

Industry 4.0 and Smart Factory

Alaa Khamis, PhD, SMIEEE

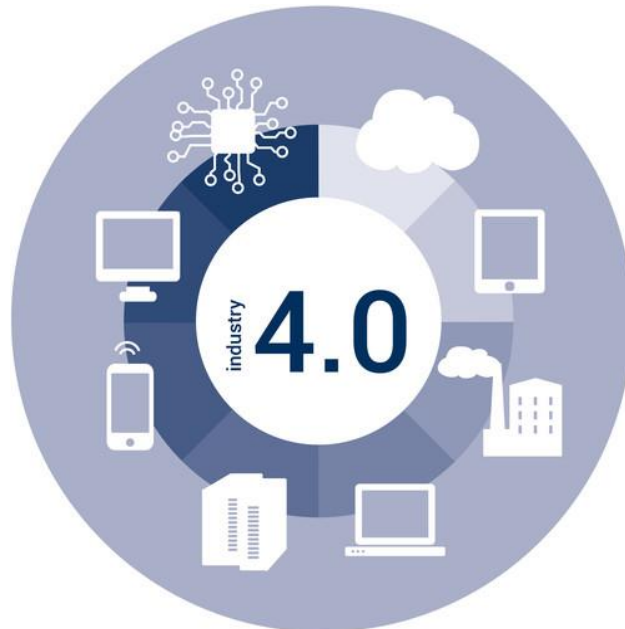
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OUTLINE

- What is Industry 4.0?
- Why Industry 4.0?
- Challenges

WHAT IS INDUSTRY 4.0?

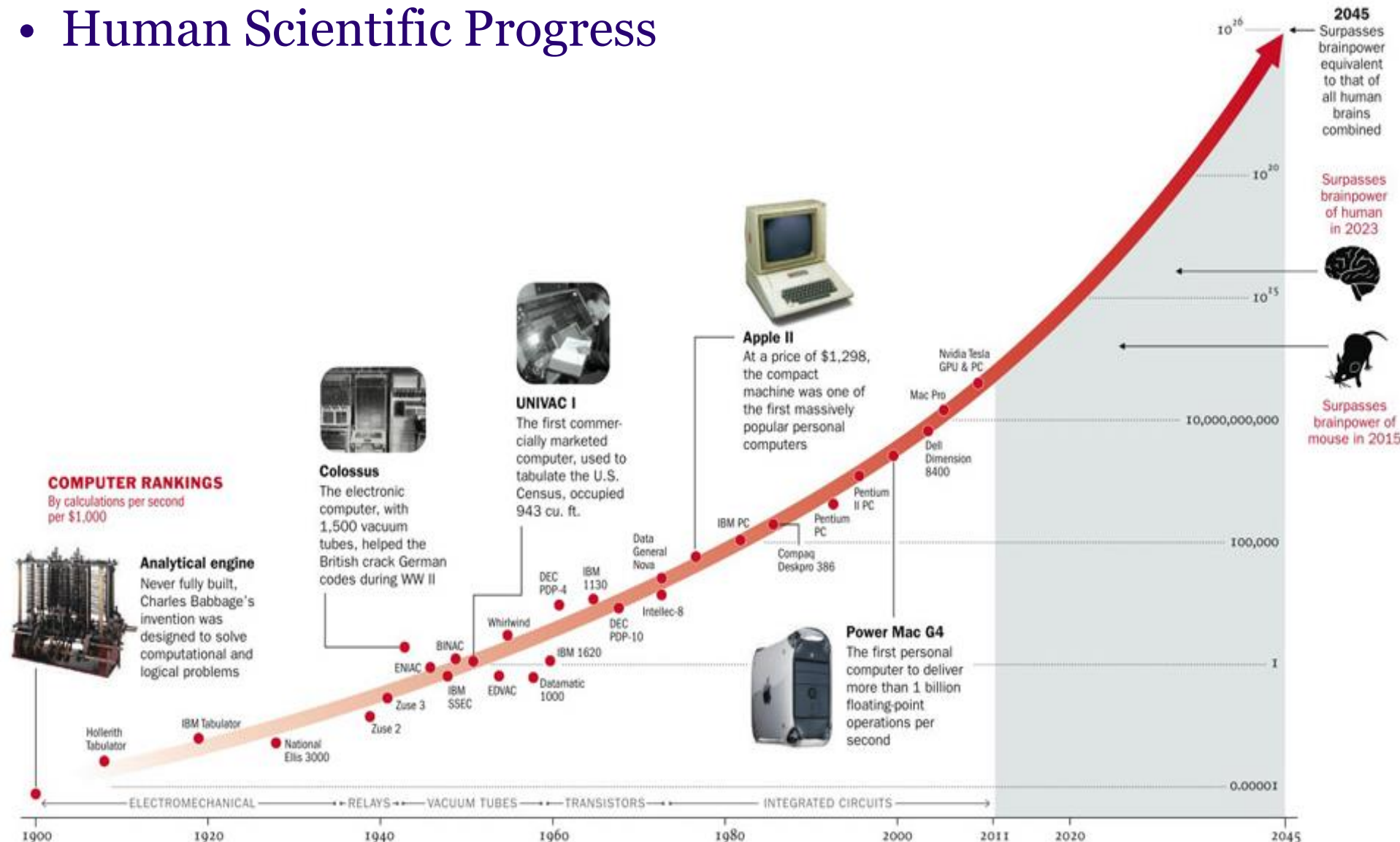


WHAT IS INDUSTRY 4.0?

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- Human Scientific Progress



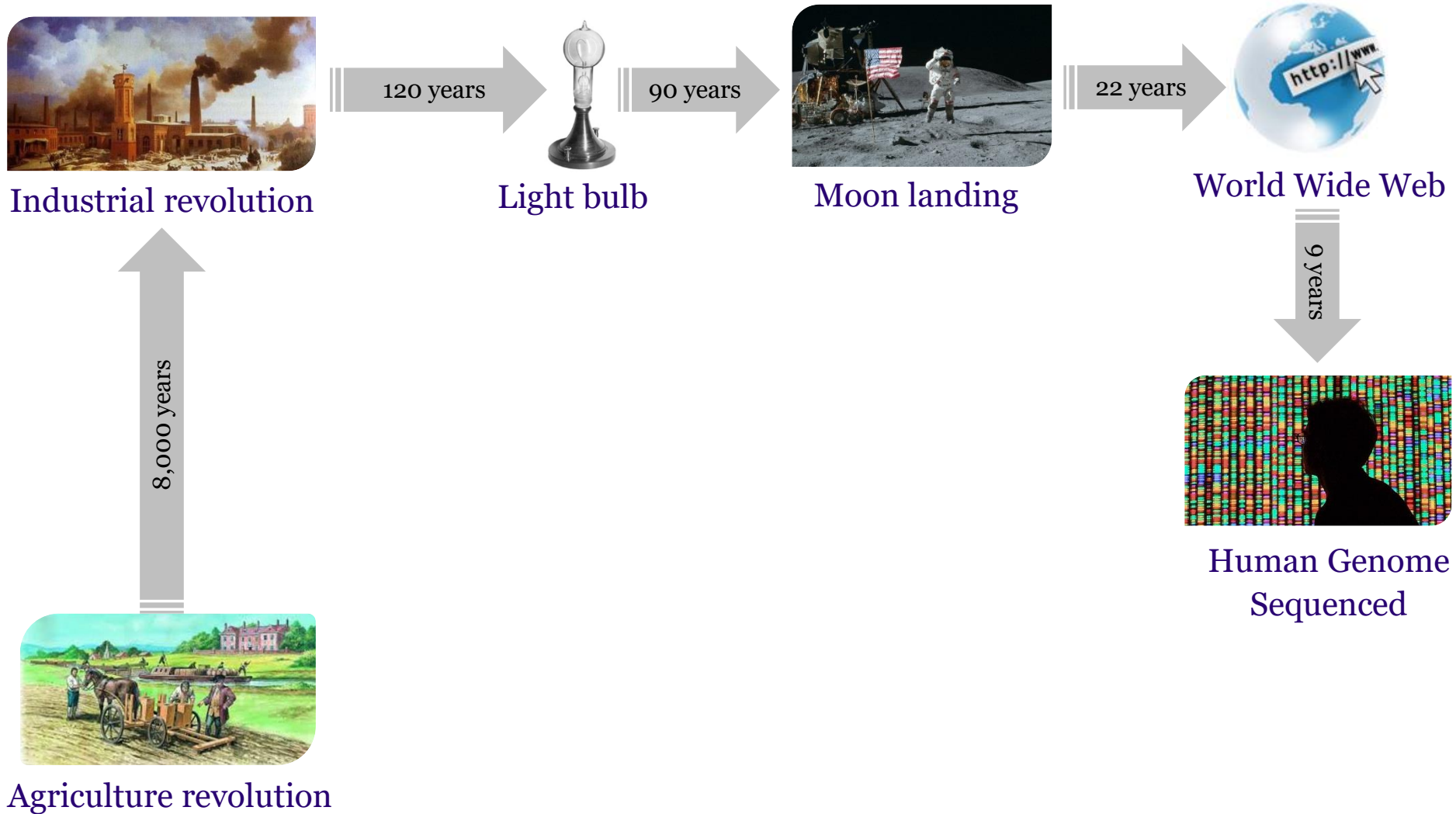
Source: Lev Grossman, "2045: The Year Man Becomes Immortal," TIME Magazine, February, 2011.

WHAT IS INDUSTRY 4.0?

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- The accelerating pace of change



Source: Lev Grossman, "2045: The Year Man Becomes Immortal," TIME Magazine, February, 2011.

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- The accelerating pace of change

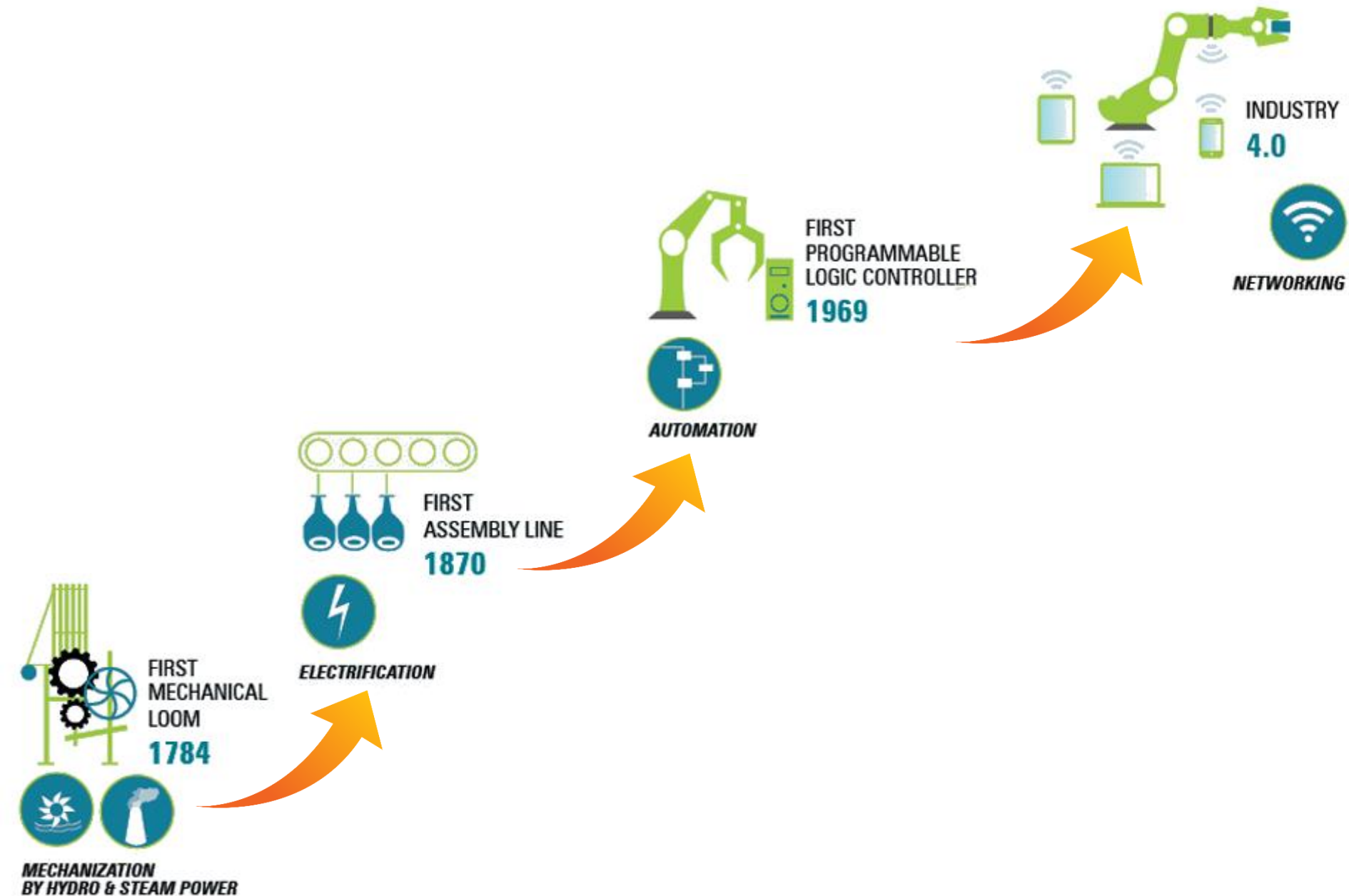
Time to reach 100 Million customers



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Automation



Electrification



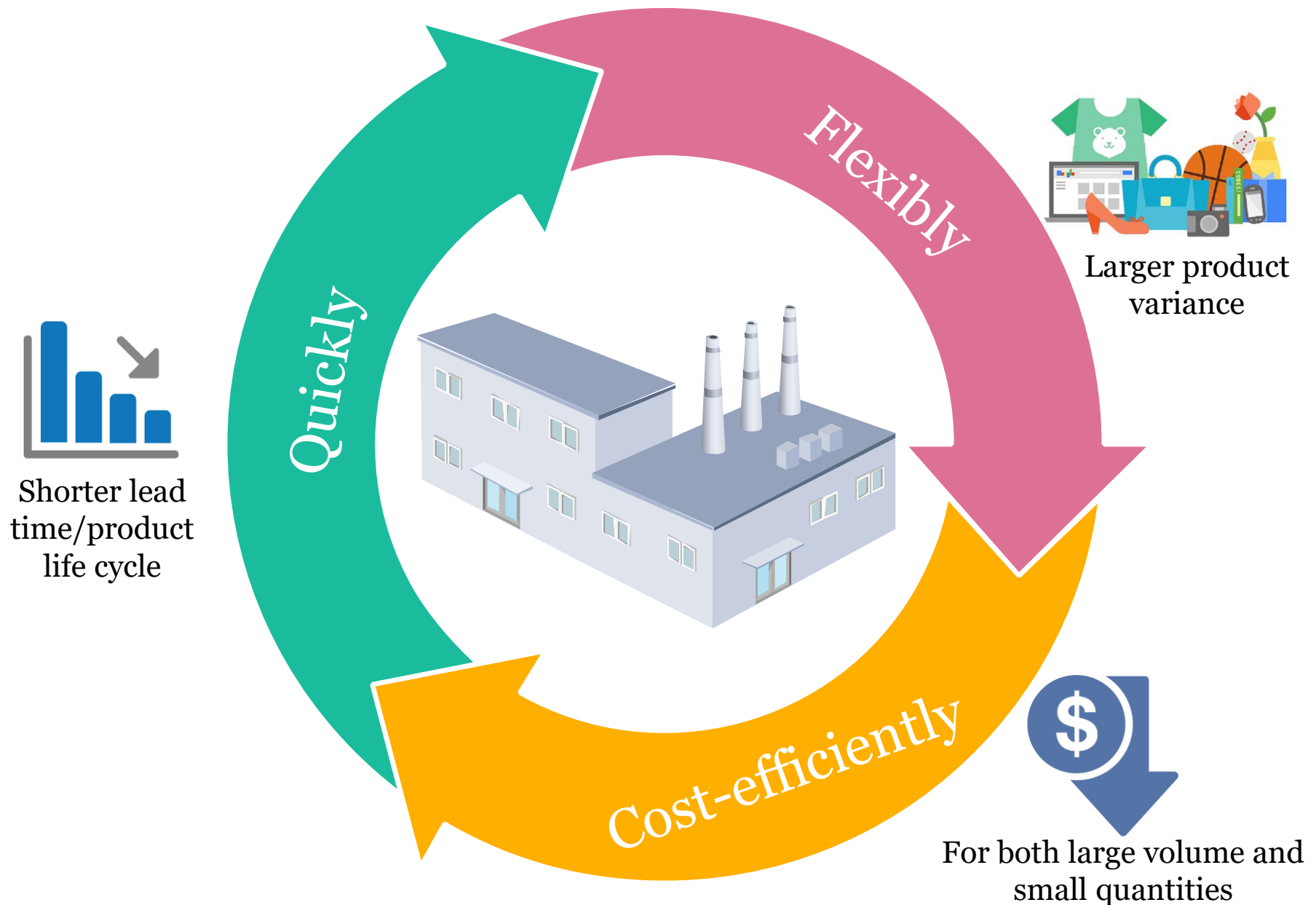
Mechanization



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WHAT IS INDUSTRY 4.0?

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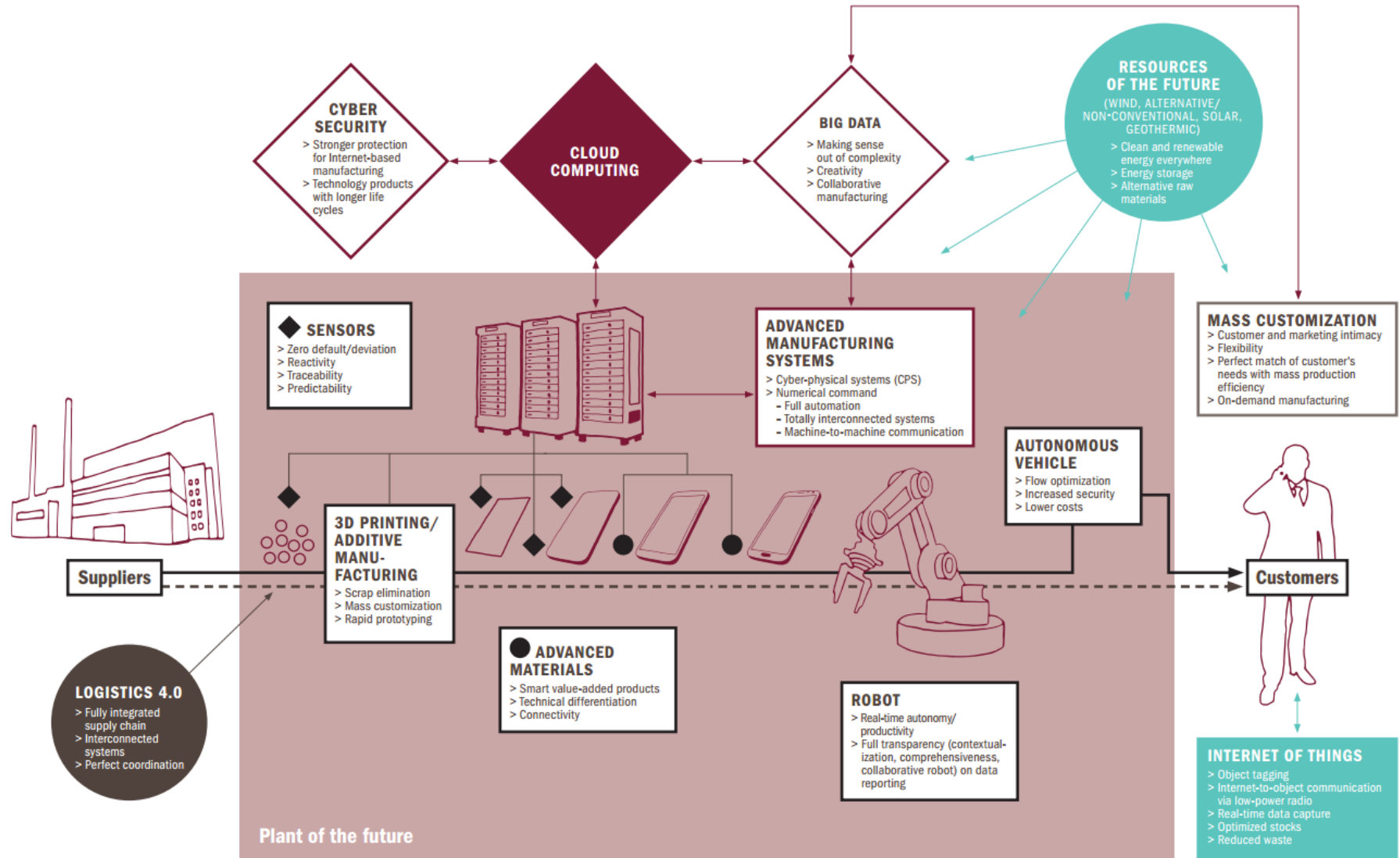
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Digitalization

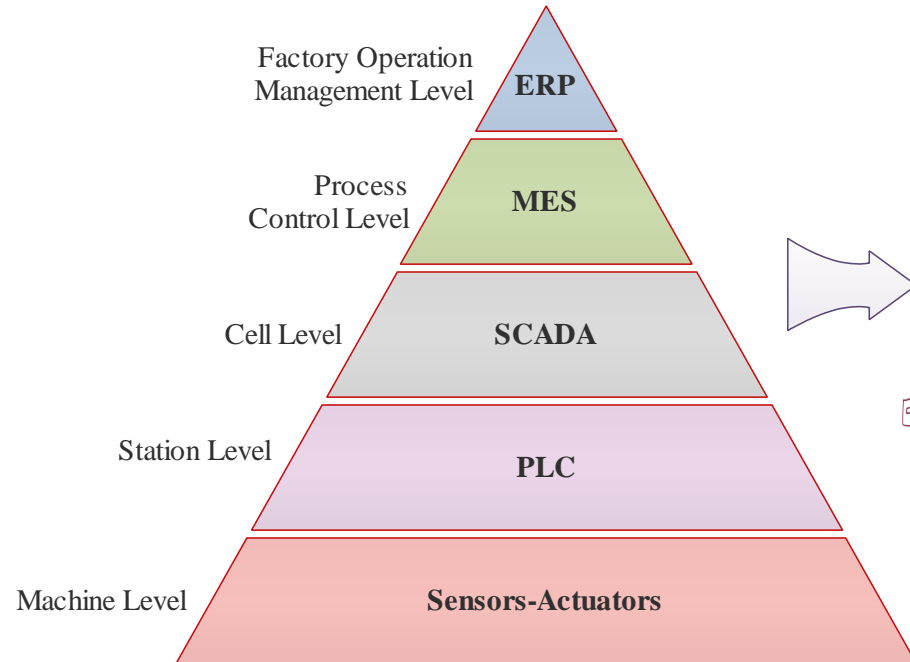
Automation

Connectivity

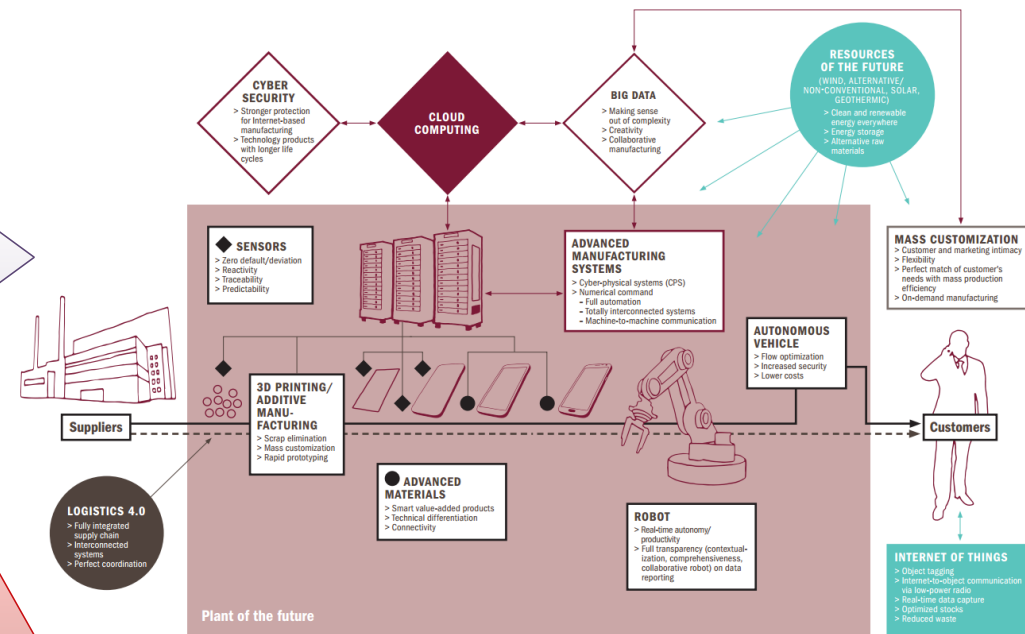
Analytics



Source: B. Roland, "INDUSTRY 4.0: The new industrial revolution How Europe will succeed," Think Act, Tech. Report, 2014.

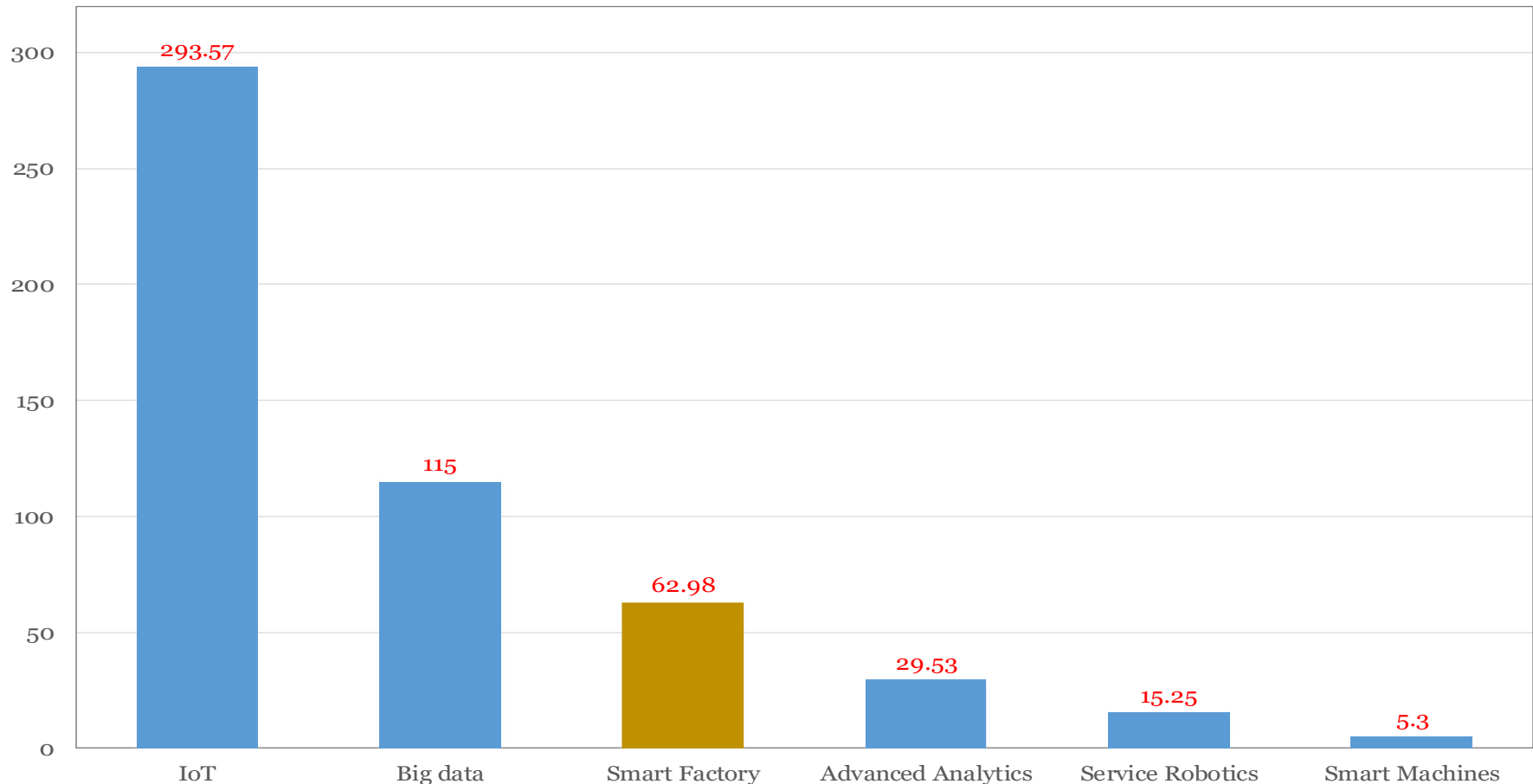


Classical 5-Layer Automation Architecture



Emerging Cyber Physical System-based Automation

- Global Market Size Forecast in 2019 (USD Billion)



Smart Factory technology will have global market size of **74.80**
Billion USD by **2022**. [Markets & Markets]



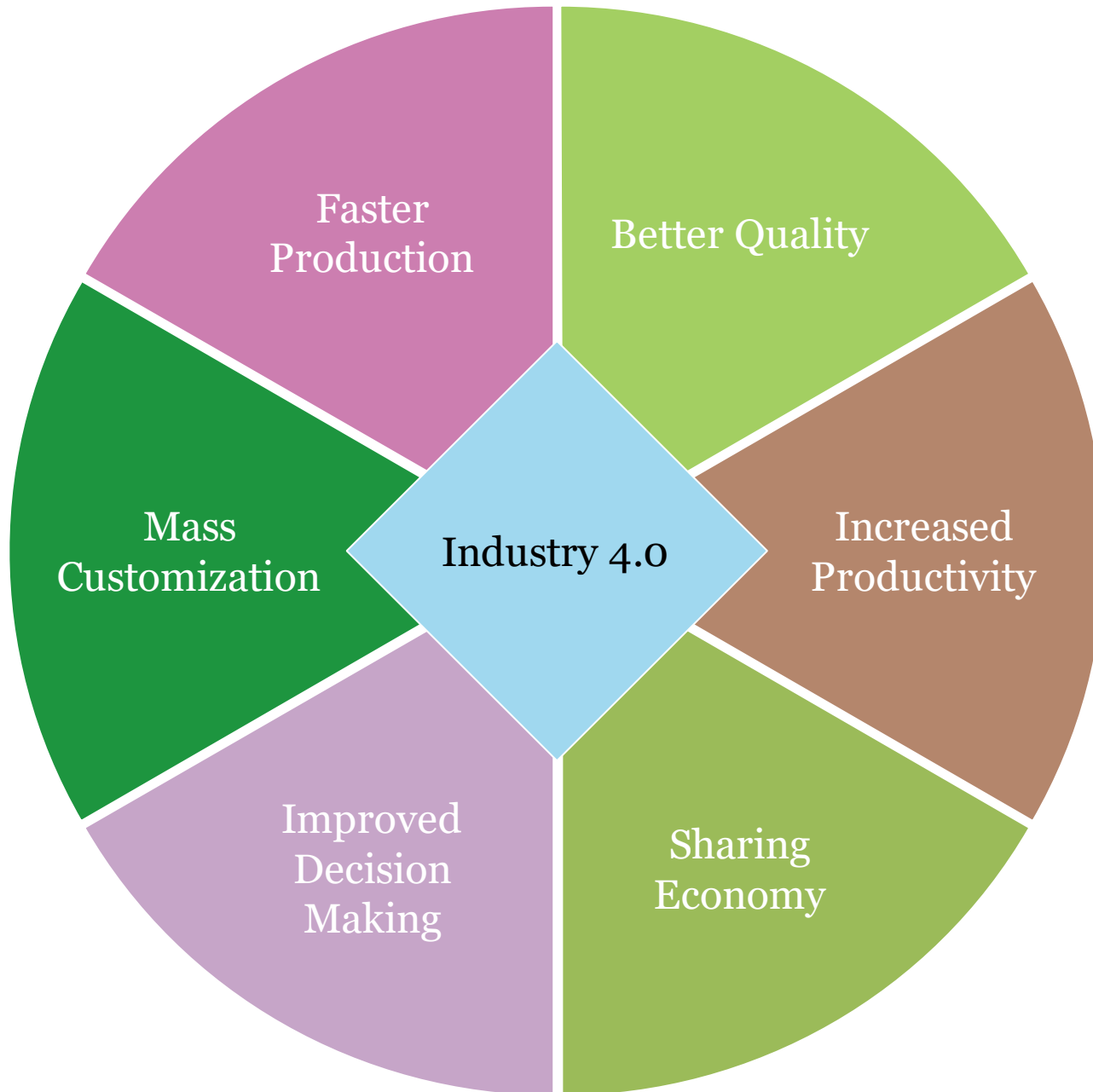
WHY INDUSTRY 4.0?



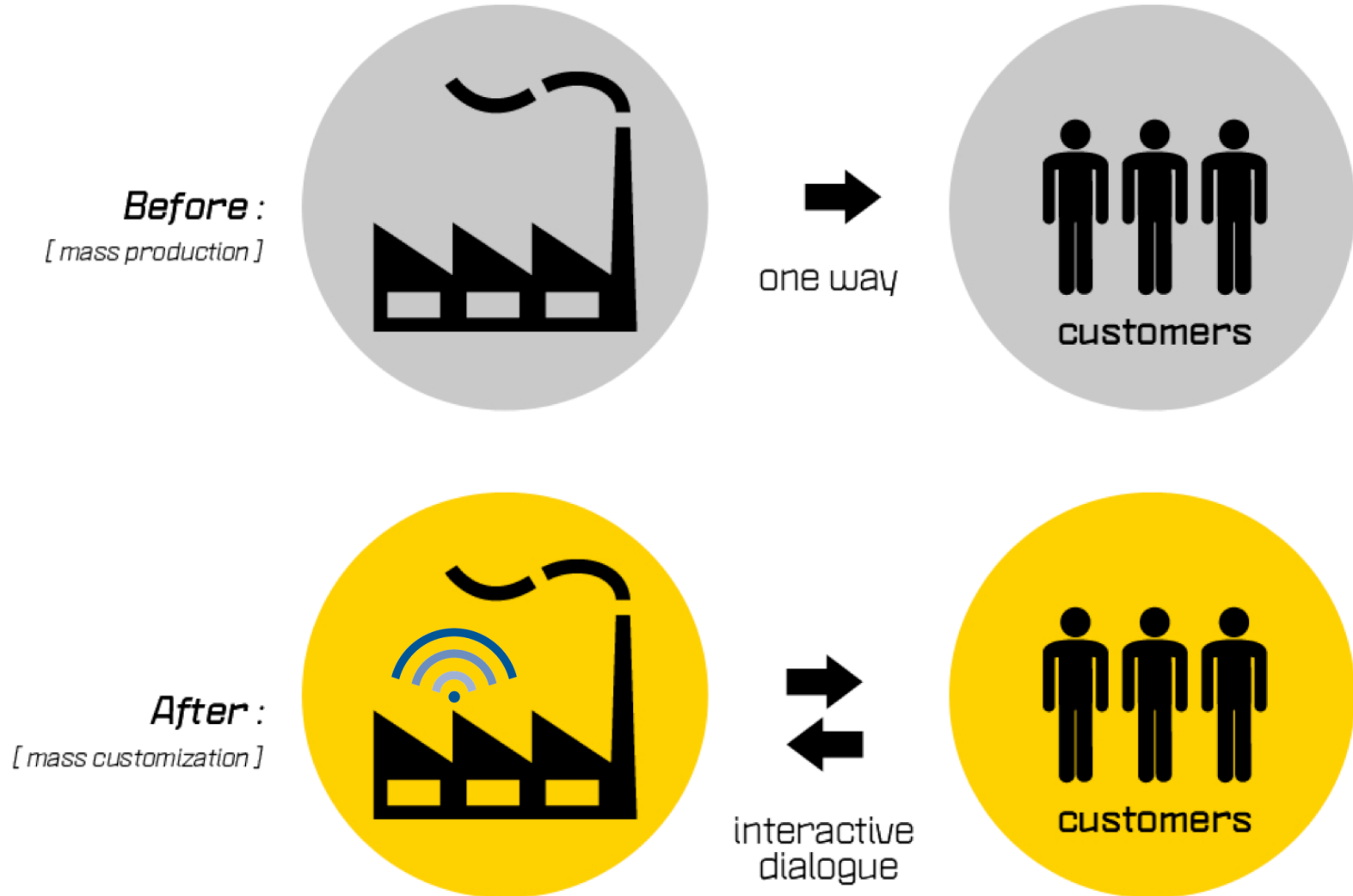
WHY INDUSTRY 4.0?

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- Mass Customization

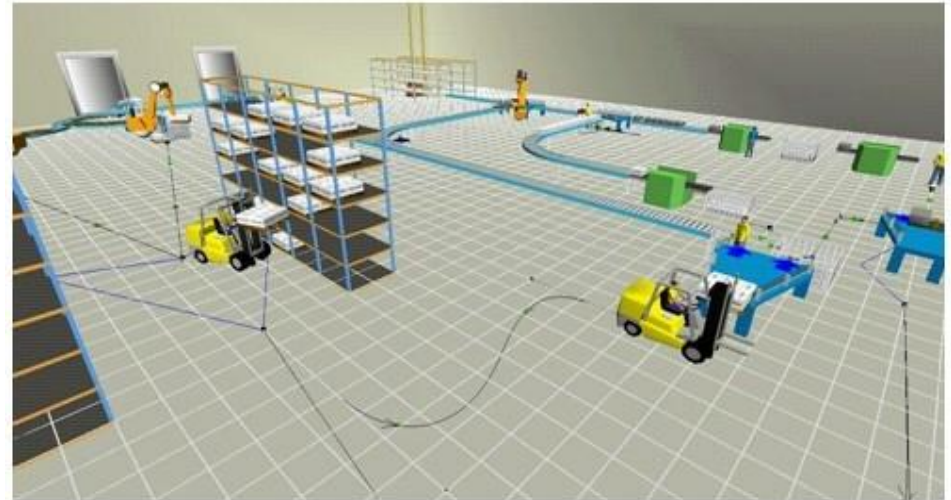


Increased flexibility in production and manufacturing on demand

- Faster Production



Digital designs



Virtual modeling of manufacturing process

Speed up the manufacturing process :



120% in time needed to **deliver orders**

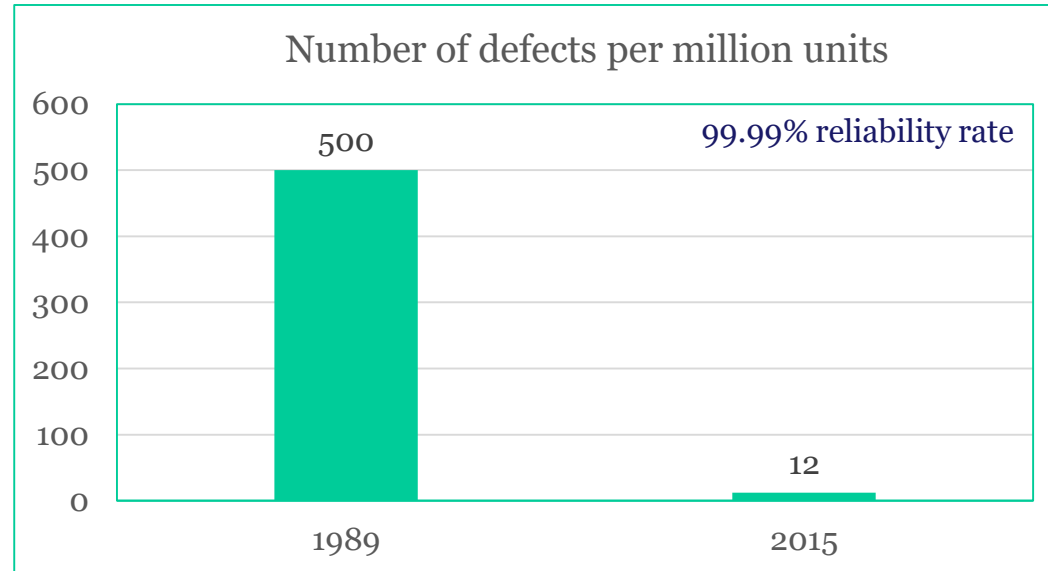


70% in time to get products to **market**



Data-driven supply chains

- Better Quality



Siemens Smart factor for custom Programmable Logic Controls (PLCs)

Top 100 European manufacturers could save an estimated **€160 billion** in the costs of scrapping or reworking defective products if they could eliminate all defects.



- Increased Productivity



Lights out/Dark factories work **24/7**

- Increased Productivity

Predictive maintenance
avoids machine failures on the
factory floor

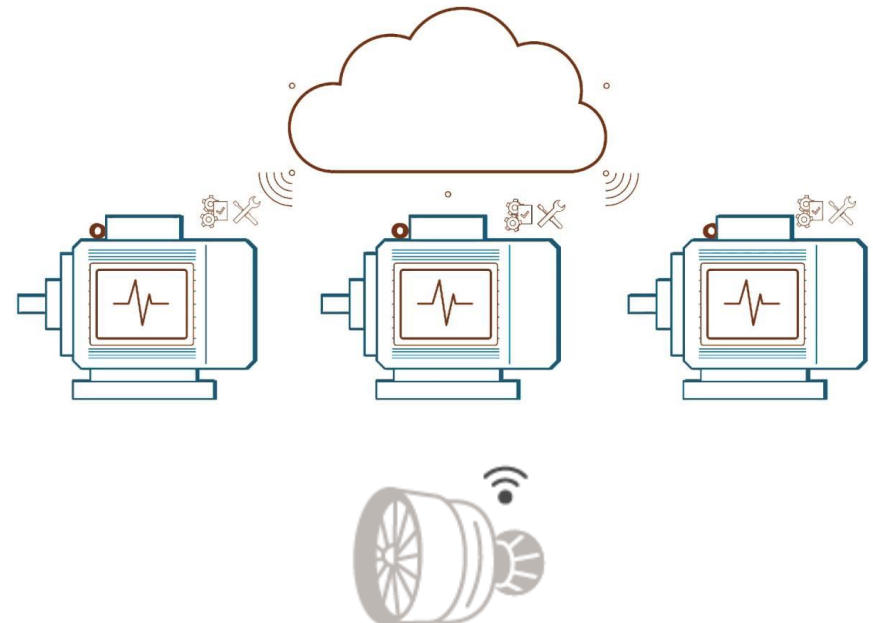
↓ **50%** decreased **downtime**

↑ **20%** increased **production**



Predictive maintenance will
help companies save **\$630
Billion** by **2025** [McKinsey]

Corrective Maintenance	Planned Maintenance	Predictive Maintenance
Repair it after it breaks	Repair it before it breaks	Do not repair it, eliminate the root cause
Hight cost, overtime	Scheduled, coordinated	Life extension, labor time reduction



- Sharing Economy



- Improved Decision Making



With access to factory and cross-market data, decision makers can **predict**, **response**, and **adapt** to factory needs and market trends

CHALLENGES



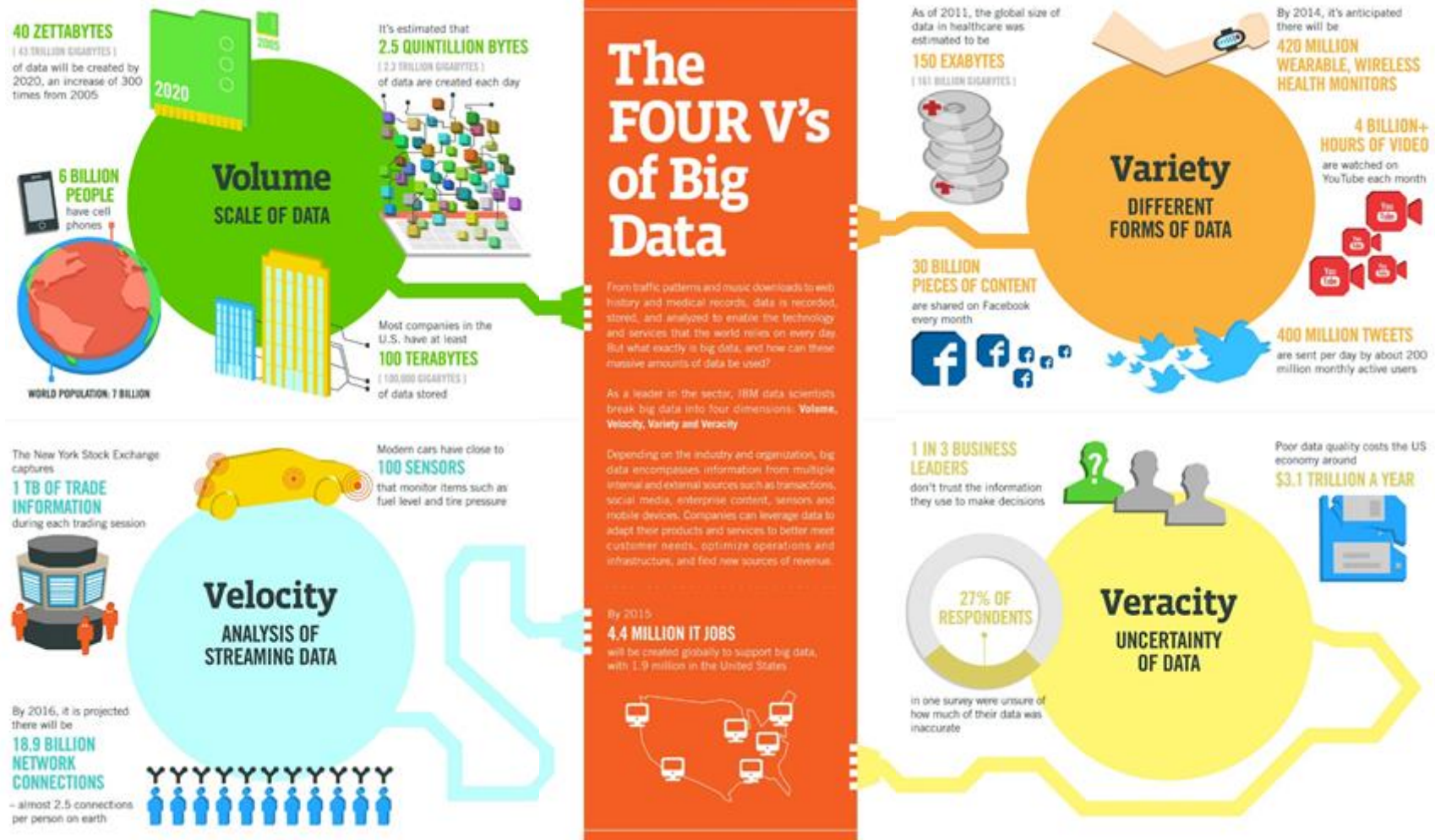
Technical Challenges

- Communication reliability and QoS
- Cyber security
- Maturity of machine intelligence
- Handling big data

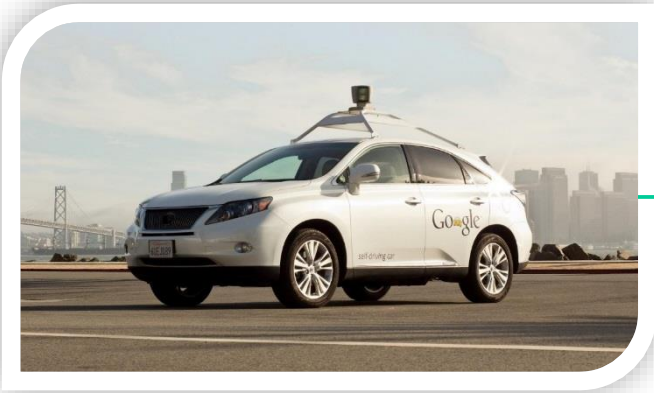
Social Impact

- General reluctance to change by stakeholders
- Lack of adequate skill-sets
- Unemployment

• Big Data



- Big Data



Autonomous Vehicle

4 TB

Per Day



RADAR: ~10-100 KB per second



Camera: ~20-40 MB per second



SONAR: ~10-100KB per second

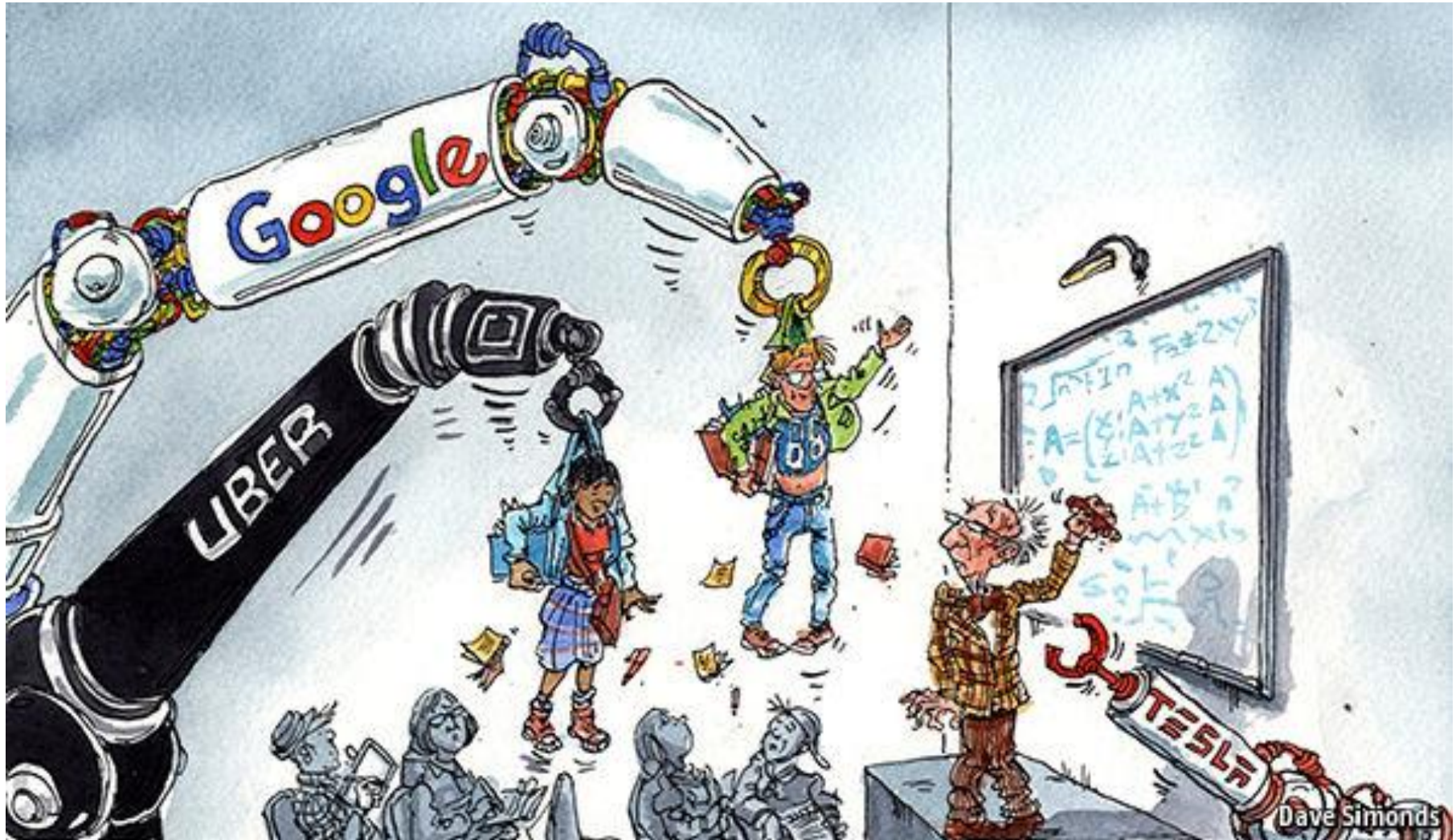


LIDAR: ~10-70 MB per second



GPS: ~50 KB per second

- Social Impact



- Social Impact

We can expect a wave of structural unemployment to spring from the technology in the medium term.

A study out of **Oxford University** in **2014** found that in the near future **artificially intelligent technology** **could take over** nearly half of all U.S. jobs.



- Social Impact

Robots find applications in
“**4D tasks**”

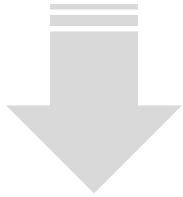






• Social Impact

Robotenomics research headcount analysis sample

	2014	2013	2012	2011	2010	2009	Increase	Increase %
Audi	77 247	71 781	67 231	62 806	59 513	58 011	19 236	33,16
BMW	116 324	110 351	105 876	100 306	95 453	96 230	20 094	20,88
Daimler	279 972	274 616	274 605	267 274	258 120	256 407	23 565	9,19
Fiat	228 690	225 587	214 836	197 021	199 924	190 014	38 676	20,35
Peugeot Citroen	189 786	196 885	202 108	209 000	198 220	186 220	3 566	1,91
Porsche	22 401	19 456	17 502	15 307	13 159	12 100	10 301	85,13
Volkswagen AG	112 561	107 559	101 794	97 691	94 787	95 164	17 397	18,28
	1 026 981	1 006 235	983 952	949 405	919 176	894 146	132 835	14,86
Nissan	160 530	160 530				155 659	4 871	3,13
Toyota	338 875	338 875				320 590	18 285	5,70
Honda	198 561	198 561				176 815	21 746	12,30
	1 724 947	1 704 201				1 547 210	177 737	

- Social Impact





-  Faster
-  More precise
-  Able to work in harsh environments
-  Higher initial cost and lower running cost



Human



-  Creative
-  Lower initial cost and higher running cost

Thank you for your attention!

Questions?