

Forecast ▶

2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024

Global robotic market (US\$billions)

MILITARY: Exoskeletons, unmanned aerial vehicles
INDUSTRIAL: Welding, assembly, painting robots
COMMERCIAL: Medical, building, farming robots
PERSONAL: Cleaning, teaching, childcare robots

7 RISE OF ROBOTS

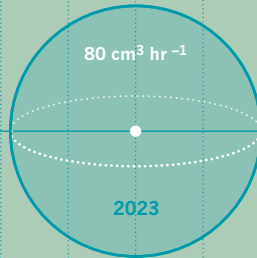
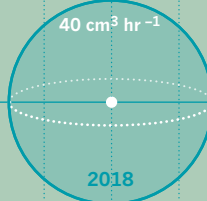
Purchases of robots are set to rocket as their capabilities increase and costs fall, a trend driven by massive investments in artificial intelligence and robotics by the military and by computing giants such as Google.

All these factors are now converging to push seemingly futuristic technologies out of the lab, and set them on the same path taken by personal computing and consumer electronics.

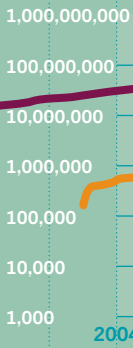
TO THE FUTURE!

6 LIKE IT, PRINT IT

3D printing is becoming cheaper and quicker — one factor that could disrupt manufacturing and allow once-pricey robotics to be mass produced.

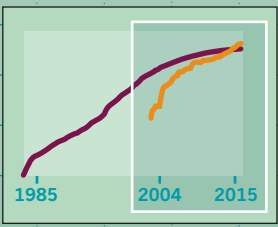


Number of sequences (logarithmic scale)



Sequence records in GenBank

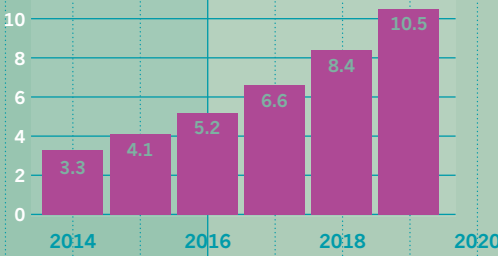
Whole genome sequences



5 BIOLOGY BOOMS

Conceptual and technological advances are driving progress in biology. DNA sequencing costs have fallen at an exponential rate and the number of sequences has soared since 1985 (see inset). Similar advances are happening in neuroscience and biological nanotechnology.

Billions of machine-to-machine connections



DRIVERS

4 TALKING DEVICES

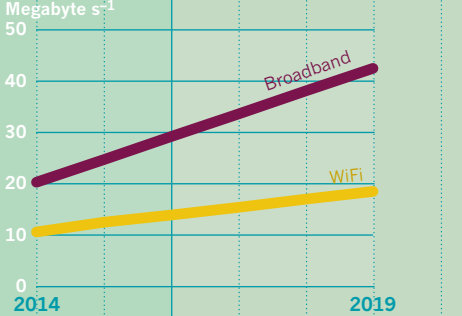
By 2020, the number of connected sensors and devices in buildings, cities and farms — the 'Internet of Things' — will be twice that of the human population.

2004 2006 2008 2010 2012

3 COMMUNICATION SPEED

Meanwhile, the performance and scale of the Internet improves. Broadband and WiFi speeds are increasing, and Internet data traffic will exceed a zettabyte this year and double by 2019.

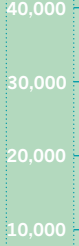
Forecast ▶



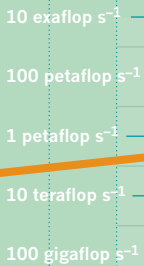
2 REALLY BIG DATA

The amount of data worldwide is predicted to reach a whopping 44 zettabytes (10^{21} bytes) by 2020 — nearly as many digital bits as there are stars in the Universe. This gives more raw material for artificial-intelligence machines to learn from.

Exabytes



Performance (logarithmic scale)



World's most powerful supercomputer

Supercomputers in 2020 are likely to be 30 times more powerful than those of today.

1 COMPUTING POWER

The exponential growth in supercomputing performance is one indicator of dizzying advances across computing.

START HERE!

ENABLERS

END HERE!

ONWARDS & UPWARDS

BY DECLAN BUTLER / DESIGN BY WES FERNANDES

Exponential advances in enabling technologies have reached the point at which they could trigger disruptive change in sectors from artificial intelligence to robotics to medicine. As a result, many experts argue that tomorrow's world will be unrecognizable from that of today.

FUTURE FOCUS

Expert predictions

A possible 'Cambrian explosion' in robotics with a rapid period of incredible machine diversification. Robots communicating with each other at speeds that are 100 million times faster than humans might allow swarms of robots to build on each other's learning experiences at lightning speed.

GILL PRATT

Head of the Toyota Research Institute, Palo Alto, California

A full brain-activity map and connectome by 2020 and by 2040 it will be routine to read and write data to billions of neurons. By 2040, 1 billion people will have their whole genome sequenced and get constant updates of their immunomes and microbiomes.

GEORGE CHURCH

Geneticist at Harvard Medical School, Cambridge, Massachusetts

The promise for the future is a world where robots are as common as cars and phones, a world where everybody can have a robot and robots are pervasively integrated in the fabric of life.

DANIELA RUS

Head of the Computer Science and Artificial Intelligence Laboratory at the Massachusetts Institute of Technology, Cambridge

In the next couple of generations, we will see the first phase of true personal, assistive robots in the home and other human environments. There will be a huge opportunity to better the quality of life, for example by freeing up people from work.

FEI-FEI LI

Head of the Stanford Artificial Intelligence Laboratory, California

Tomorrow's scientists will have armies of virtual graduate students, doing lab work, statistical analysis, literature search and even paper-writing for them.

PEDRO DOMINGOS

Machine-learning researcher, University of Washington, Seattle

ILLUSTRATIONS BY GREYGOULAR

