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Industry 4.0: The Fourth Revolution

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Historical Context

- Revolution: instantaneous and complete shift
- First Shift: from foraging to farming (10,000 years ago)
 - Results: production, transportation, communication
 - Growth in food production, prodding of population growth
- Industrial Revolution
 - Developments of new technologies and new approaches
 - Prompts shifts in economic models and social architecture

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Historical Context

➤ First Industrial Revolution

- During 1760 – 1840
- Driver: invention of steam engine and construction of railway stimulated the revolution
- Results: utilization of machines in production

➤ Second Industrial Revolution

- During the transition from 19th century to 20th century
- Driver: electricity and assembly line triggered the revolution
- Results: mass production

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Historical Context

- Third Industrial Revolution
 - Prompted in 1960s
 - Computer or Digital Revolution
 - Driver: production of semiconductor triggered the revolution
 - Results: mainframe, personal computer, and internet

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Fourth Industrial Revolution

- Stimulated in 21st century
- Proposed to uplift German economy*
- Digital Revolution triggered the revolution
- Extensive use of ubiquitous and mobile internet
- During the revolution, sensors become cheaper, reduced in size, powerful
- Extensive use of Artificial Intelligence, Machine Learning, Cyber Physical System (CPS)

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Source *: Lu, Y., 2017. Industry 4.0: A survey on technologies, applications and open research issues. Journal of Industrial Information Integration, 6, pp.1-10.

Fourth Industrial Revolution

- Computers have become more sophisticated and integrated
 - Results: radical transformation of societies and global economies
- Fourth Industrial Revolution is coined as “The second Machine Age”* by Prof. Erik Brynjolfsson, MIT and Andrew McAfee, MIT
- Industry 4.0, another synonym of Fourth Industrial Revolution, is coined by Hannover Fair in 2011.

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Source *: Brynjolfsson, E. and McAfee, A., 2014. The second machine age: Work, progress, and prosperity in a time of brilliant technologies. WW Norton & Company

Fourth Revolution

- Scope of Fourth Revolution:
 - Smart Connected Machines
 - Smart Factories
 - Gene Sequencing
 - Nanotechnology
 - Renewables
 - Quantum Computing

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Profound and Systematic Change

- The scale and scope of innovation of Fourth Industrial Revolution defines today's acute disruption and innovation
- Airbnb, Uber, Alibaba, etc., disruptors of today, are relatively new
- Ubiquitous iPhone launched in 2007 → Billions of smart phones are being mass produced currently
- Google announced fully autonomous car in 2010 → AI-based self navigating cars are on the way

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Profound and Systematic Change

- Not only the speed of profound change, but scale of profound change is equally staggering
- Example *:
 - In 1990, industry giants in Detroit had a combined market of \$36 billion capitalization, \$250 billion revenues, 1.2 million employee
 - In 2014, industry giants in Silicon Valley had a combined market of \$1.09 trillion capitalization, \$247 billion revenues, 1,37,000 employee

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Source *: Manyika, J. and Chui, M., 2014. Digital era brings hyperscale challenges. Financial Times, 13.

Profound and Systematic Change

- With marginal costs, digital business creates unit of today's wealth with fewer workers
- Business, providing information goods, has virtually zero transportation and replication cost
- In the context of Industry 4.0, Instagram, WhatsApp, etc. do not require much capital to begin with, but it changes the role of capital and scaling business

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Profound and Systematic Change

- In the context of Fourth Industrial Revolution
 - Digital fabrication technologies are able to communicate with biological world
 - Designers and architects are, now, combining
 - Computational design
 - Additive manufacturing
 - Material engineering
 - Synthetic biology
 - Results: producing objects that are mutable and adaptable

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

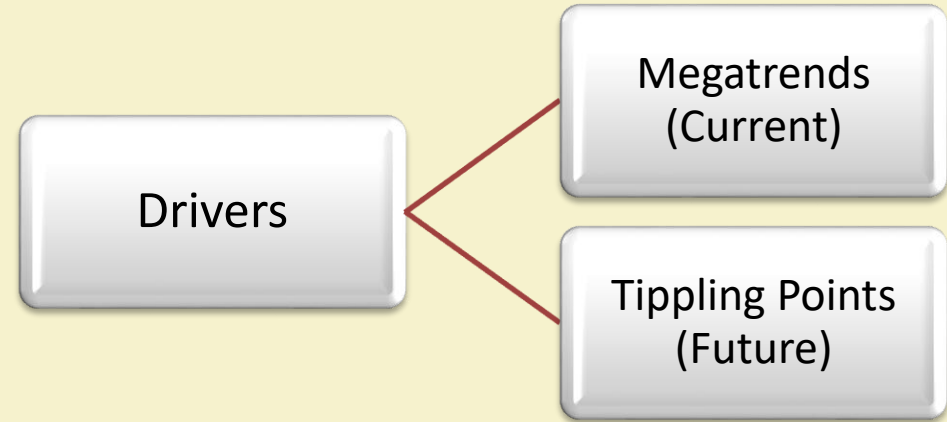
Profound and Systematic Change

- In context of Fourth Industrial Revolution
 - Use of AI
 - Self driving car
 - Virtual assessment
 - Transitional software
 - Discover new drugs
 - Prediction of cultural Interest
 - Application of Siri in Apple is one of the examples of strength of AI (Voice Search) – Also, Cortana for Windows.

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Drivers

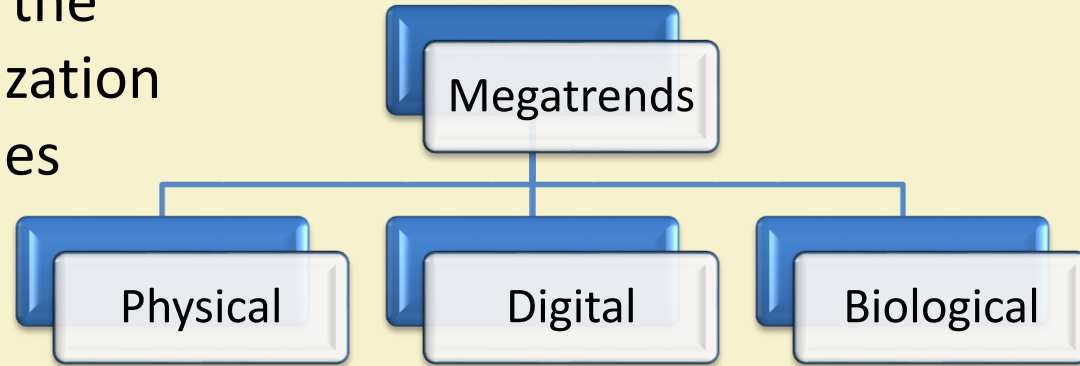
- Various aspects that drive the fourth industrial revolution
 - Scientific Breakthroughs
 - New Technologies



Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

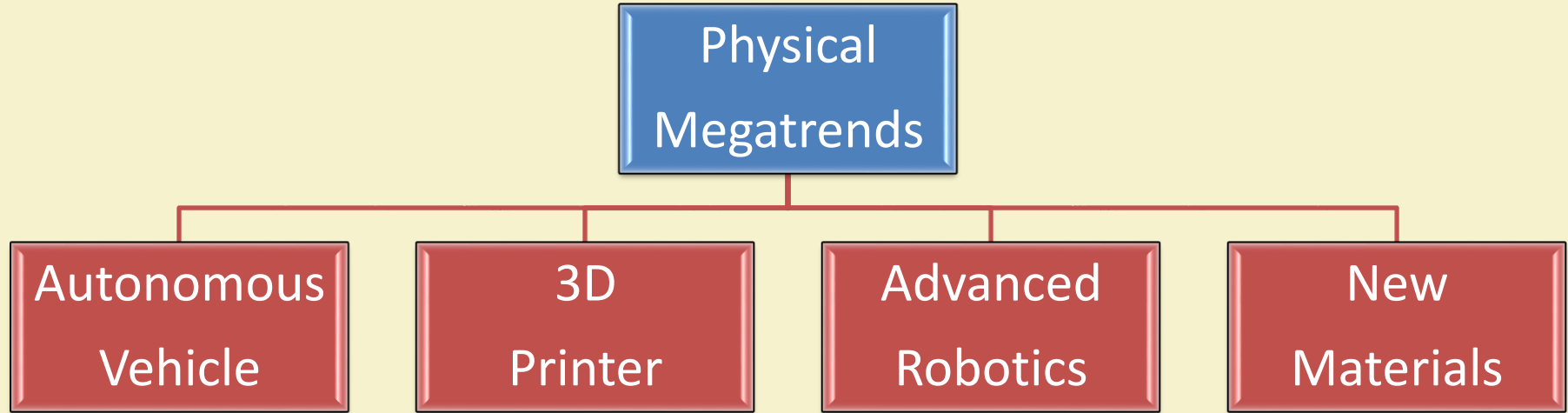
Megatrends

- All recent technologies and development that leverage the pervasive potential of digitization and information technologies



Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Physical Megatrends

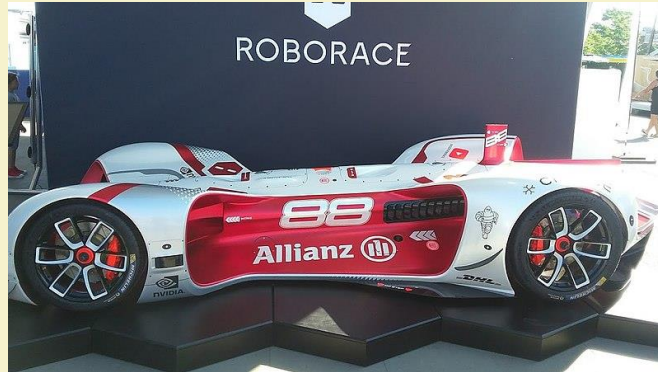


Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Autonomous Vehicle

➤ Driver-less vehicles

- Trucks
- Drones
- Aircrafts
- Boats



Source: Wikipedia, By Dllu, Published: Nov 19, 2017, Online: https://en.wikipedia.org/wiki/Autonomous_car



Source: Wikipedia, By Bcschneider, Published: Jul 16, 2017, Online: https://en.wikipedia.org/wiki/Autonomous_car

3D Printers

- Manifesting physical objects based on digital specifications
- Application
 - Wind Turbines
 - Medical Implants



Source: Wikipedia, By Tyler Caros, Published: Feb 20, 2015, Online: https://en.wikipedia.org/wiki/Airwolf_3D

Advanced Robotics

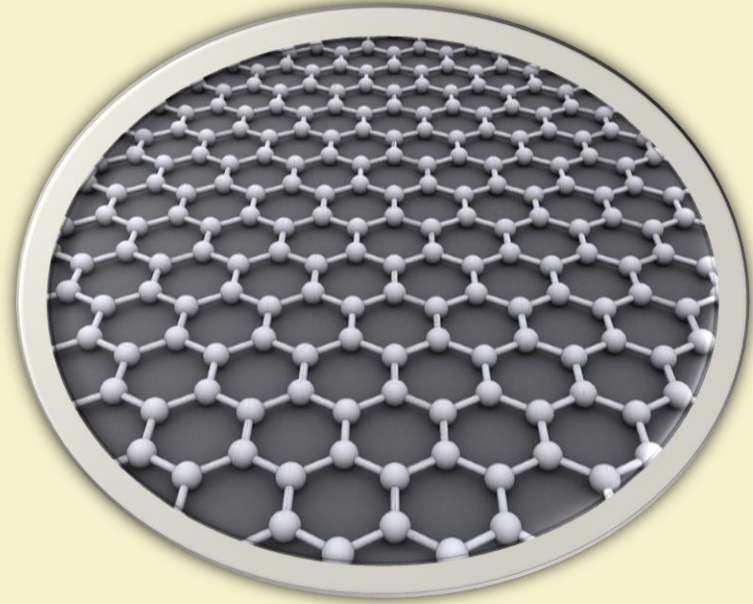
- Conventional application of robots: automotive
- Recently, robotics are used from precision agriculture to nursing



Source: Wikipedia, By BMW Werk Leipzig, Published: Jul 19, 2005, Online: https://en.wikipedia.org/wiki/Smart_manufacturing

New Materials

- Lighter, stronger, recyclable and adaptive
- Example: Thermoset plastics, Graphene



Source: Wikipedia, By AlexanderALUS, Published: Aug 26, 2010, Online: <https://en.wikipedia.org/wiki/Graphene>

Digital

- Internet of Things (IoT)
- Application of IoT in Industry
 - RFID
 - Tracking of package delivery
 - Complex supply chain
 - Monitoring systems
- Bitcoin (digital currency) and Blockchain (securing bank/government transactions)
- Uber model for transportation (car pooling etc.)

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Biological

- Genetic sequencing
- DNA writing
- Recommender system (IBM Watson)
- Cell Modification
- Genetic Engineering (CRISPER)

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

Tipping Points

- Tipping points represent the radical changes in that are required in near future
- Probable tipping points in 2025
 - Clothes connected to the internet
 - Unlimited and free storage
 - 1 trillion sensors connected to the internet
 - Robotic pharmacist, etc.

Source: Schwab, K., 2017. The fourth industrial revolution. Crown Business.

References

- [1] Schwab, K., 2017. The fourth industrial revolution. Crown Business.
- [2] Lu, Y., 2017. Industry 4.0: A survey on technologies, applications and open research issues. Journal of Industrial Information Integration, 6, pp.1-10.
- [3] Brynjolfsson, E. and McAfee, A., 2014. The second machine age: Work, progress, and prosperity in a time of brilliant technologies. WW Norton & Company.
- [4] Manyika, J. and Chui, M., 2014. Digital era brings hyperscale challenges. Financial Times, 13.
- [5] Isaiah, D., 2015. Automotive grade graphene. The clock is ticking. Automotive World, 26.
- [6] Laskow, S., 2014. The Strongest, Most Expensive Material on Earth. The Atlantic, 23.

Thank You!!