เมื่อโลกถูกขับเคลื่อนด้วยเครื่องจักรและข้อมูล

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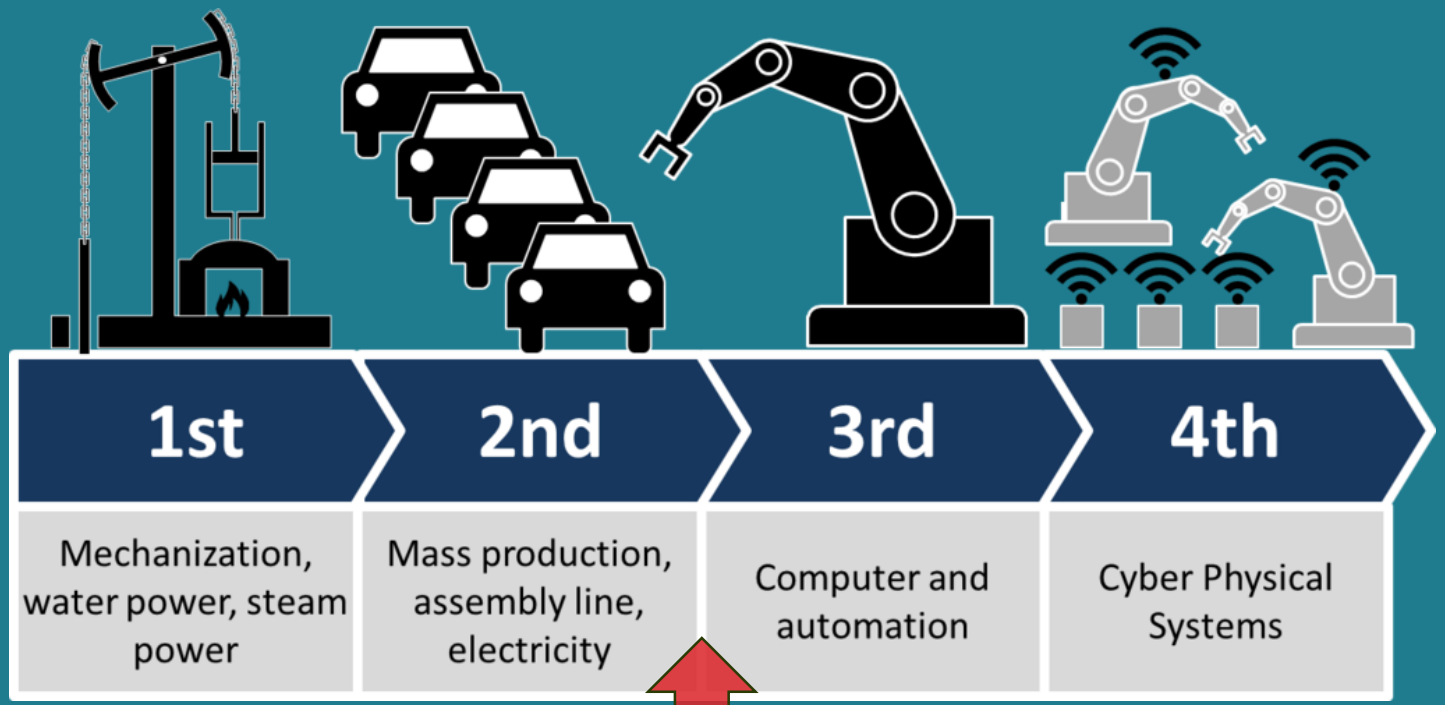
13 มีนาคม 2561

Industry Revolution



Semi-automation

PLC

IoT, Cloud computing

Data Analytics, AI

Advanced hw/sw

Thailand (I2.0-2.5 70%)

The figure is credited to Christoph Roser,http://www.allaboutlean.com/industry-4-0/"

U.S. President's Council of Advisors on Science and Technology (PCAST) Report 2007

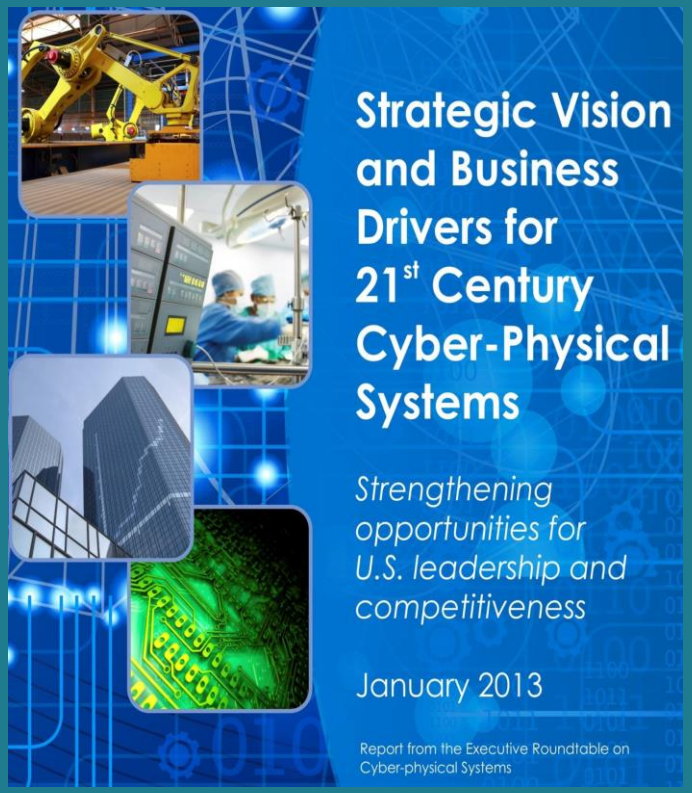
"…**the first four areas** should receive disproportionately larger funding increases because they address issues for which progress will have both the greatest effect on important applications and the highest leverage in advancing networking and information technology capabilities."

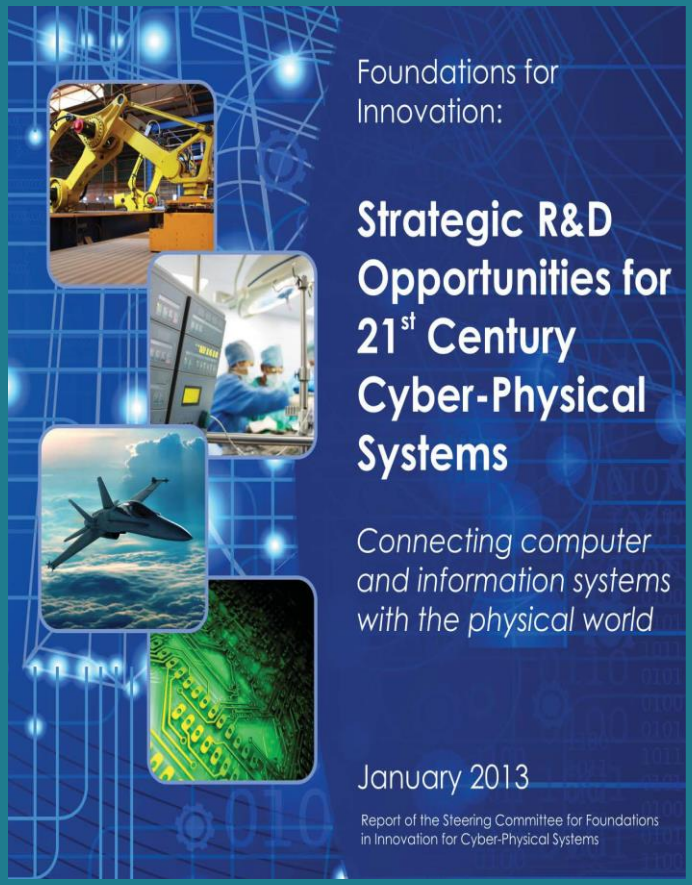
Cyber-Physical Systems

Later: PCAST 2010, PCAST 2011, PCAST 2010, NITRD 2009

Source: https://cps-vo.org/node/207

National Institute of Standards and Technology (NIST), U.S.A.



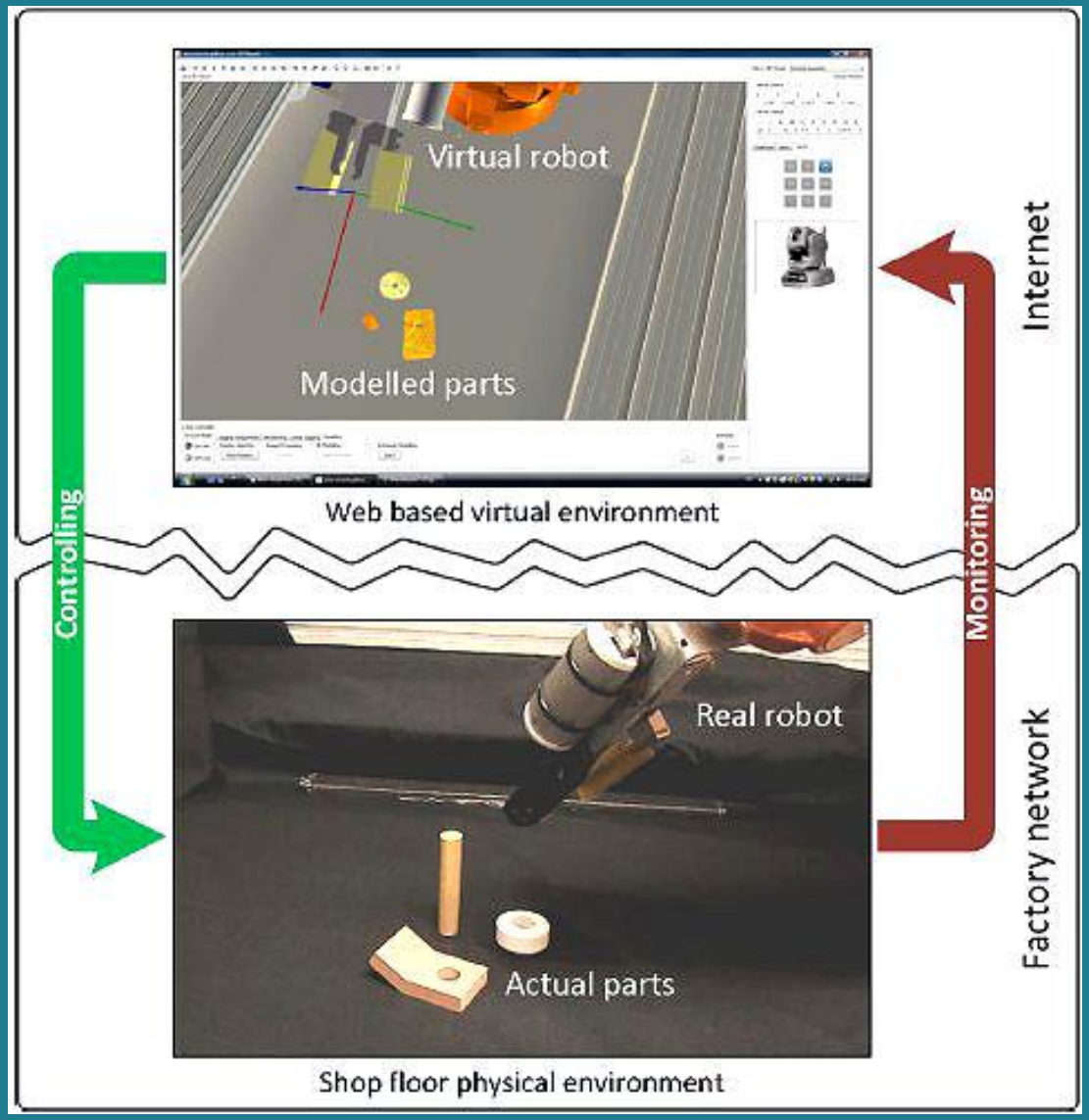


Cyber Physical System = Smart System

CPS are integrations of computation, networking, and physical processes. Embedded computers and networks monitor and control the physical processes, with feedback loops where physical processes affect computations and vice versa.

Credit: http://cyberphysicalsystems.org/

Cyber and Physical Worlds

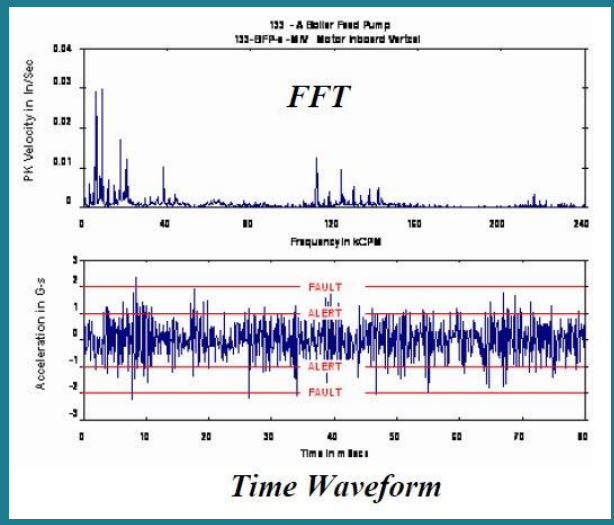


Source: L. Wang et al. , "Current status and advancement of cyber-physical systems in manufacturing", J. of Manufacturing Systems 37, 2015.

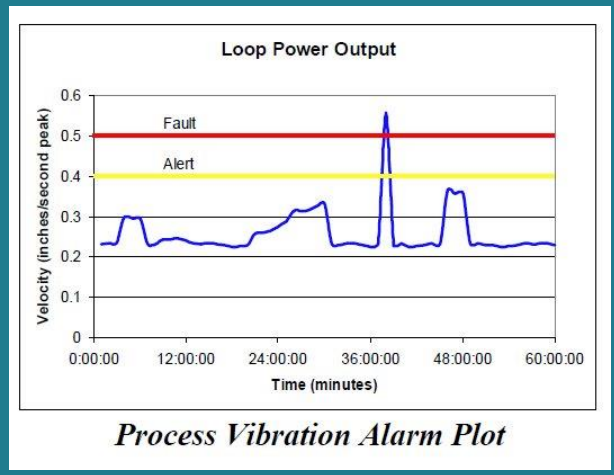
Machine + Sensors

Accelerometer,
Velocity transducers,
displacement probes

Measuring Motor Bearing Vibration



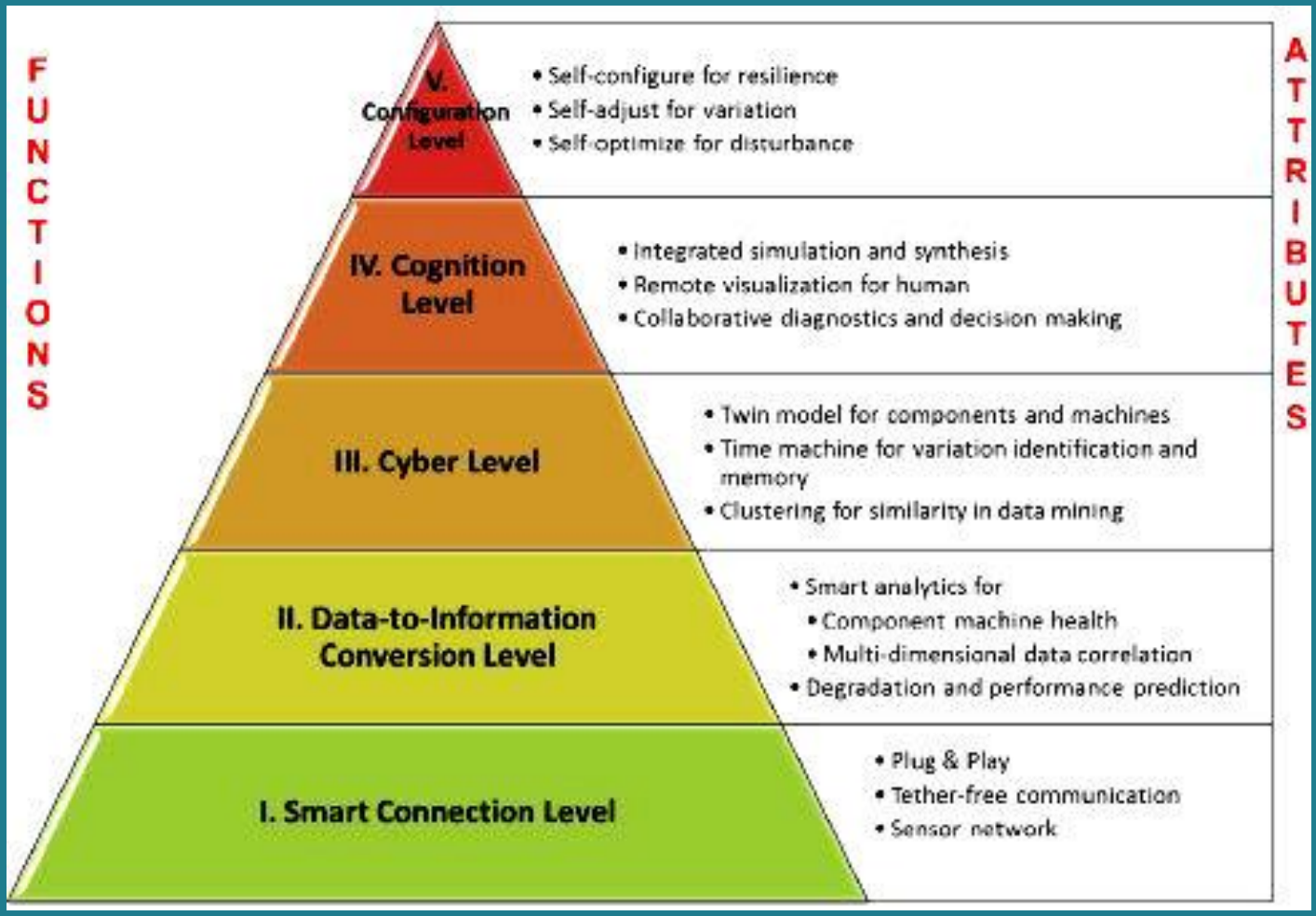
Time Waveform



Process Vibration Alarm Plot

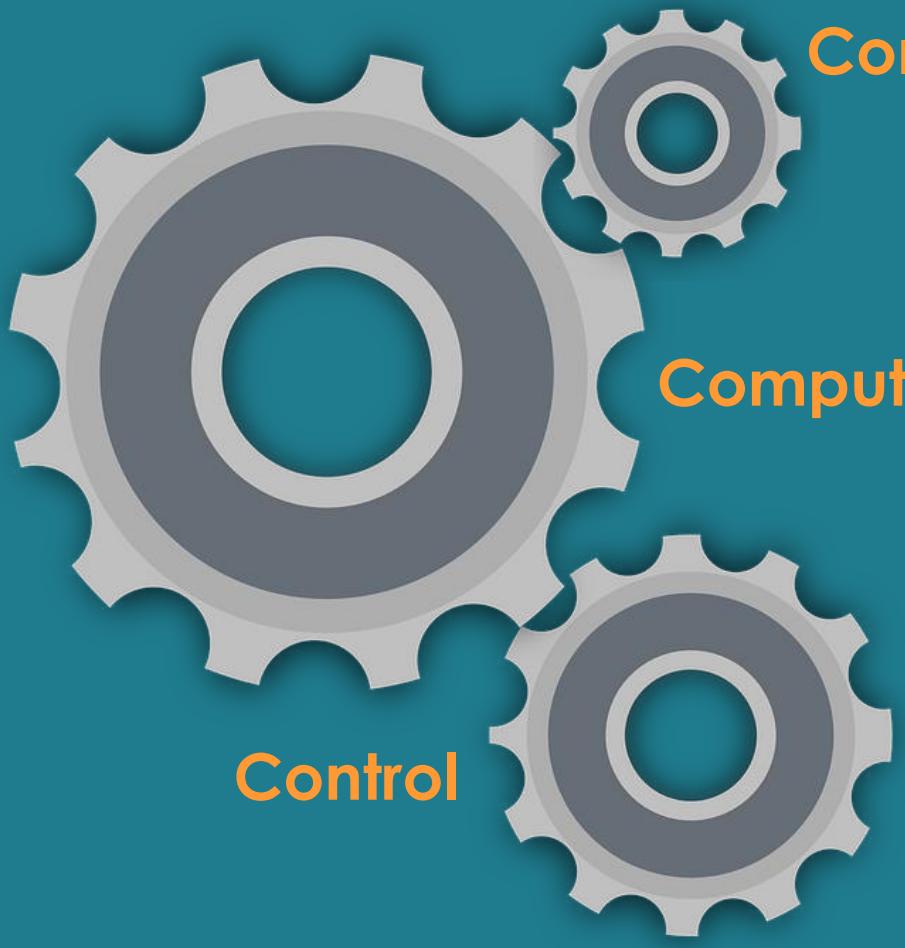
Source: Connection Technology Center, Inc. "Industrial Vibration Analysis for Predictive Maintenance and Improve Machine Reliability"

CPS's 5C Architecture



Source: Lee J, Bagheri B, Kao H-A , "A Cyber-Physical Systems Architecture for Industry 4.0-based Manufacturing Systems", Manufacturing Letters 3:18–23, 2015

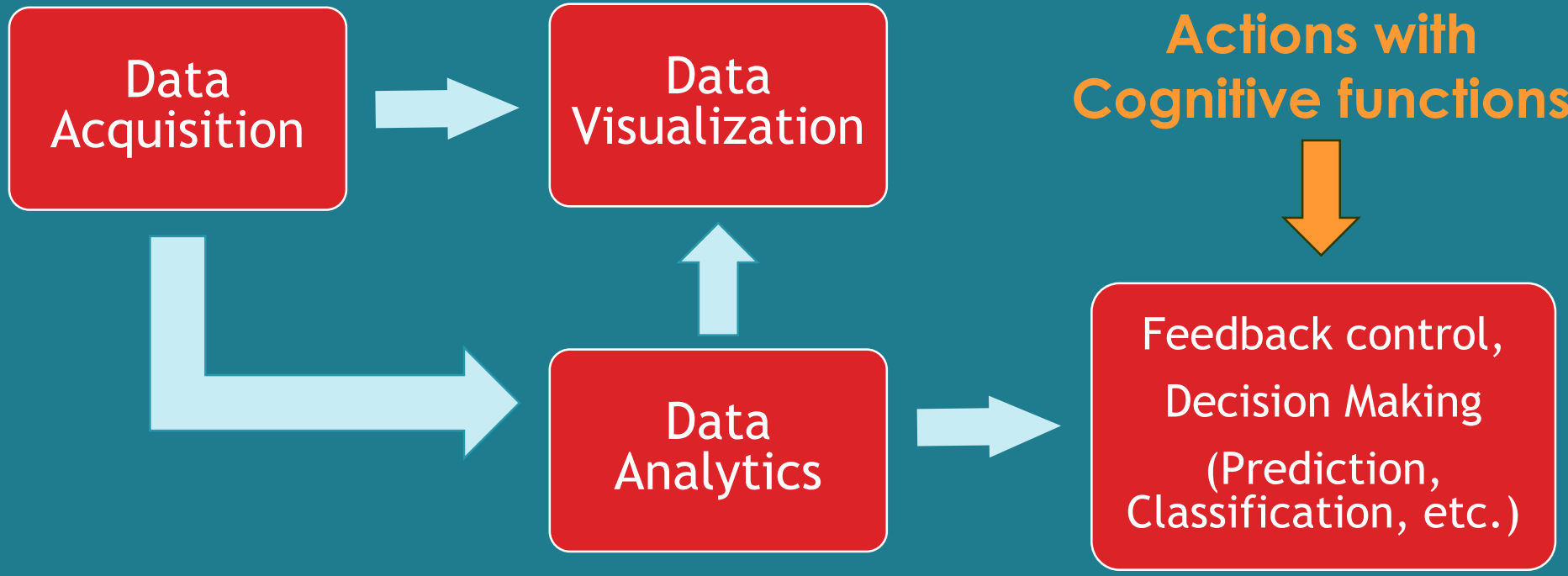
CPS Research Areas



Multidisciplinary

Engineering (Electrical, Computer, Control, Electronics, Mechanical, Mechatronics, Industrial, Manufacturing)
Computer Science, Cognitive Science, Mathematics, etc.

Sense → Collect → Analyze → React



Smart Factory: Measure & Improve

- OEE (Overall Equipment Effectiveness) = function {
  Availability (run time/planned time),
  Performance (actual/expected speed),
  Quality (good units/total units) }
- Maintenance:
  - MTTR (Mean time to repair) = Total up time/ no. of breakdowns for maintainability
  - MTBF (Mean time between failures) = Total down time/ no. of breakdowns for reliability
- Process: delay(bottleneck), cost, efficiency
- Factory environment: temperature, energy saving.

Case study: Smart Factory in German

Smart Plant: Siemens' Amberg Plant

Credit: https://www.siemens.com/innovation/en/home/pictures-of-the-future/industry-and-automation/digital-factories-defects-a-vanishing-species.html

The Results

- Mass Customization: 950 production lines, 250 suppliers
- Availability & Quality: 24 hours turn around time with an error rate < 10 ppm
- Productivity: 7 times improvement since 20 years ago.
- Future: The end of defects!!!
- This is made possible with IoT, Data Analytics, High-end control systems

IoT Cloud

Instant-Message Communication

Visualization

Access Control

Local Data Storage

Connection Security

Domestic Communication

https://netpie.io

NECTEC
a member of NSTDA

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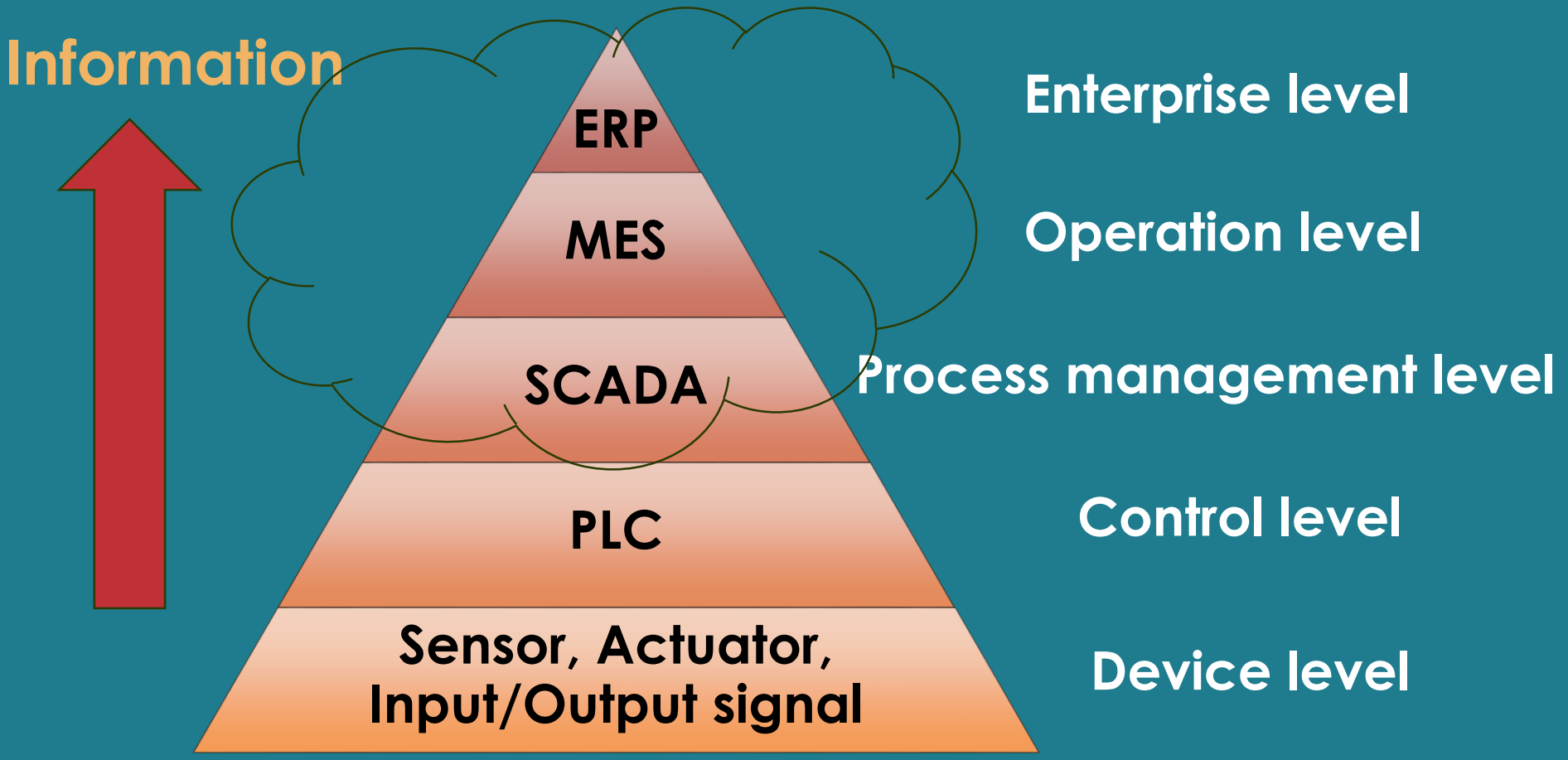
Industrial Automation Pyramid



Cloud Manufacturing

Cisco's Kinetic

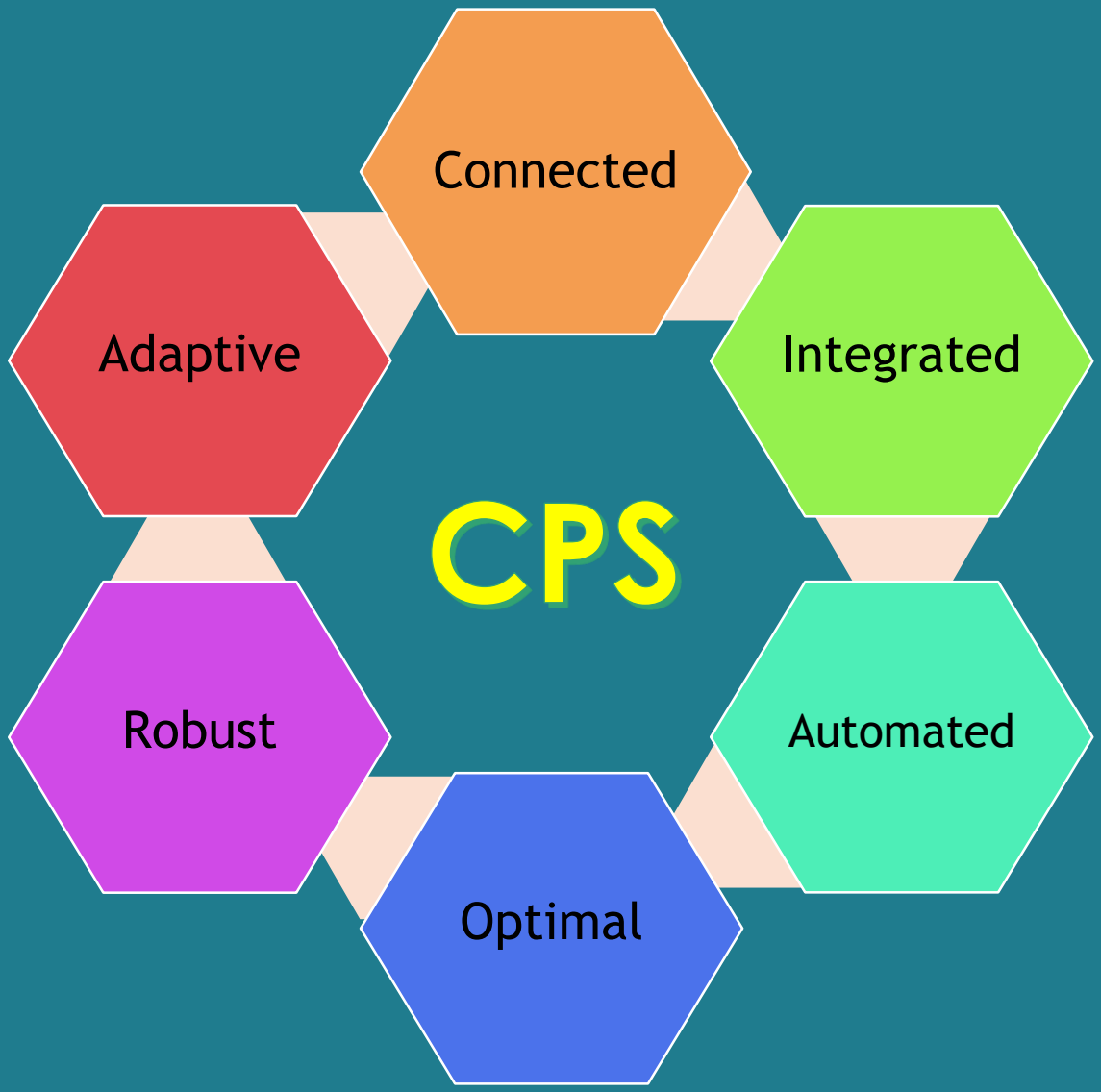
Siemens' MindSphere

IBM's Watson

GE's Predix

Microsoft Azure

Interoperability?
Standards?
Cost-effective?
Secure?



Guidelines for CPS Evaluations

CPS Challenges

- Integration of Everything (human, machine/hardware, software, process, system, information, service) → Digital and Physical gaps.
- Complex system models (with tons of the unknowns)
- Cost-effective and Secure system design
- Standards development