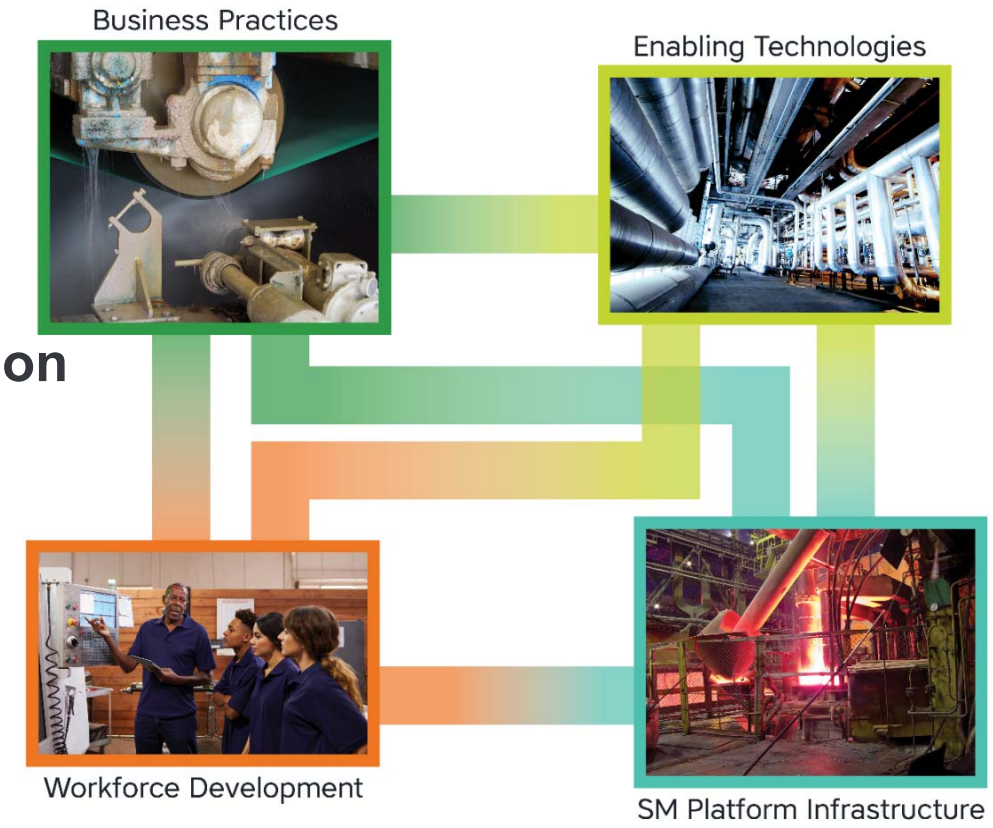
California Plug Load Research Center Workshop

Prof. G. P. Li, PI
California Institute for Telecommunications and Information Technology, Irvine Division

Dr. Richard P Donovan, Director of Research Development, Donald Bren School of Information and Computer Sciences and the Henry Samueli School of Engineering

What is Smart Manufacturing?

Smart Manufacturing (SM) is the business, technology, infrastructure, and workforce practice of optimizing manufacturing through the use of engineered systems that integrate operational technologies and information technologies (i.e. cyber-physical systems)

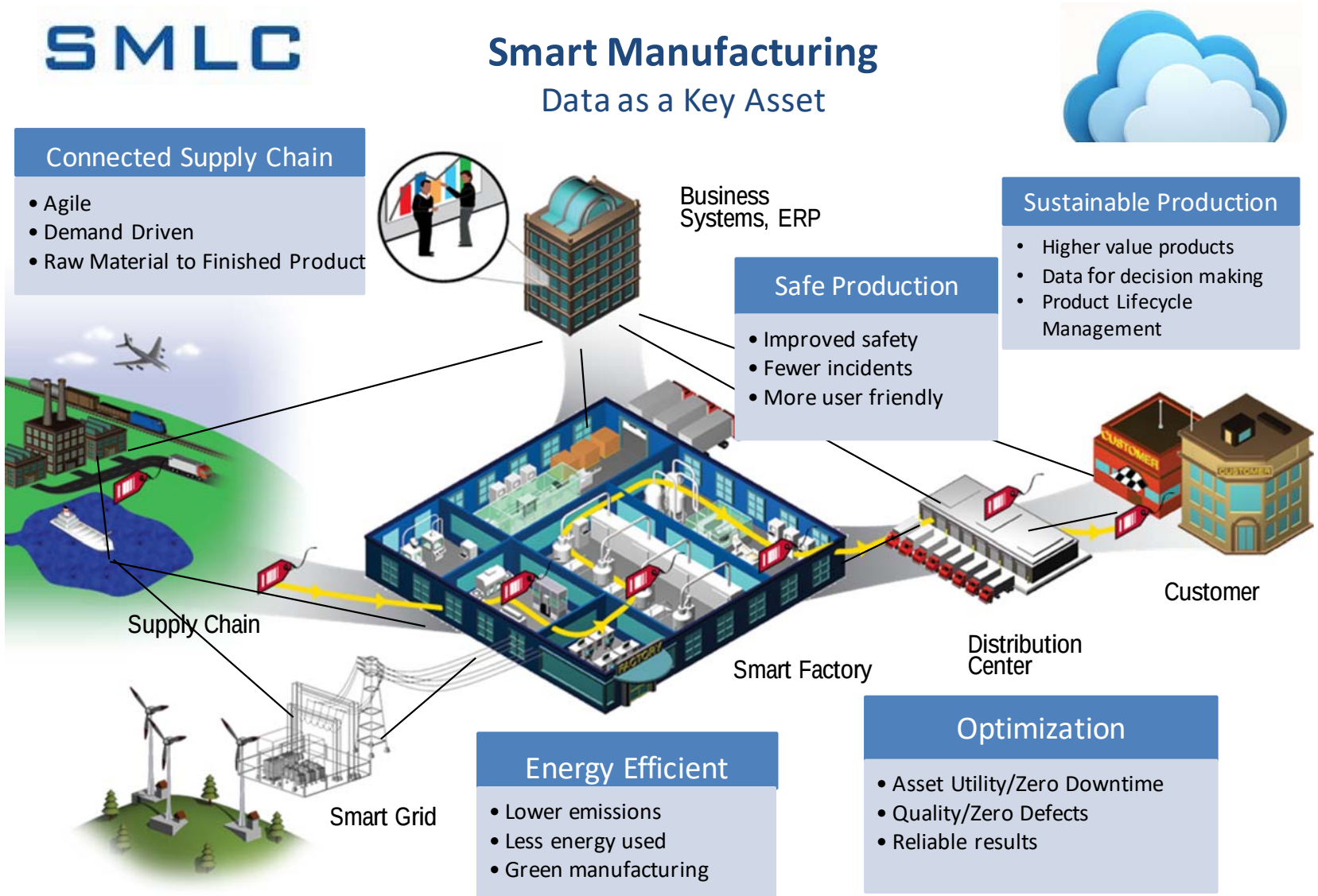


Clean Energy Smart Manufacturing Innovation Institute- Vision

SMLC

Smart Manufacturing

Data as a Key Asset



Connected Supply Chain

- Agile
- Demand Driven
- Raw Material to Finished Product

Sustainable Production

- Higher value products
- Data for decision making
- Product Lifecycle Management

Safe Production

- Improved safety
- Fewer incidents
- More user friendly

Energy Efficient

- Lower emissions
- Less energy used
- Green manufacturing

Optimization

- Asset Utility/Zero Downtime
- Quality/Zero Defects
- Reliable results

CESMII Overview

CESMII Vision: Smart Manufacturing *is* manufacturing in 2030

MISSION

Radically accelerate the development and adoption of advanced sensors, controls, platforms, and models to enable Smart Manufacturing (SM) to become the driving, sustainable engine that delivers real-time business improvements in U.S. manufacturing.

OBJECTIVES

To enhance U.S. manufacturing productivity, global competitiveness, and reinvestment by:

- ↑ energy productivity
- ↑ economic performance
- ↑ Institute sustainability
- ↑ workforce capacity

GOALS

15% improvement in energy efficiency in first-of-a-kind demonstrations at manufacturing plants or of major processes within 5 years

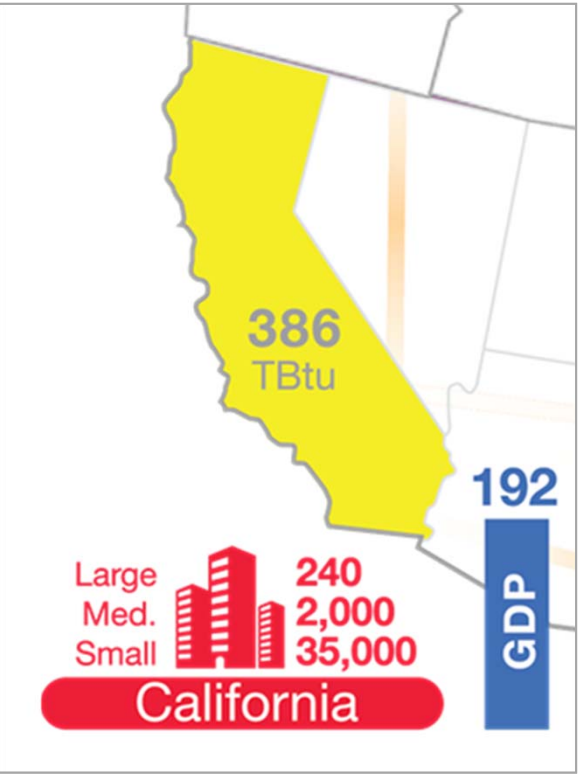
50% reduction in cost and time to deploy SM in existing processes within 5 years

Significant industry adoption of SM technology within 5 years

Sustainable portfolio of business, technology, research and development, and workforce development activities that directly replaces initial Federal funding within 6 years

50% improvement in energy productivity within 10 years

California Energy Data Analysis Reflects a Diverse Manufacturing Ecosystem



Rank	California			
	Energy (All enterprises)	TBTU	Output (All enterprises)	$Million
1	Petroleum and Coal Products	100-120	Computer and Electronic Products	57,405
2	Primary Metals	75-85	Petroleum and Coal Products	33,359
3	Food & Beverage Processing	40-50	Chemicals	25,500
4	Chemicals	40-50	Food & Beverage Processing	19,900
5	Nonmetallic Mineral Products	25-30	Aerospace & Other Transp. Eq.	12,585
6	Paper Products	25-30	Miscellaneous	12,395
7	Miscellaneous	15-20	Fabricated Metal Products	11,331
8	Fabricated Metal Products	8-15	Machinery	10,058
9	Plastics and Rubber Products	7-12	Motor Vehicles	5,142
10	Machinery	5-10	Plastics and Rubber Products	4,682
	Sum of Top Ten	386	Sum of Top Ten	192,357
	Sum of Top Five	314	Sum of Top Five	148,749

Rank	California					
	Small Enterprises (<100 employees)	TBTU	Medium Enterises (100-499 employees)	TBTU	Large Enterprises (500+ employees)	TBTU
1	Primary Metals	13-19	Petroleum and Coal Products	90-95	Primary Metals	18-22
2	Food & Beverage Processing	5-10	Primary Metals	45-50	Petroleum and Coal Products	15-20
3	Chemicals	5-10	Food & Beverage Processing	22-28	Chemicals	10-15
4	Nonmetallic Mineral Products	2-6	Chemicals	21-27	Food & Beverage Processing	10-15
5	Miscellaneous	2-6	Paper Products	15-20	Nonmetallic Mineral Products	4-8
6	Petroleum and Coal Products	2-4	Nonmetallic Mineral Products	13-19	Paper Products	4-8
7	Paper Products	2-4	Miscellaneous	7-11	Miscellaneous	4-8
8	Fabricated Metal Products	2-4	Fabricated Metal Products	3-7	Fabricated Metal Products	2-5
9	Plastics and Rubber Products	1-3	Plastics and Rubber Products	2-6	Plastics and Rubber Products	2-5
10	Machinery	<2	Machinery	2-6	Machinery	-
	Sum of Top Ten	52	Sum of Top Ten	244	Sum of Top Ten	91
	Sum of Top Five	40	Sum of Top Five	206	Sum of Top Five	69

California RMC Capabilities Summary

Sensors, Controls & Algorithms, Platforms, HPC

UCLA

UC Irvine

Berkeley
University of California

Calit2
University of California · Irvine

USC University of Southern California

Missouri S&T

JPL
Jet Propulsion Laboratory

Lawrence Livermore National Laboratory

Energy Sustainability, Economic Development, Workforce Development, etc.

CSU5 – For Greater Los Angeles Research Education Innovation – Northridge · Pomona · Dominguez Hills · Long Beach · Los Angeles

California Community Colleges

El Camino College

USC Price
Sol Price School of Public Policy
Center for Economic Development

CSUN

LA n Sync

City of Los Angeles – Founded 1781

California Governor's Office of Business and Economic Development

Michigan Tech – 1885

SFI

UCLA

Creating Connections. Powering Innovation. Boosting Efficiency.

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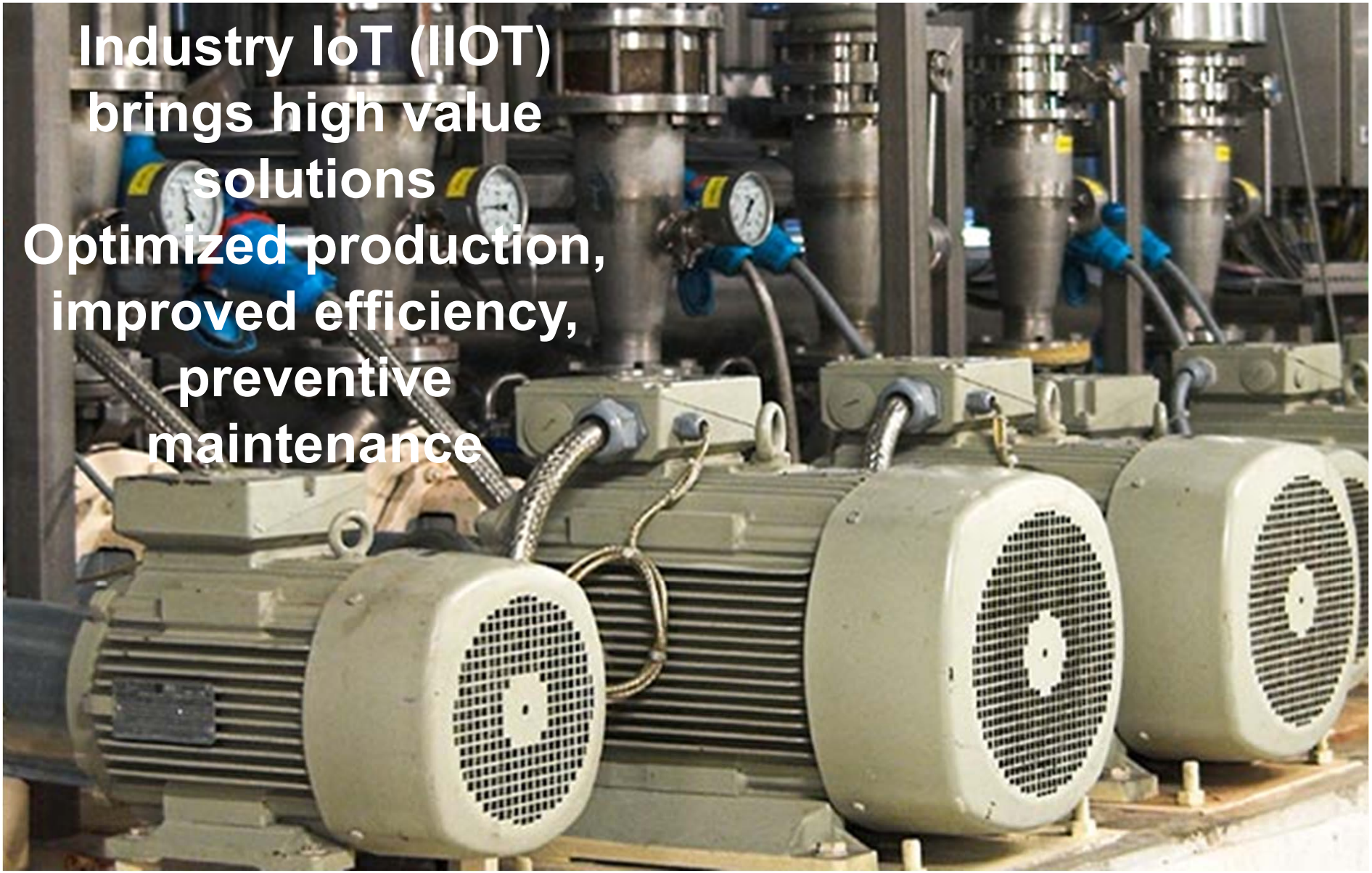
From the Internet of Things to the Internet of Smart Workers



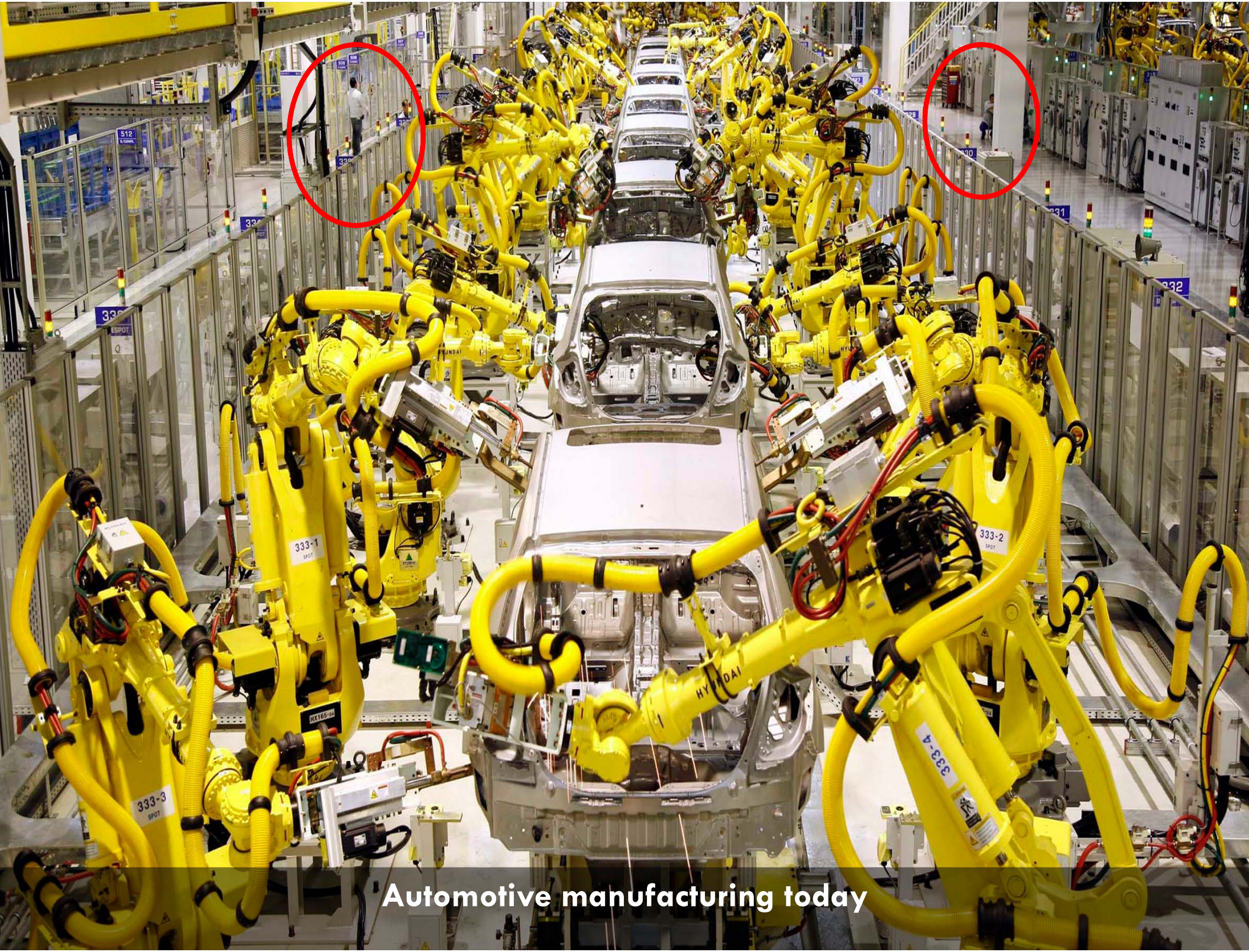
The manufacturing worker

Losing in the battle against the machine

The manufacturing worker's asset: Hands

Primary function of industrial workforce has been manual labor

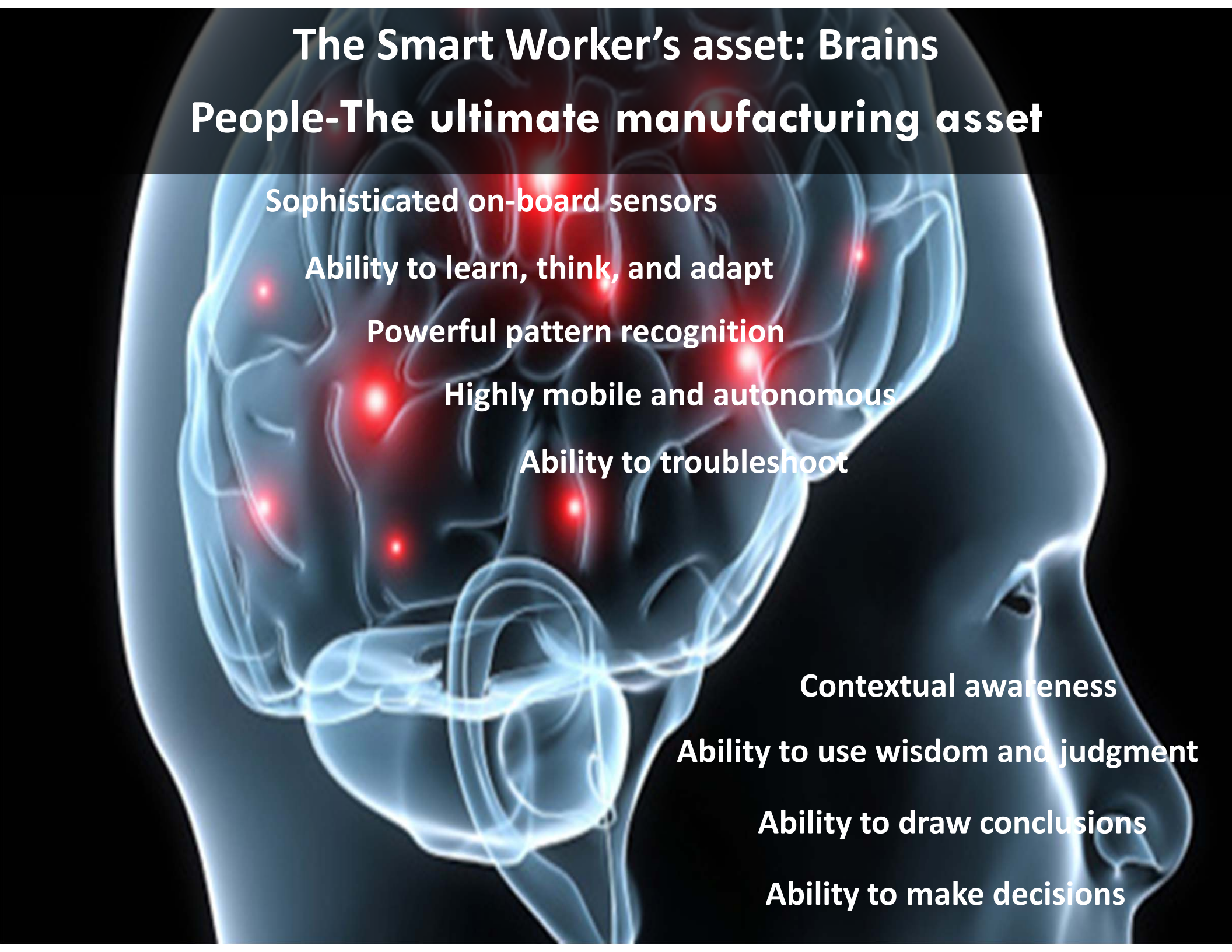
Automotive manufacturing circa 1950



Automotive manufacturing today

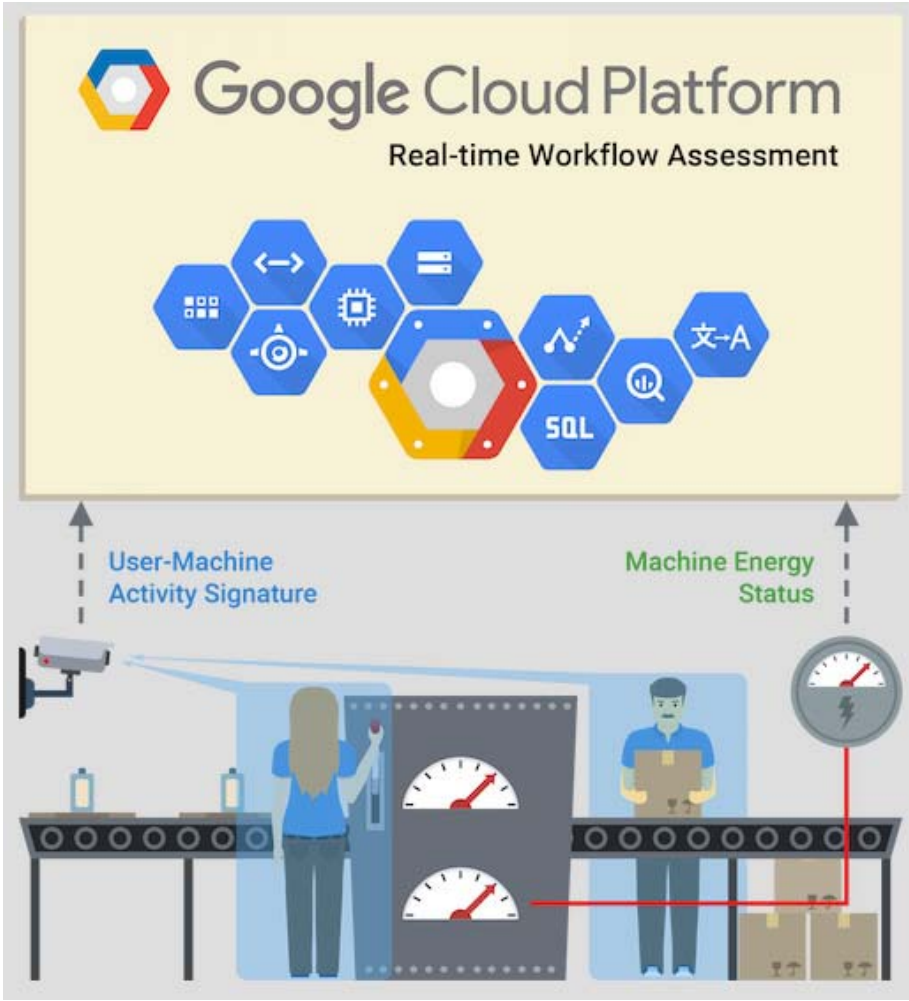
The Smart Worker's asset: Brains

People-The ultimate manufacturing asset

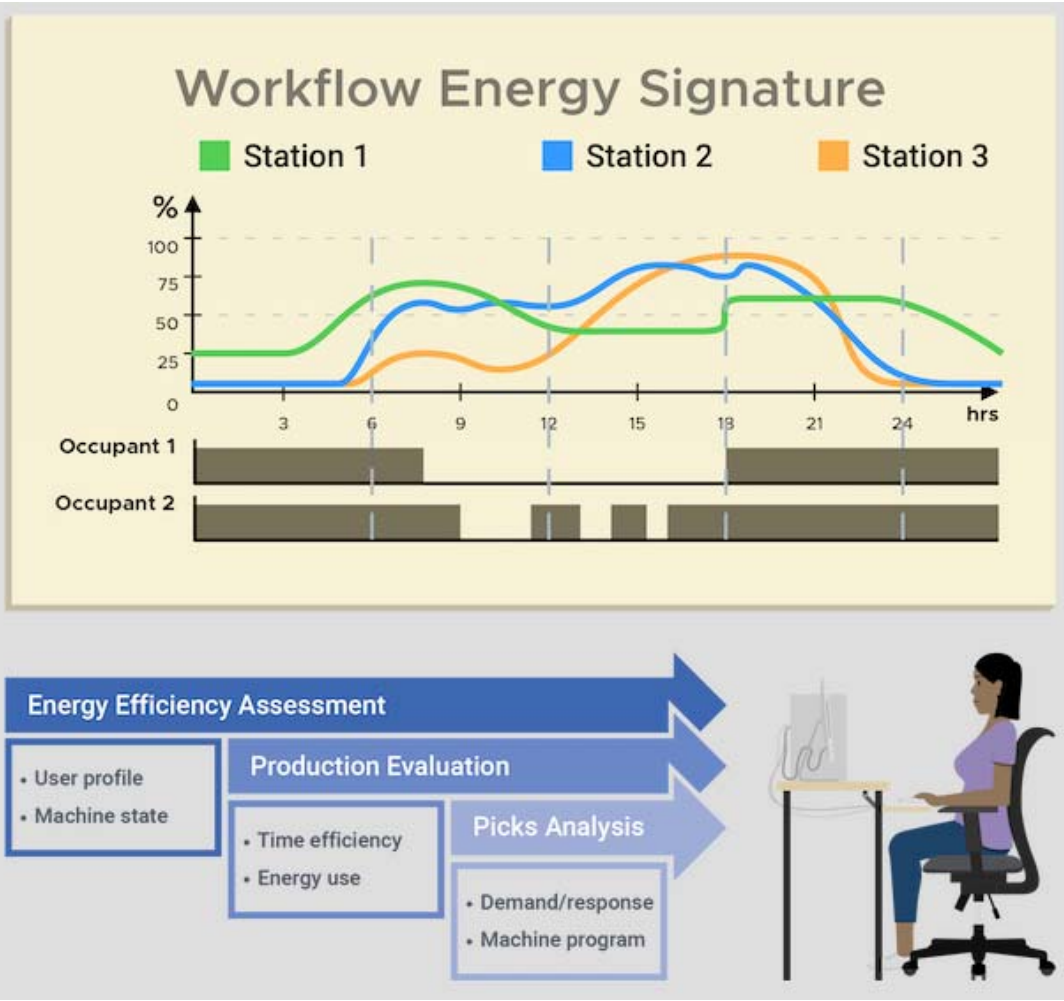


Smart Connected Workers Infrastructure for Enabling Advanced Manufacturing

Affordable Cloud Services



Accessible Data Analytics



Scalable Data Acquisition (via Autology and SCE)

Portable Decision Making

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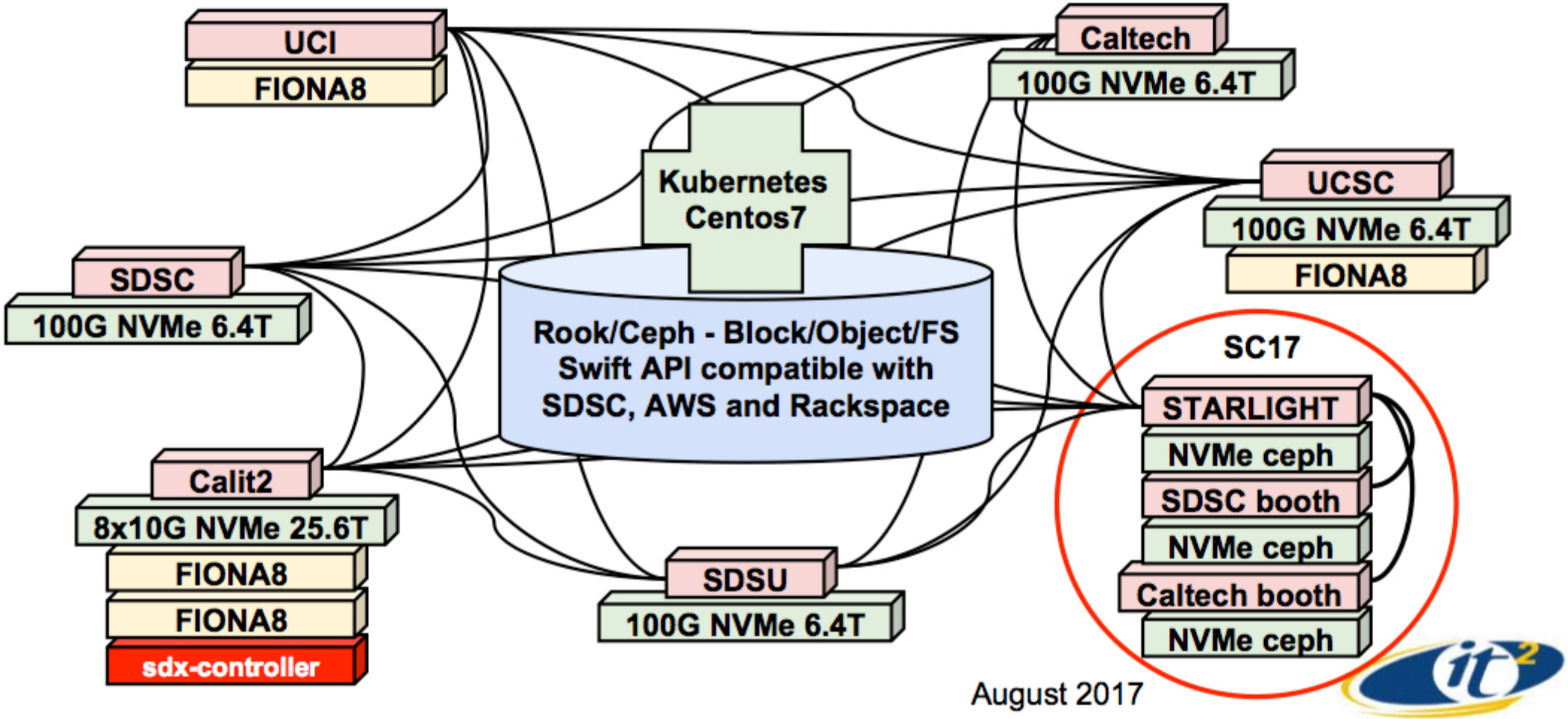
Cloud Infrastructure via Pacific Research Platform

Science DMZ for advanced data intensive simulations



Data Analytics via Cognitive Hardware and Software Ecosystem Community Infrastructure (CHASE-CI)

PI: Larry Smarr, Professor of Computer Science and Engineering, Director Calit2, UCSD
Co-Pi: Ilkay Altintas, Chief Data Science Officer, San Diego Supercomputer Center, UCSD

- **System Attributes (Includes performance metrics)**
  - 320 GPUs in 32 FIONAs connected by the PRP into a Condor-managed cloud
    - FIONAs—Custom Platforms built for Fast Data Transfer and GP
  - NvN components that are coprocessors drawn from a variety of architecture types, available to users provided over high-speed networks
    - Field Programmable Gate Array (FPGA) Component, KnuEdge Hermosa Processor (sparse ML), IBM's TrueNorth (neuromorphic), Qualcomm Inc. Snapdragons (mobile)
  - Software that includes a wide range of open ML algorithms
    - ML Algorithms deployed on NNvN Processors: Deep Neural Network (DNN) and Recurrent Neural Network (RNN); Reinforcement Learning (RL) algorithms; Variational Autoencoder (VAE) and Markov Chain Monte Carlo (MCMC), Support Vector Machine (SVM)

Acknowledgements

- California Manufacturing Technology Consulting (CMTC)-Greg Profozich, Director of Advanced Manufacturing Technologies
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- National Science Foundation (CHASE CI, PRP)

The End

We welcome opportunities for collaboration.

Thank you!