



# Digital Twins

## Lifecycle Management & Value Delivery



Optimizing Mine Performance Through Digital Innovation Seminar, October 18, 2017

Daniel Koffler, Chief Digital Architect, Smart Industries

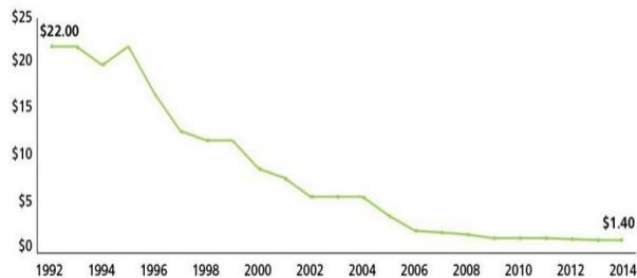
# What is a Digital Twin?



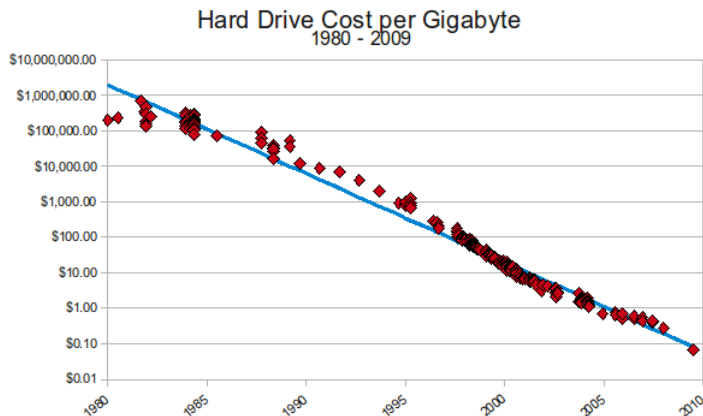
Picture credits: © Michael Hitoshi

# Sensors, Compute, Storage & Networking Prices over Time

Figure 5. Sensors prices on the decline over the last 25 years

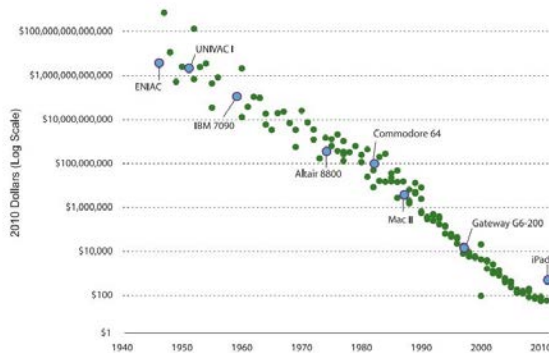


Source: Rob Lineback, IC Insights Inc. "The market for next-generation microsystems: More than MEMS!," [http://itac.ca/uploads/events/executorum2010/rob\\_lineback\\_10-6-10-2.ppt](http://itac.ca/uploads/events/executorum2010/rob_lineback_10-6-10-2.ppt), June 10, 2010, accessed January 28, 2015; Lee Simpson and Robert Lamb, *IoT: Looking at sensors*, Jeffries Equity Research, February 20, 2014, p. 4.

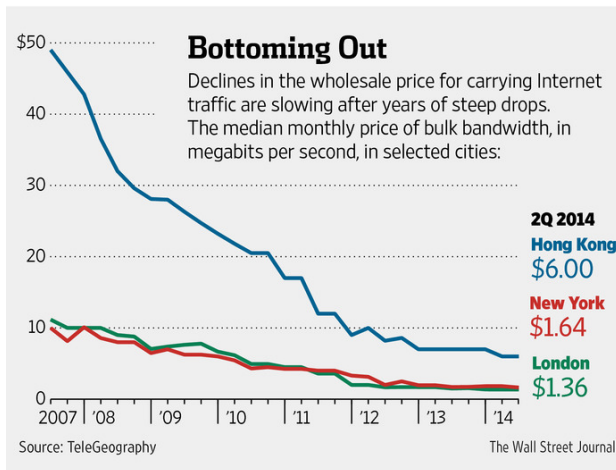


# Sensors, Compute, Storage & Networking Prices over Time

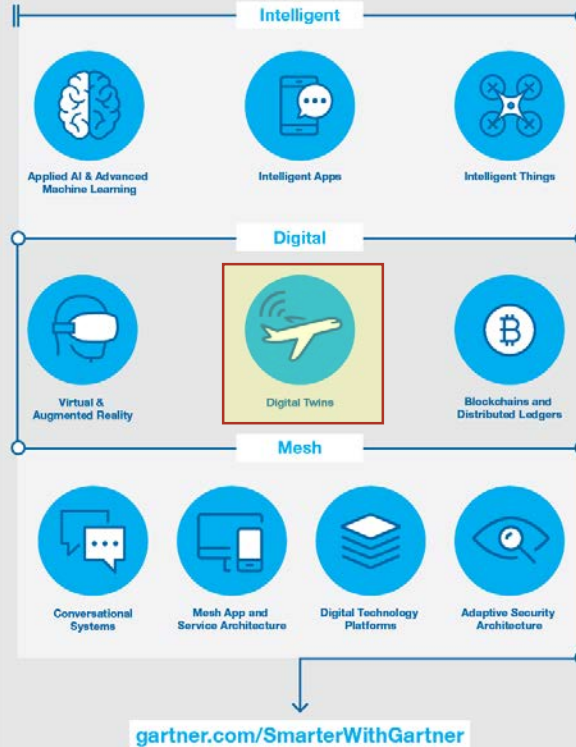
Cost of Computing Power Equal to an iPad 2



Note: The iPad2 has computing power equal to 1000 million instructions per second (MIPS). Each data point represents the cost of 1000 MIPS of computing power based on the power and price of a specific computing device released that year.  
Source: Morawiec n.d.

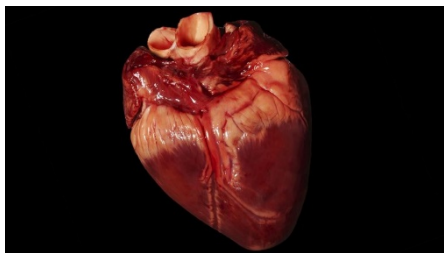


## Top 10 Strategic Technology Trends 2017



# Don't we already create Digital Twins?

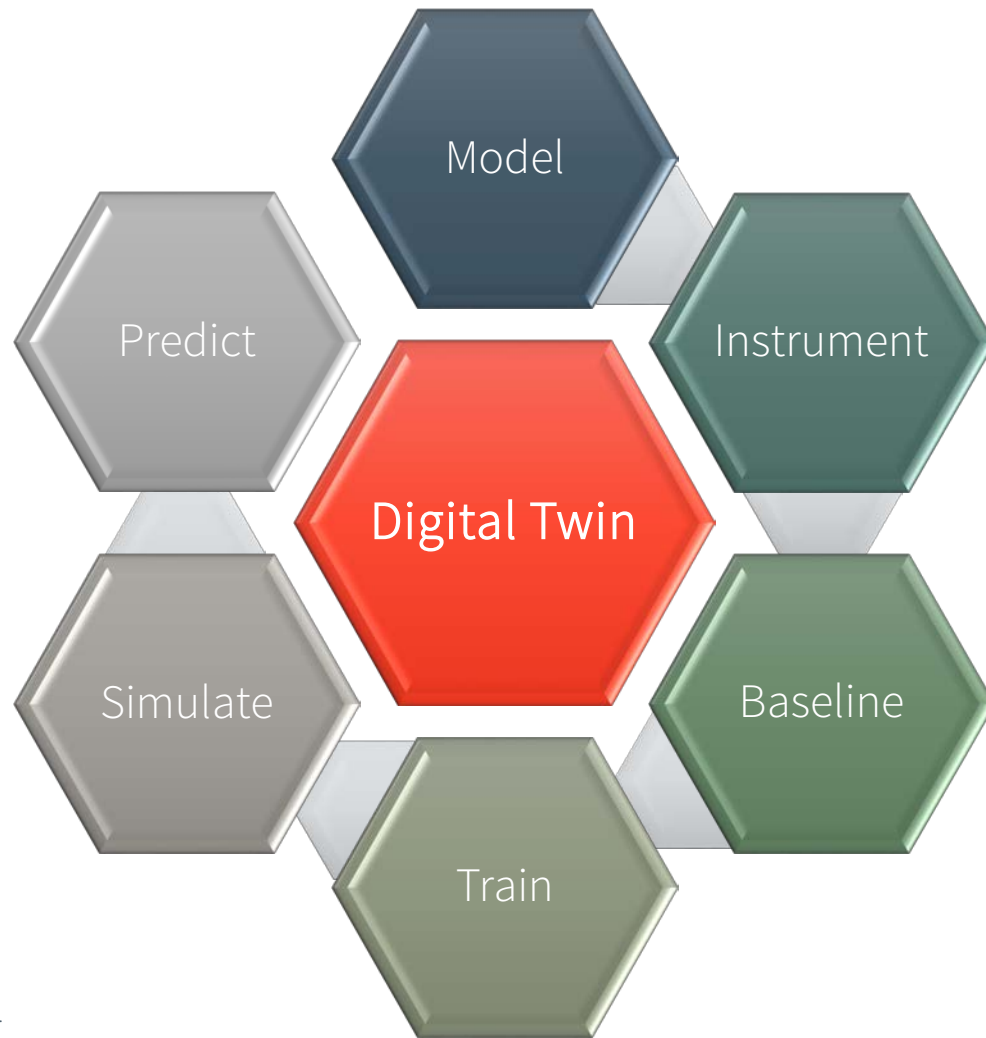
— What we do well today



— What we need to learn

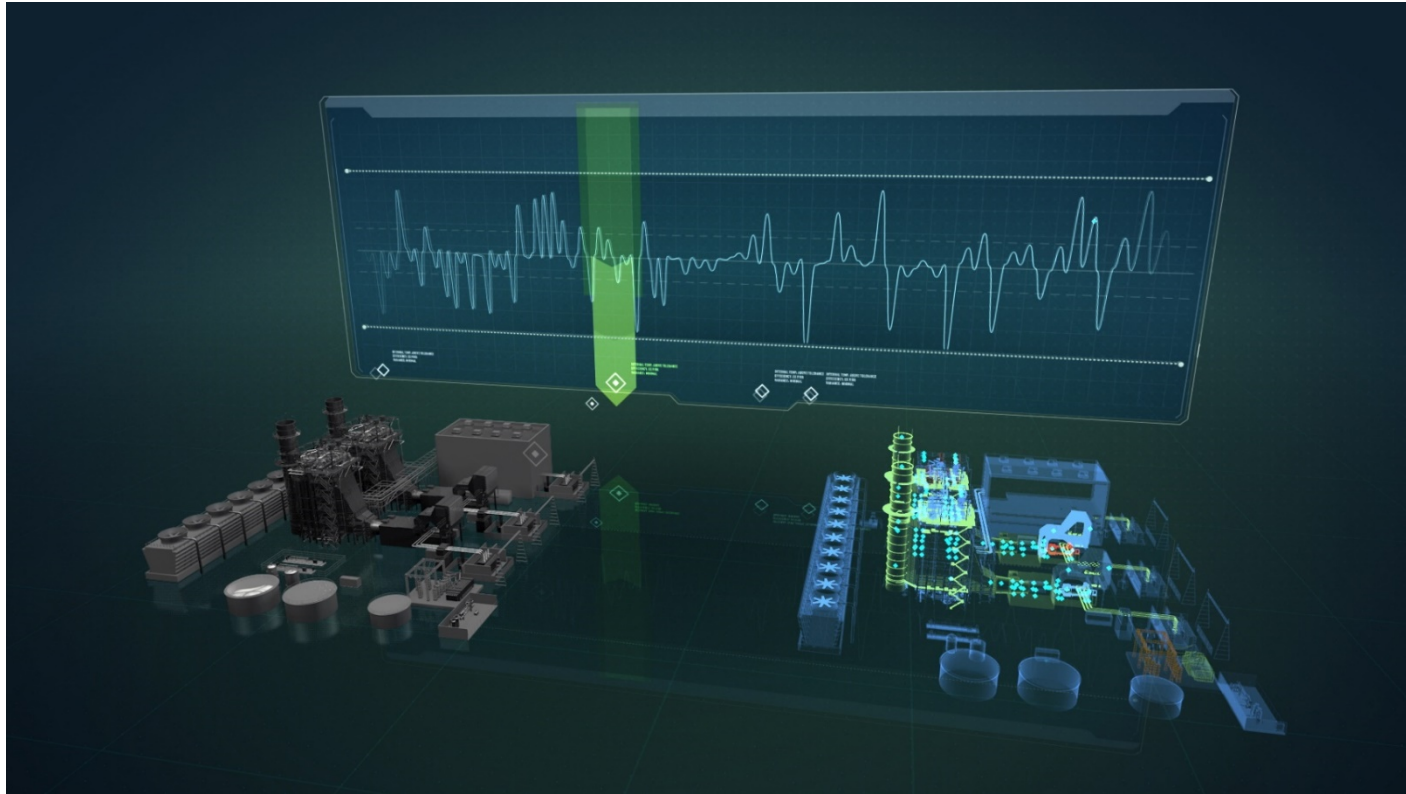


# Digital Twin Lifecycle





# Model



Picture credits: © GE



# Instrument

## How Many Sensors are in a Smartphone?



- Light
- Proximity
- 2 cameras
- 3 microphones (ultrasound)
- Touch
- Position
  - GPS
  - WiFi (fingerprint)
  - Cellular (tri-lateration)
  - NFC, Bluetooth (beacons)
- Accelerometer
- Magnetometer
- Gyroscope
- Pressure
- Temperature
- Humidity

19

Picture credits: © Open Knowledge

# Baseline: What is normal?

Stable



Ascending



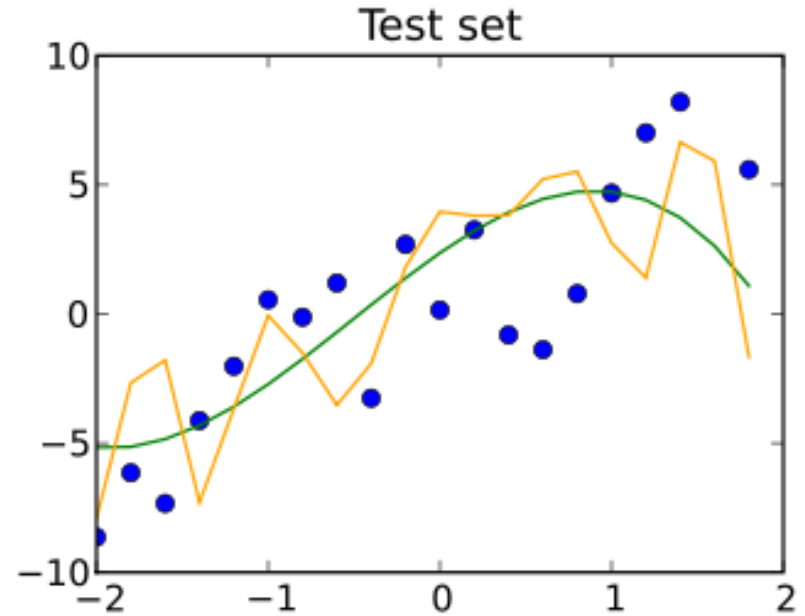
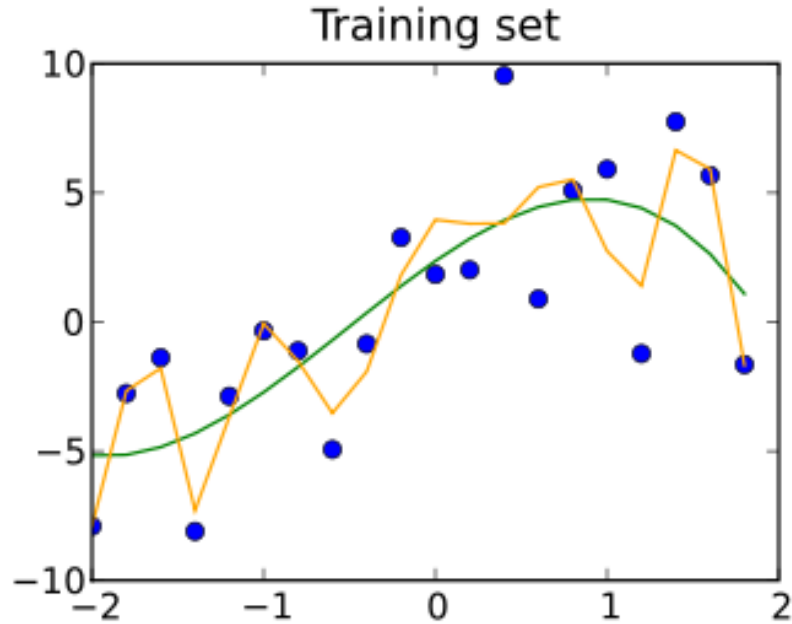
Descending



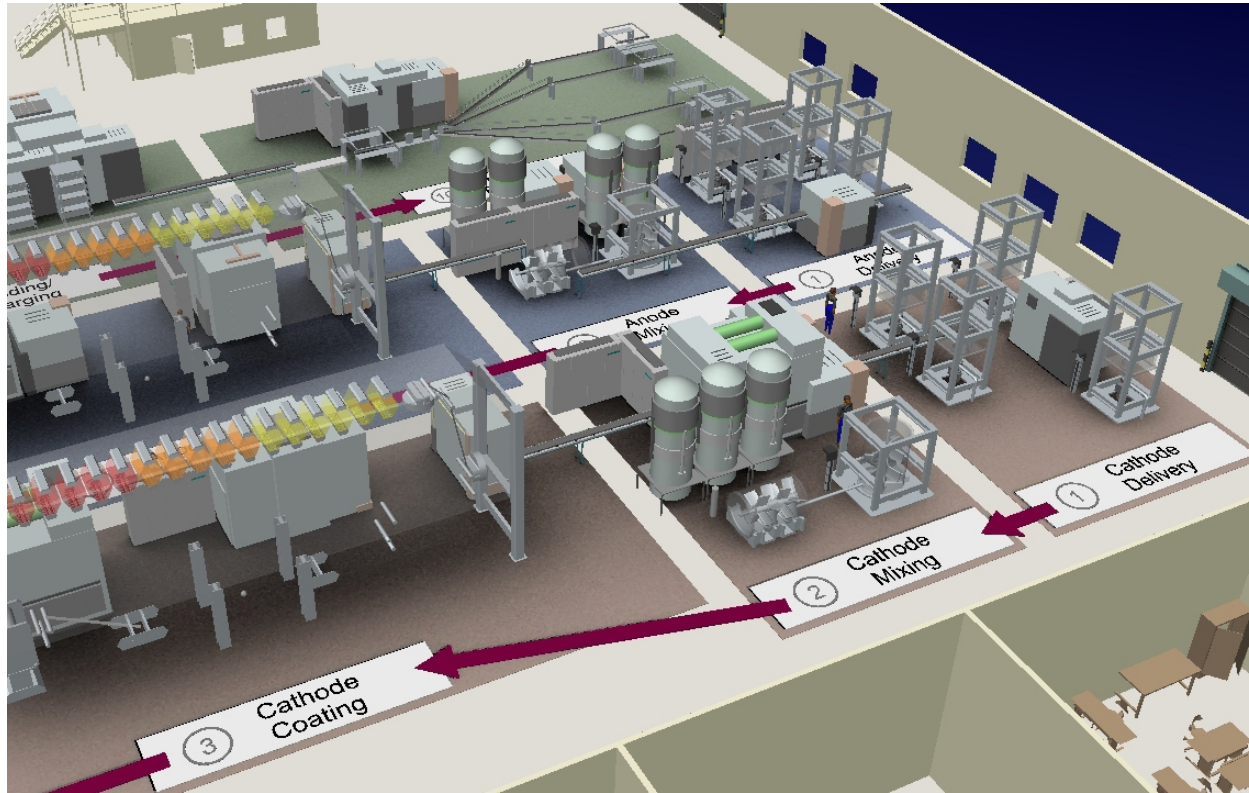
Variable



# Train your model based on real world data



# Short-path simulation



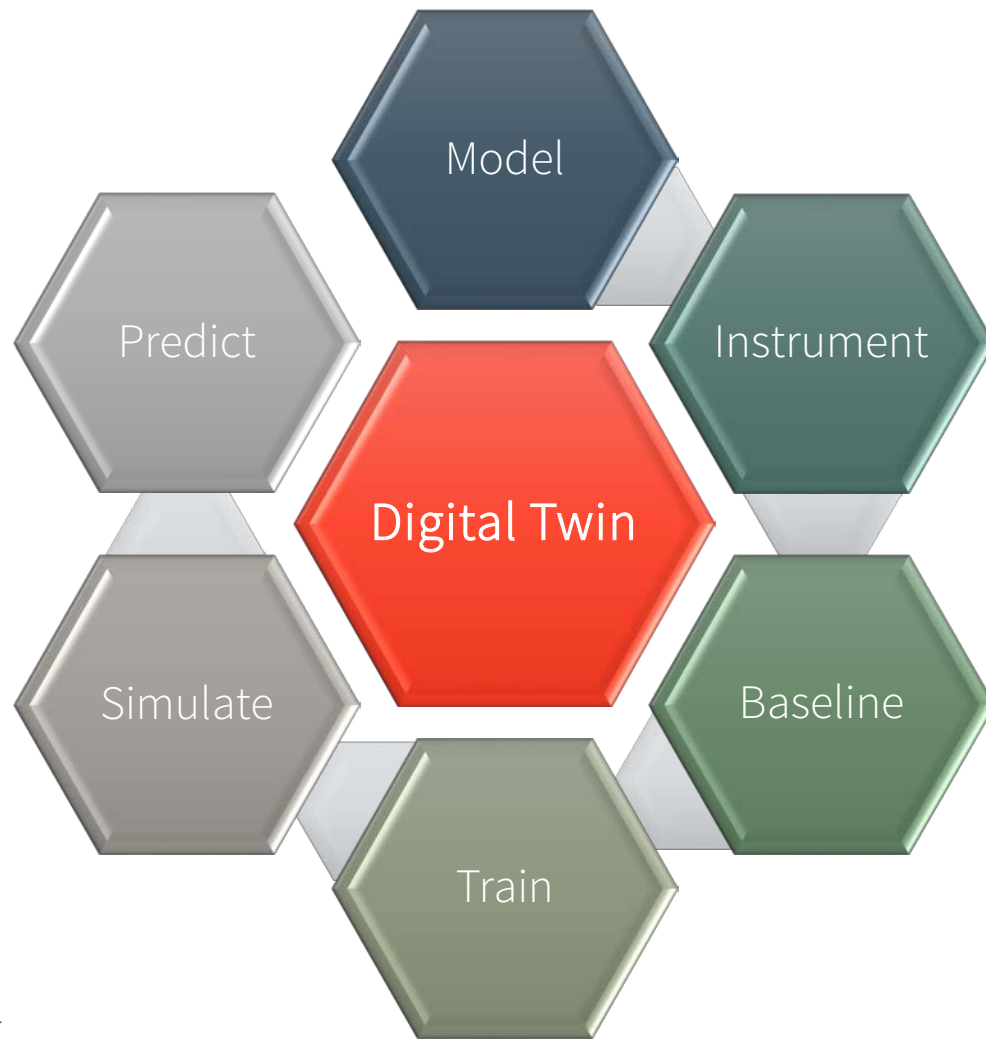
Picture credits: © Cards PLM Solutions

# Predict the Future



Picture credits: © Shutterstock

# Digital Twin Lifecycle





# Facets of Digital Twin Value





Thank you.

For more information,  
please visit [www.hatch.com](http://www.hatch.com)  
or contact [Daniel.Koffler@hatch.com](mailto:Daniel.Koffler@hatch.com)