Disruptive Technologies

Presented by Ryan Rechkemmer | October 17th, 2013

Disruptive Technologies

"Advances that will transform life, business, and the global economy"

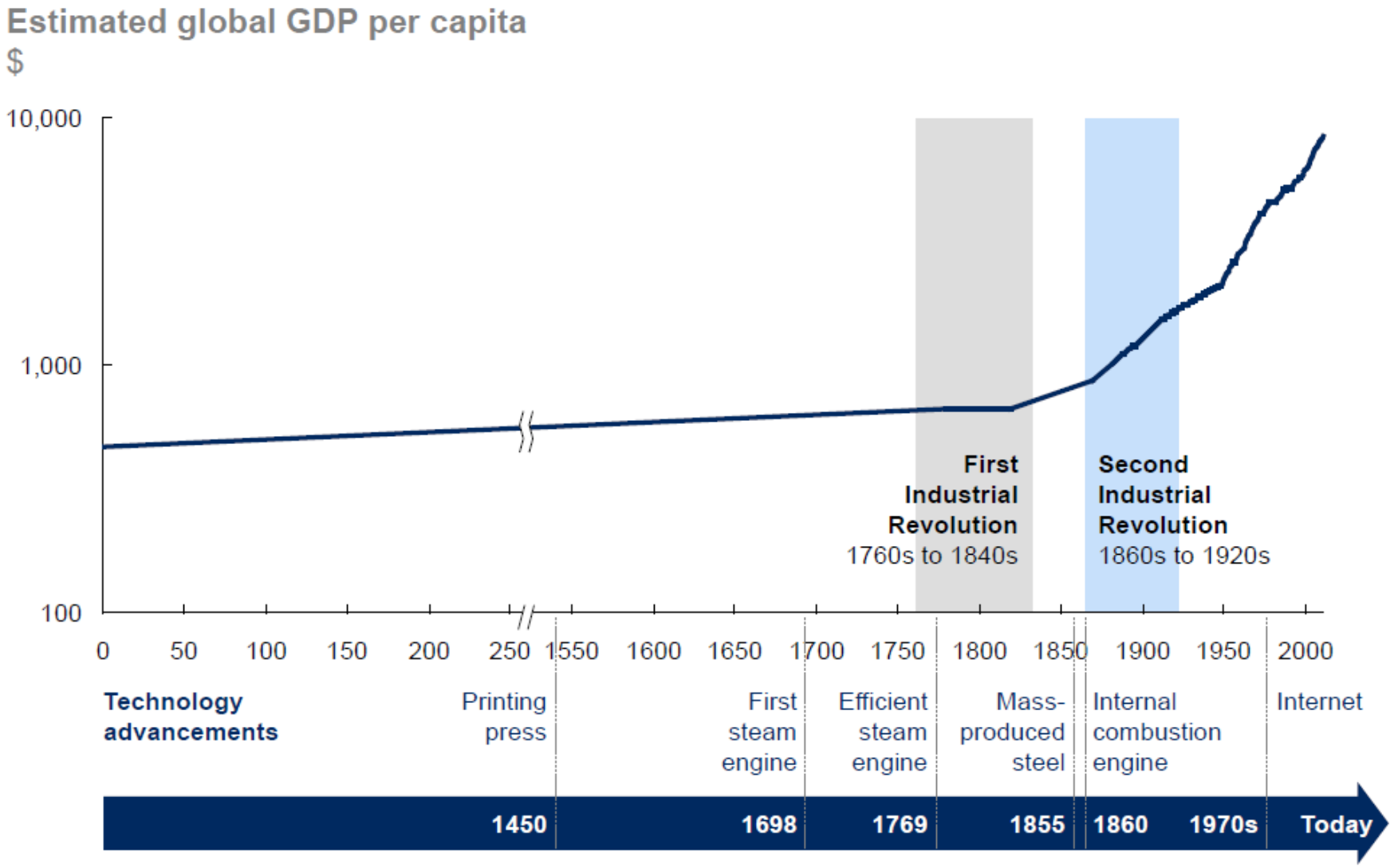
McKinsey Global Institute's Criteria

- The technology is rapidly advancing or experiencing breakthroughs
- The potential scope of impact is broad
- Significant economic value could be affected
- Economic impact is potentially disruptive

General Observations

- "Creative disruption" alters the economics of an industry
- Societal challenges accompany the "next big thing"

Historical Precedent



SOURCE: Angus Maddison, "Statistics on World Population, GDP and Per Capita GDP, 1–2008 AD"; McKinsey Global Institute analysis

Case Study

- Focused on preserving its leadership in the photographic film market
- Developed and marketed "film-based digital imaging"
- Underestimated competition from Fujifilm
- Made unrelated acquisitions to diversify its business
- Belatedly transitioned to digital photography

- Filed for Chapter 11 bankruptcy in January 2012

12 Potentially Disruptive Technologies

Mobile Internet

Automation of knowledge work

Internet of Things

Cloud technology

Advanced robotics

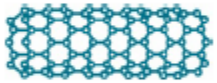
Autonomous and near-autonomous vehicles

Advanced oil and gas exploration and recovery

3D printing

Next-generation genomics

Energy storage

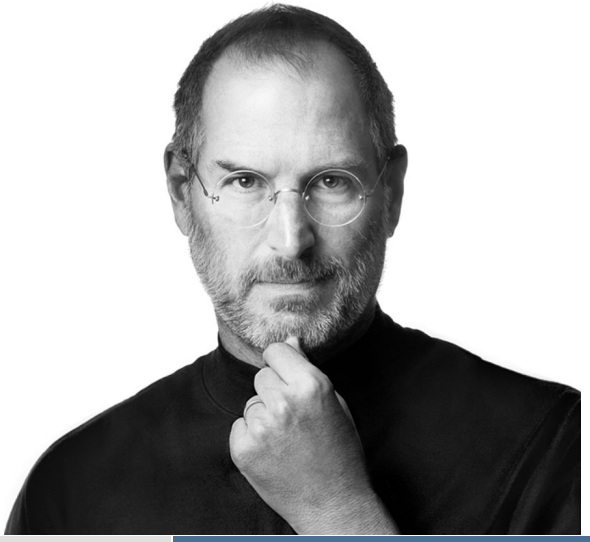


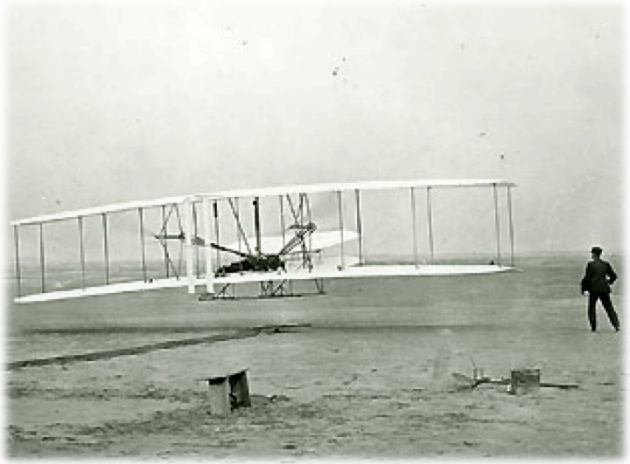
Advanced materials

Renewable energy

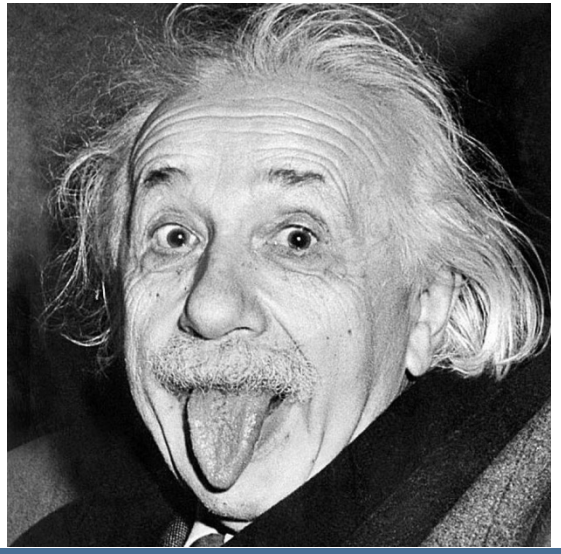
Underestimated Disruptive Technologies

"The desktop computer industry is dead. Innovation has virtually ceased. Microsoft dominates with very little innovation. That's over. Apple lost."
– Steve Jobs, 1996





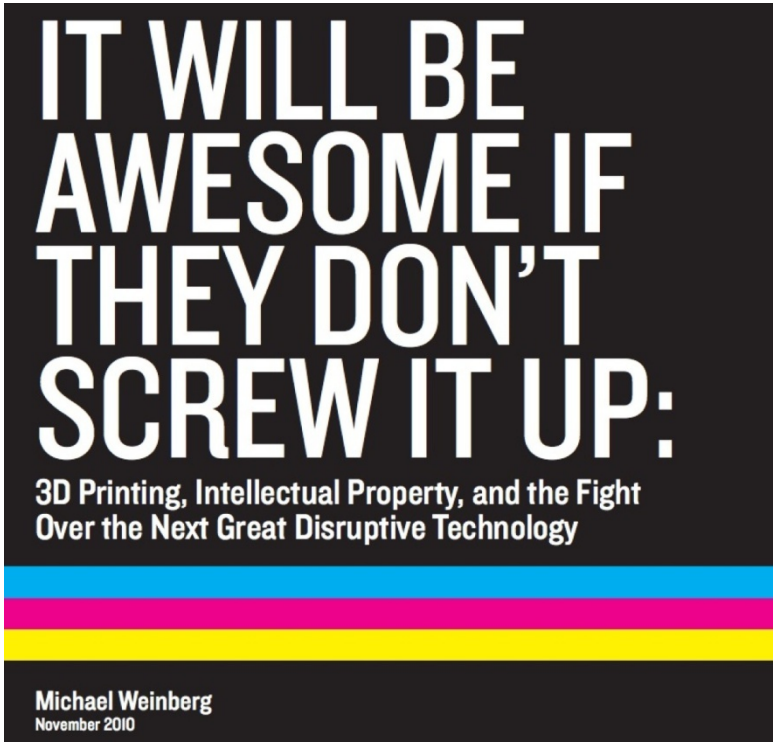
"There is not the slightest indication that nuclear energy will ever be obtainable. It would mean that the atom would have to be shattered at will."
— Albert Einstein



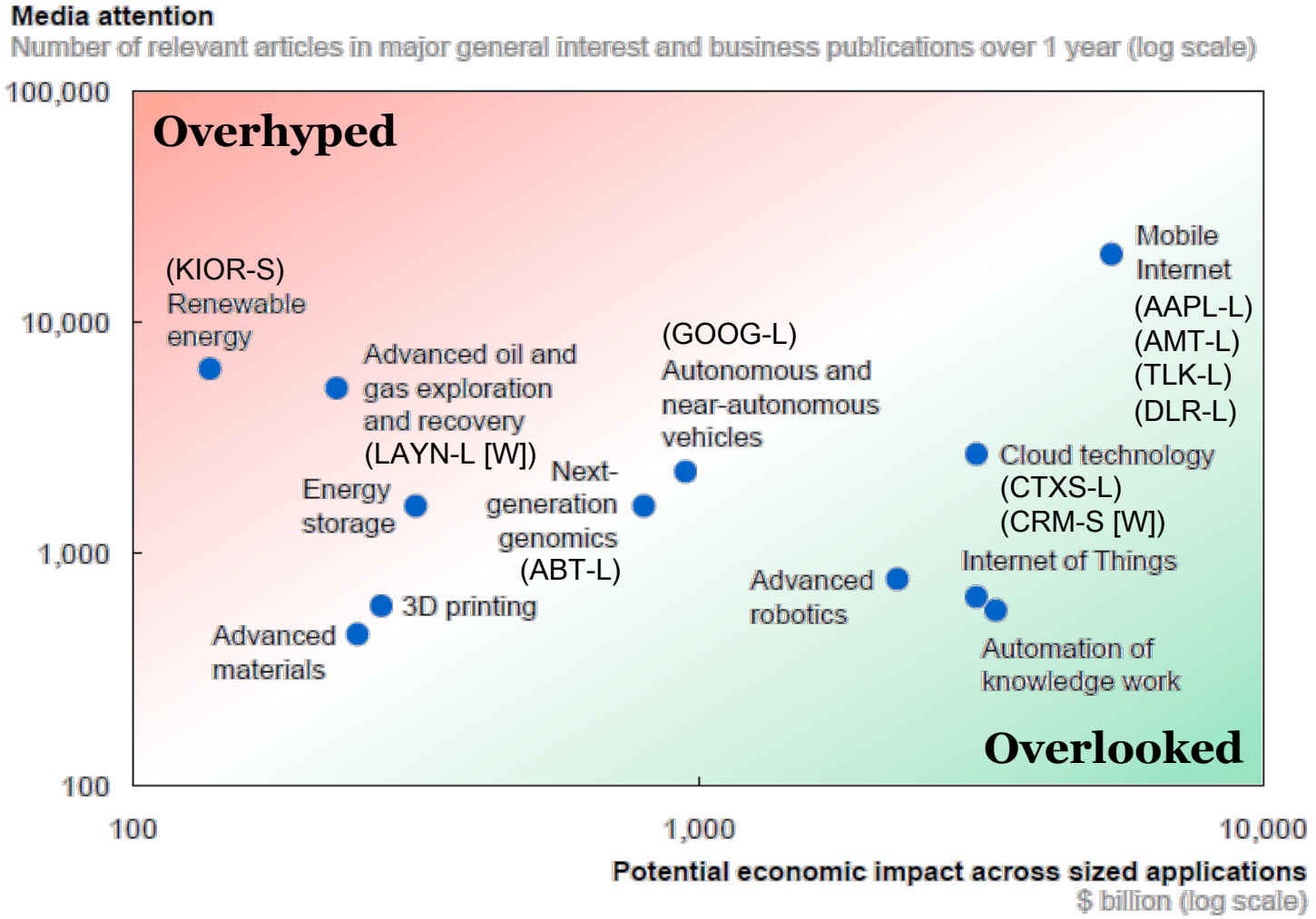
"Not within a thousand years will man ever fly!"
– Wilbur Wright, 1901

De-railed Disruptive Technologies

"**Nuclear powered vacuum cleaners will probably be a reality within 10 years.**" —Alex Lewyt, quoted in the New York Times, June 10th, 1955



Too Much or Too Little Attention



NOTE: Estimates of potential economic impact are for only some applications and is not a comprehensive estimate of total potential impact. Estimates include consumer surplus and cannot be related to potential company revenue, market size, or GDP impact. We do not size possible surplus shifts among companies and industries, or between companies and consumers. These estimates are not risk- or probability-adjusted.

SOURCE: Factiva; McKinsey Global Institute analysis

Other Technologies of Interest

Runner-Ups

- Next-generation nuclear (fission)
- Fusion power
- Carbon sequestration
- Advanced water purification
- Quantum computing

Honorable Mentions

- Private space flight
- OLED / LED lighting
- Wireless charging
- Flexible displays
- 3D and volumetric displays

Group Breakout Activity

Task

1. Select a disruptive technology
2. Meet the corresponding Manager or Associate to form a group (see below)
3. Research and discuss the investment implications of your technology

Disruptive Technology	Group Leader
3D printing	Ajay
Advanced materials	Ryan R.
Advanced oil and gas exploration and recovery	Chase
Advanced robotics	Joe
Automation of knowledge work	Alvin
Autonomous and near-autonomous vehicles	Rahul
Cloud technology	Kevin
Energy storage	Max
Internet of Things	Selena
Mobile Internet	Harrison
Next-generation genomics	Jessica
Renewable energy	Mitchell

12 Potentially Disruptive Technologies

Mobile Internet

Increasingly inexpensive and capable mobile computing devices and Internet connectivity

Automation of knowledge work

Intelligent software systems that can perform knowledge work tasks involving unstructured commands and subtle judgments

Internet of Things

Networks of low-cost sensors and actuators for data collection, monitoring, decision making, and process optimization

Cloud technology

Use of computer hardware and software resources delivered over a network or the Internet, often as a service

Advanced robotics

Increasingly capable robots with enhanced senses, dexterity, and intelligence used to automate tasks or augment humans

Autonomous and near-autonomous vehicles

Vehicles that can navigate and operate with reduced or no human intervention

Next-generation genomics

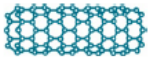
Fast, low-cost gene sequencing, advanced big data analytics, and synthetic biology ("writing" DNA)

Energy storage

Devices or systems that store energy for later use, including batteries

3D printing

Additive manufacturing techniques to create objects by printing layers of material based on digital models



Advanced materials

Materials designed to have superior characteristics (e.g., strength, weight, conductivity) or functionality

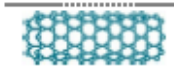
Advanced oil and gas exploration and recovery

Exploration and recovery techniques that make extraction of unconventional oil and gas economical

Renewable energy

Generation of electricity from renewable sources with reduced harmful climate impact

Speed, Scope, and Economic Value at Stake

	Illustrative rates of technology improvement and diffusion	Illustrative groups, products, and resources that could be impacted[1]	Illustrative pools of economic value that could be impacted[1]
 **Next-generation genomics**	**10 months** Time to double sequencing speed per dollar **100x** Increase in acreage of genetically modified crops, 1996–2012	**26 million** Annual deaths from cancer, cardio-vascular disease, or Type 2 diabetes **2.5 billion** People employed in agriculture	**$6.5 trillion** Global health-care costs **$1.1 trillion** Global value of wheat, rice, maize, soy, and barley
 **Energy storage**	**40%** Price decline for a lithium-ion battery pack in an electric vehicle since 2009	**1 billion** Cars and trucks globally **1.2 billion** People without access to electricity	**$2.5 trillion** Revenue from global consumption of gasoline and diesel **$100 billion** Estimated value of electricity for households currently without access
 **3D printing**	**90%** Lower price for a home 3D printer vs. 4 years ago **4x** Increase in additive manufacturing revenues in past 10 years	**320 million** Manufacturing workers, 12% of global workforce **8 billion** Annual number of toys manufactured globally	**$11 trillion** Global manufacturing GDP **$85 billion** Revenue from global toy sales
 **Advanced materials**	**$1,000 vs. $50** Difference in price of 1 gram of nanotubes over 10 years **115x** Strength-to-weight ratio of carbon nanotubes vs. steel	**7.6 million tons** Annual global silicon consumption **45,000 metric tons** Annual global carbon fiber consumption	**$1.2 trillion** Revenue from global semiconductor sales **$4 billion** Revenue from global carbon fiber sales
 **Advanced oil and gas exploration and recovery**	**3x** Increase in efficiency of US gas wells, 2007–11 **2x** Increase in efficiency of US oil wells, 2007–11	**22 billion** Barrels of oil equivalent in natural gas produced globally **30 billion** Barrels of crude oil produced globally	**$800 billion** Revenue from global sales of natural gas **$3.4 trillion** Revenue from global sales of crude oil
 **Renewable energy**	**85%** Lower price for a solar photovoltaic cell per watt since 2000 **19x** Growth in solar photovoltaic and wind generation capacity since 2000	**21,000 TWh** Annual global electricity consumption **13 billion tons** Annual CO_2 emissions from electricity generation, more than from all cars, trucks, and planes	**$3.5 trillion** Value of global electricity consumption **$80 billion** Value of global carbon market transactions

1 Not comprehensive; indicative groups, products, and resources only.
2 For CDC-7600, considered the world's fastest computer from 1969 to 1975; equivalent to $32 million in 2013 at an average inflation rate of 4.3% per year since launch in 1969.
3 Baxter is a general-purpose basic manufacturing robot developed by startup Rethink Robotics.
SOURCE: McKinsey Global Institute analysis

	Illustrative rates of technology improvement and diffusion	Illustrative groups, products, and resources that could be impacted[1]	Illustrative pools of economic value that could be impacted[1]
Mobile Internet	**$5 million vs. $400[2]** Price of the fastest supercomputer in 1975 vs. that of an iPhone 4 today, equal in performance (MFLOPS) **6x** Growth in sales of smartphones and tablets since launch of iPhone in 2007	**4.3 billion** People remaining to be connected to the Internet, potentially through mobile Internet **1 billion** Transaction and interaction workers, nearly 40% of global workforce	**$1.7 trillion** GDP related to the Internet **$25 trillion** Interaction and transaction worker employment costs, 70% of global employment costs
Automation of knowledge work	**100x** Increase in computing power from IBM's Deep Blue (chess champion in 1997) to Watson (Jeopardy winner in 2011) **400+ million** Increase in number of users of intelligent digital assistants like Siri and Google Now in last 5 years	**230+ million** Knowledge workers, 9% of global workforce **1.1 billion** Smartphone users, with potential to use automated digital assistance apps	**$9+ trillion** Knowledge worker employment costs, 27% of global employment costs
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 last 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 revenues **$155 billion** Revenue from sales of civilian, military, and general aviation aircraft