

Cities & Urbanization: Focal Point for Megatrends



Managing Our Planet

Earth Day 22 April 2015

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Massive Urbanization Ahead

1800: 3% of 1 billion pop or about **30** million

1900: 14% of 1.6 billion or about **220** million

1950: 30% of 2.5 billion or about **750** million

2015: 50% of 7.2 billion or about **3.6** billion

2030: 60% of 8.3 billion or about **5** billion

2050: 70% of 9.6 billion or about **6.7** billion

70 million people added to cities each year

Additional 100 Jakartas globally by 2050?

“Our Struggle for Sustainability Will Be Won or Lost in Cities” – Ban Ki-moon

- Global resource demand growth driven by growing urban population & the growing global middle class
- Urban construction to 2050 will be nearly as massive as all of human history
- Cities are source of economic growth, innovation & opportunity
 - 600 cities generate 50% of global growth with 20% of global population
 - Attractors of talent & entrepreneurialism
 - Focus of development and use of technology
- Greening cities will be multi-trillion dollar market
 - “Smart Cities” technology, Internet of Things, transportation, health care, communications, autonomous vehicles

China's Urbanization Posing Resource & Environmental Challenges



Pudong – Rice Paddies to Skyscrapers
in Two Decades

Rising Global Middle Class & Christmas Consumption in Shanghai



Dystopian Urban Future?

- Environmental disasters from pollution, waste, climate change, resource depletion – greater stress global environment
- Expanding slums & informal economy
- Poverty, disease, violence, gangs, terrorism
- Unmet expectations & increasing inequality leading to revolt of middle class
- Poor governance – chaos or police state control
- Decline of global economy & international cooperation
- Climate change impact on unprepared cities
- Failing states and failing cities

... Or Civilization's Global Urban Renewal?

- Green infrastructure, energy, & built environment
- Cities as global actors, from economics to politics to environment to peace & security
- Smart city technology for efficiency & delivery of services, including health & education
- Technology to enhance inclusive, effective democratic governance
- Democratized technology to foster innovation & jobs
- Local production of energy, food, & goods - vision for sustainable future
- Lock-in of urban infrastructure shows need for foresight in long-term planning

Cost of Lock-in: Alexandria's GenOn Coal-fired Power Plant 1949-2012

Yearly

63 years of operation

[Estimates based on typical 500 MW Plant*]

Coal: 1.4 m/tons

88 million tons

Water: 2.2 billion gal

138 billion gal

SOx: 10,000 tons

630,000 tons

NOx: 10,200 tons

650,000 tons

CO2: 3.7 million tons

233 million tons

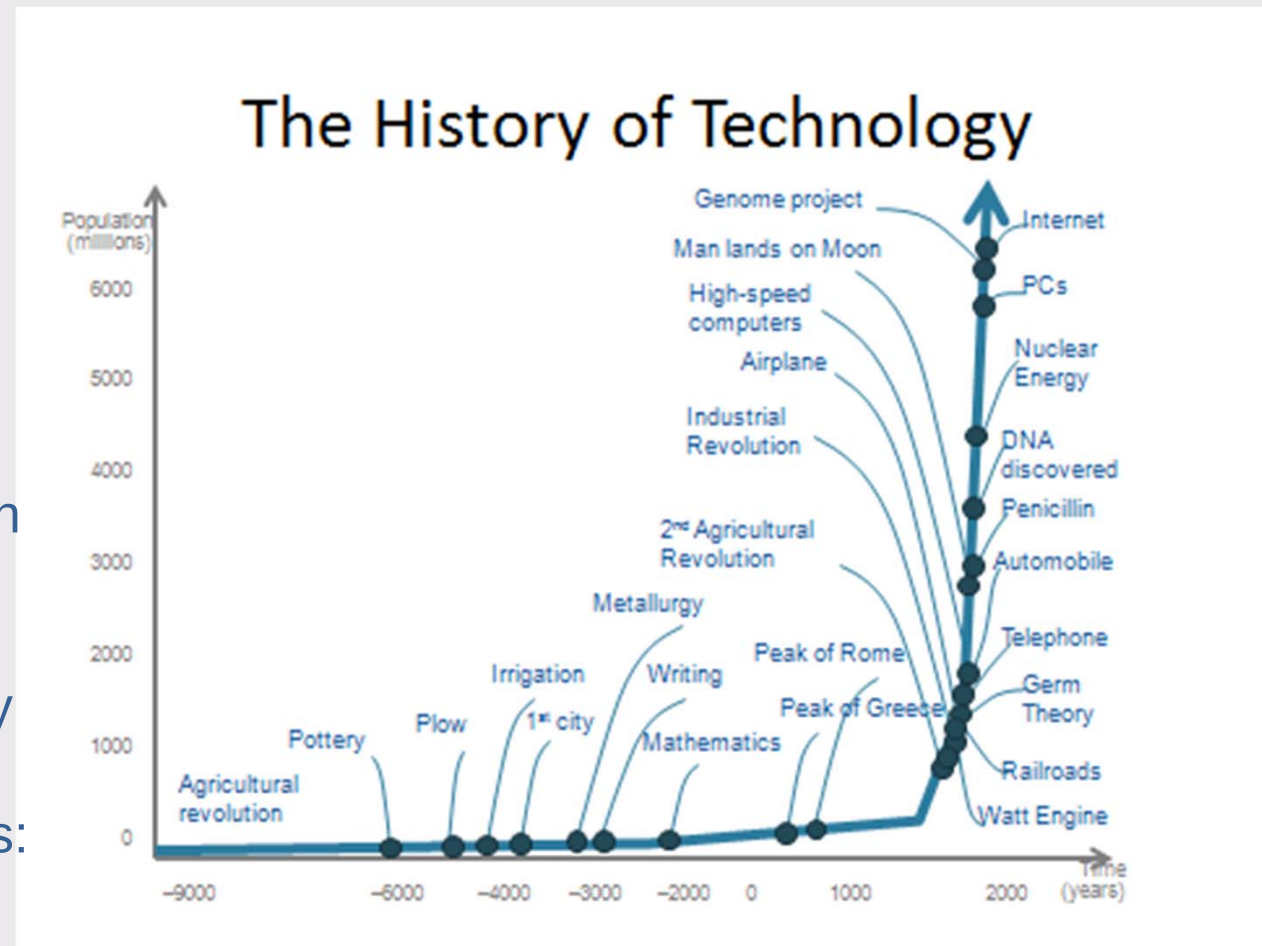
Fuel cost: \$70 million

\$4.4 billion

* Union of Concerned Scientists

Emerging Technologies & Urban Transformation

- Rapid growth in computing innovation leads to subsequent new revolutions
- Moore's Law is now applicable to more than computing, which means many technologies are evolving exponentially at the same time
- 30 exponential steps: 25x around the earth



Disruptive Technologies: More Change in Next 20 Years than last 50?

- Ubiquitous computing & universal connectivity
 - Big Data, cloud computing, pervasive connectivity, wearable computing, social media, Internet of Things, quantum computing; artificial intelligence
- Third Industrial Revolution
 - New robotics (Baxter and Google cars), drones, 3/4D printing, nano materials, bioengineering, leveraged ICT,
- Resource technology
 - Energy: Unconventional gas, solar, wind, biofuels, storage, fusion
 - Food: GMOs, precision agriculture, vertical farms, printed meat
 - Water: efficiency, desalinization & purification
- Health and human augmentation
 - Personalized medicine; technologies to extend life, ameliorate disease and physical and mental disabilities; augmentation of human capabilities; 3D printed organ and tissue replacement; and reduced health costs
- Exponential Organizations
 - Leveraging exponential technologies
 - Disrupting current business models
 - 10X larger than peers: Uber, AirBnB, Waze, Google, Facebook

“Democratization of Technology” Boost for Sustainable Cities

- Exponential drop in cost & increase in capability
 - Ubiquitous computing
 - DIY genomics - \$200 personal DNA sequencing near?
 - DIY manufacturing – 3D printing
- Global Internet connectivity
 - 7.4 billion cell phone accounts
 - More than 2 billion mobile Internet devices
 - 2.7 billion people online with another 500 – 900 million by 2017
 - Smartphones & social media becoming ubiquitous
 - Leveling the global playing field: leveraging the cloud to do anything from anywhere
- Small scale, scaling up of distributed systems

3D Printing Changing the World



Made-in-Space:
First 3D printer on
Space Station

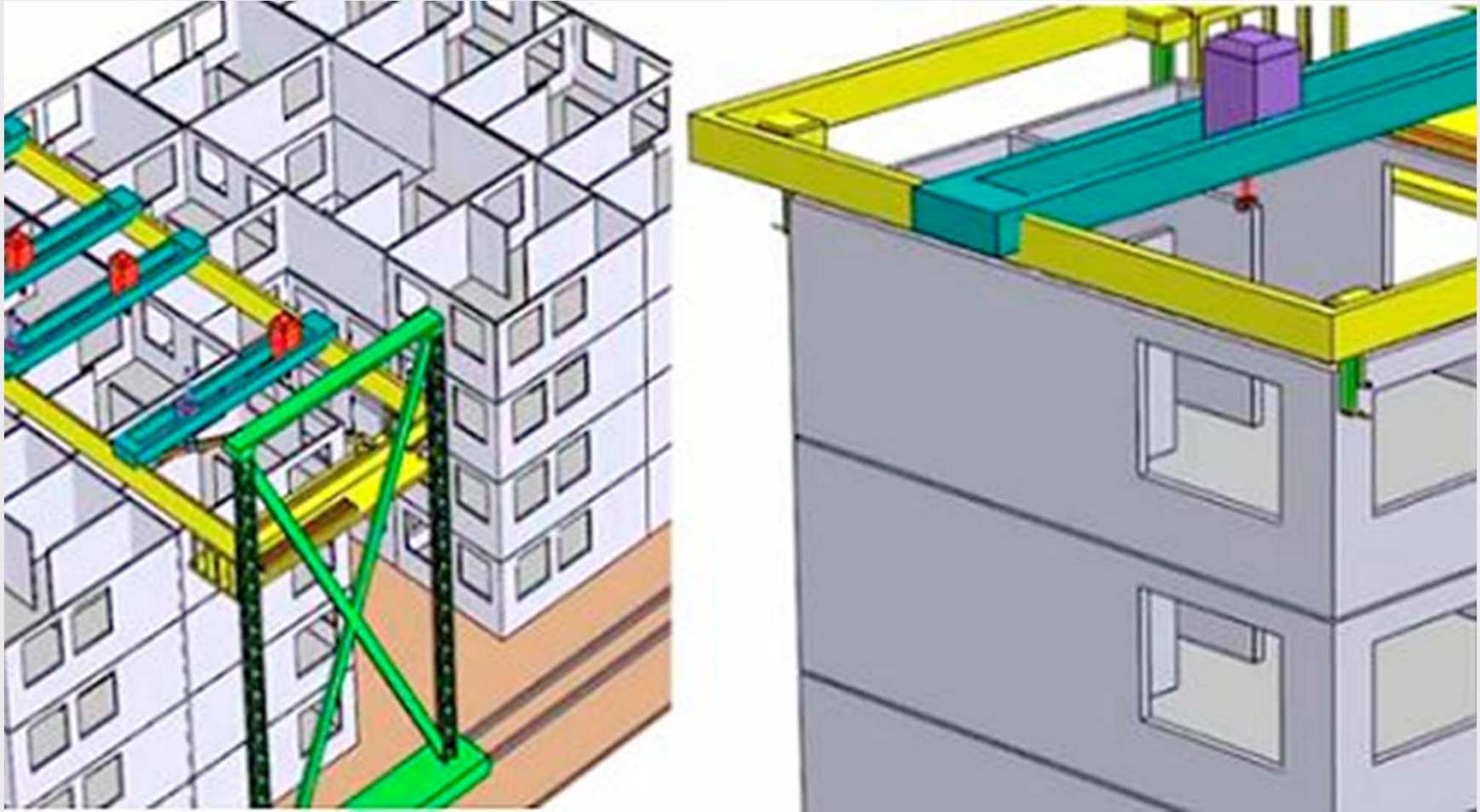


Complex 3D Printed object on
display at Autodesk



Organovo's Bioprinter for Human
Tissue

3D Printing Buildings



China Building World's Largest 3D Printer for Constructing Houses



Vertical Farms: Producing Food at Point of Consumption



Thank You

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