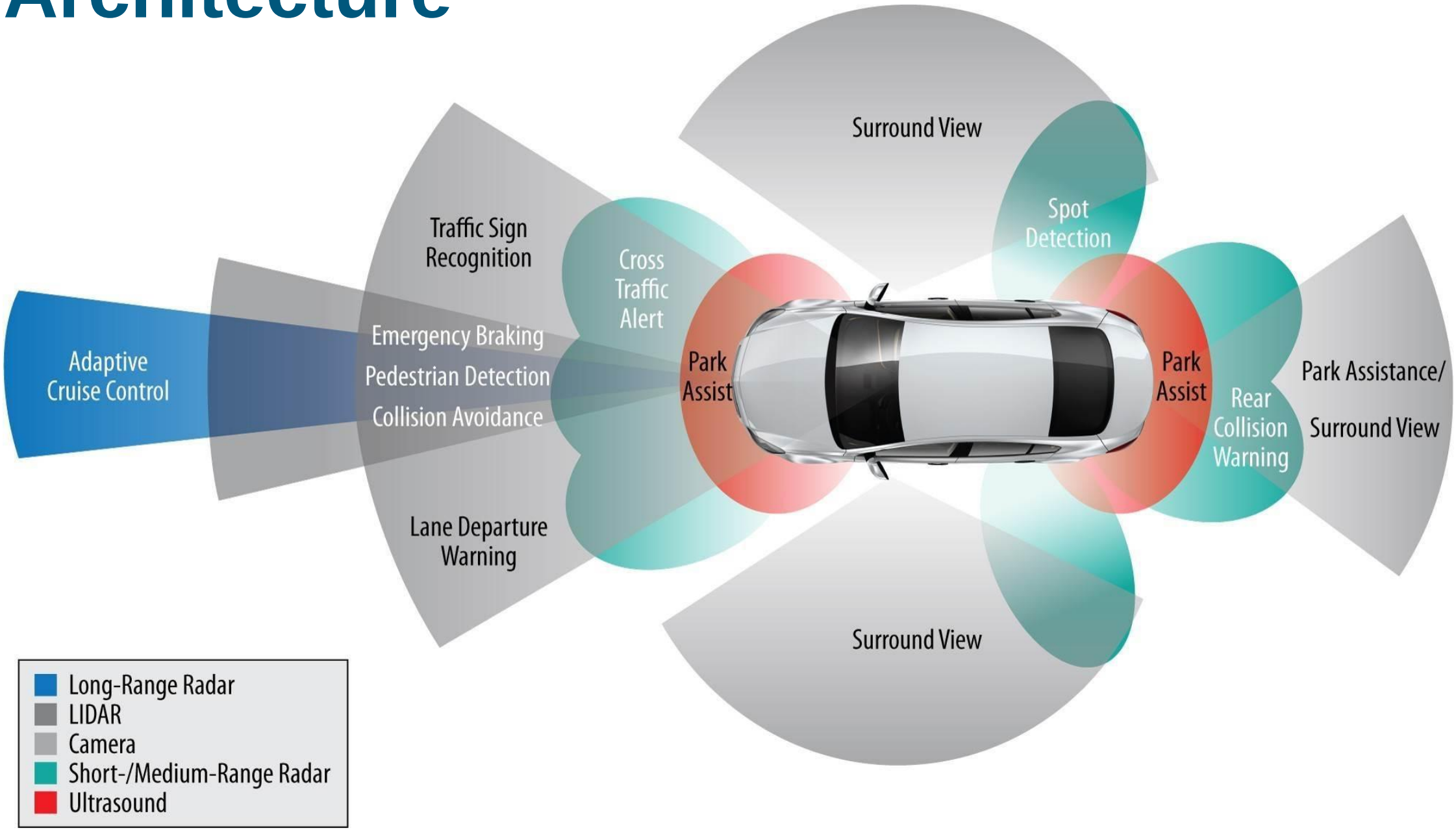
- **Predictive systems: software and algorithms (dynamical systems)**

4. What Should I Do?

- **Decision systems (neural networks for decision making, connected cars, trip planning)**

SENSOR FUSION AND BIG DATA

Architecture



Conclusions

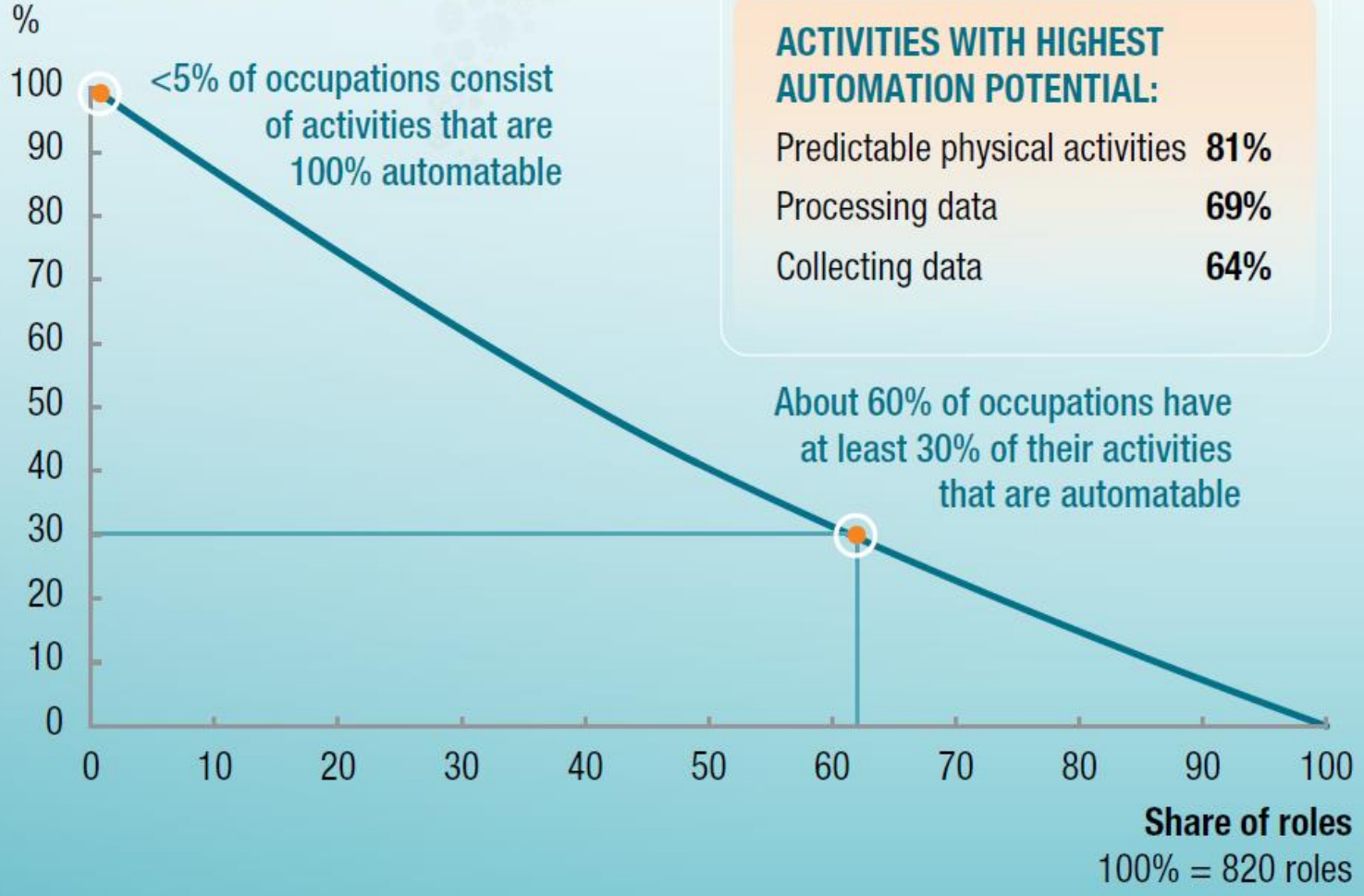
- **Digit(al)izatic**

  - Computing: **stron** …cloud, digital chips, …
  - IoT: **weak** on prot …EMS.
  - Big Data analytics
  - Advanced Robots …oston Dynamics, DaVinci
  - Advanced Factor… **ss** on analytics.
  - Autonomous Driv… …ng up.
  - BioCyber Physica… …specially in research
  - System Engineer… **ting** civil aerospace
  - CyberSecurity for… …uropean Start-up looked strong but moved to SFO

Technical automation potential by adapting currently demonstrated technologies

While few occupations are fully automatable, 60 percent of all occupations have at least 30 percent technically automatable activities

Technical automation potential

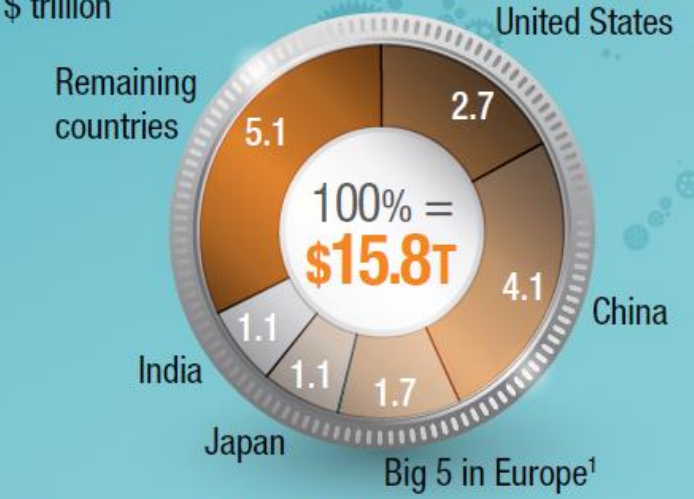


ACTIVITIES WITH HIGHEST AUTOMATION POTENTIAL:

Predictable physical activities	**81%**
Processing data	**69%**
Collecting data	**64%**

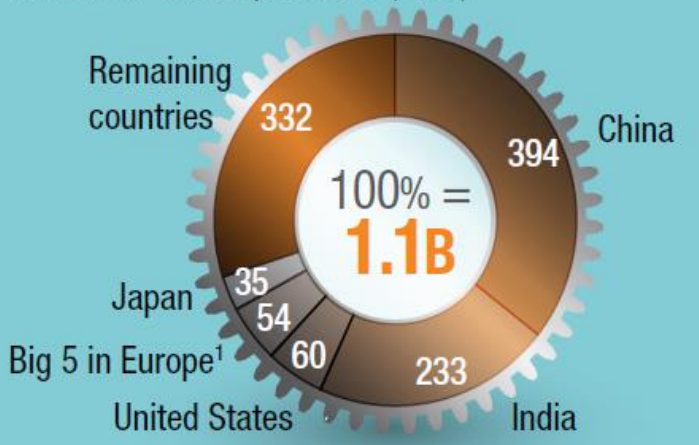
Wages associated with technically automatable activities

$ trillion



Labor associated with technically automatable activities

Million full-time equivalents (FTEs)



[1] France, Germany, Italy, Spain, and the United Kingdom.