



# Winning the Fire Drill: How Not To Lose the IIoT Game

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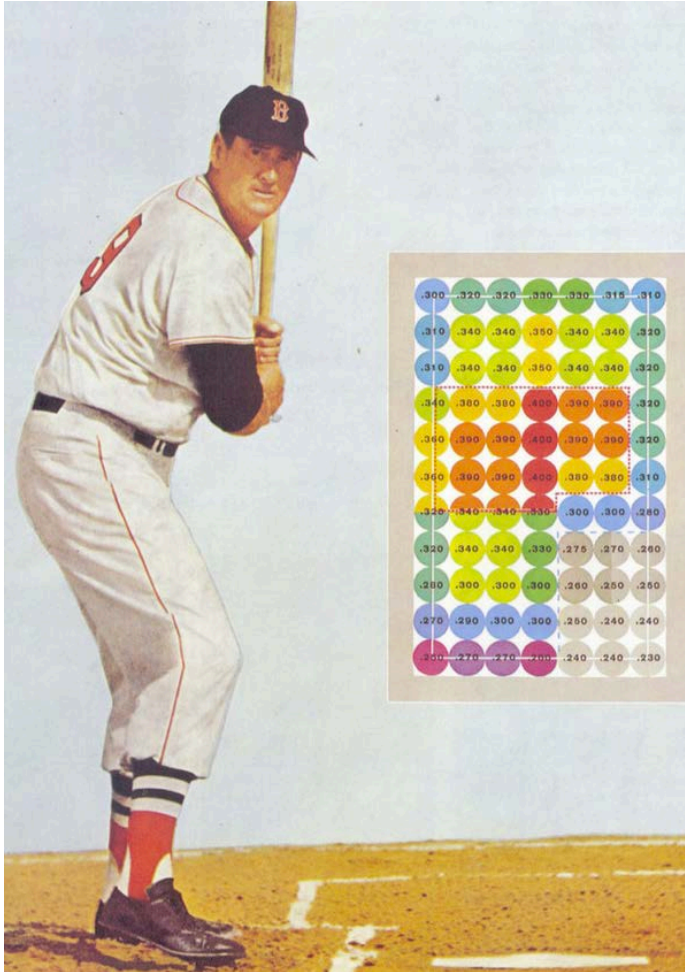
# About Dr. John Carrier



- Dr. Carrier works with senior and front-line managers to improve manufacturing and business processes and serves as an on-site hands-on coach in support of projects.
- His research focuses on the competitive advantage of synchronization of operations within supply chains.
- He teaches a popular Executive Education course on Industry 4.0 and IIoT (<https://tinyurl.com/yafmbdqe> )
- He has more than 20 years of experience in a variety of corporate, entrepreneurial, and consulting environments.
- Dr. Carrier holds a BS in Chemical Engineering from the University of Michigan, a PhD in Chemical Engineering from MIT, and an MBA from Harvard Business School.

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# Big Data in Boston



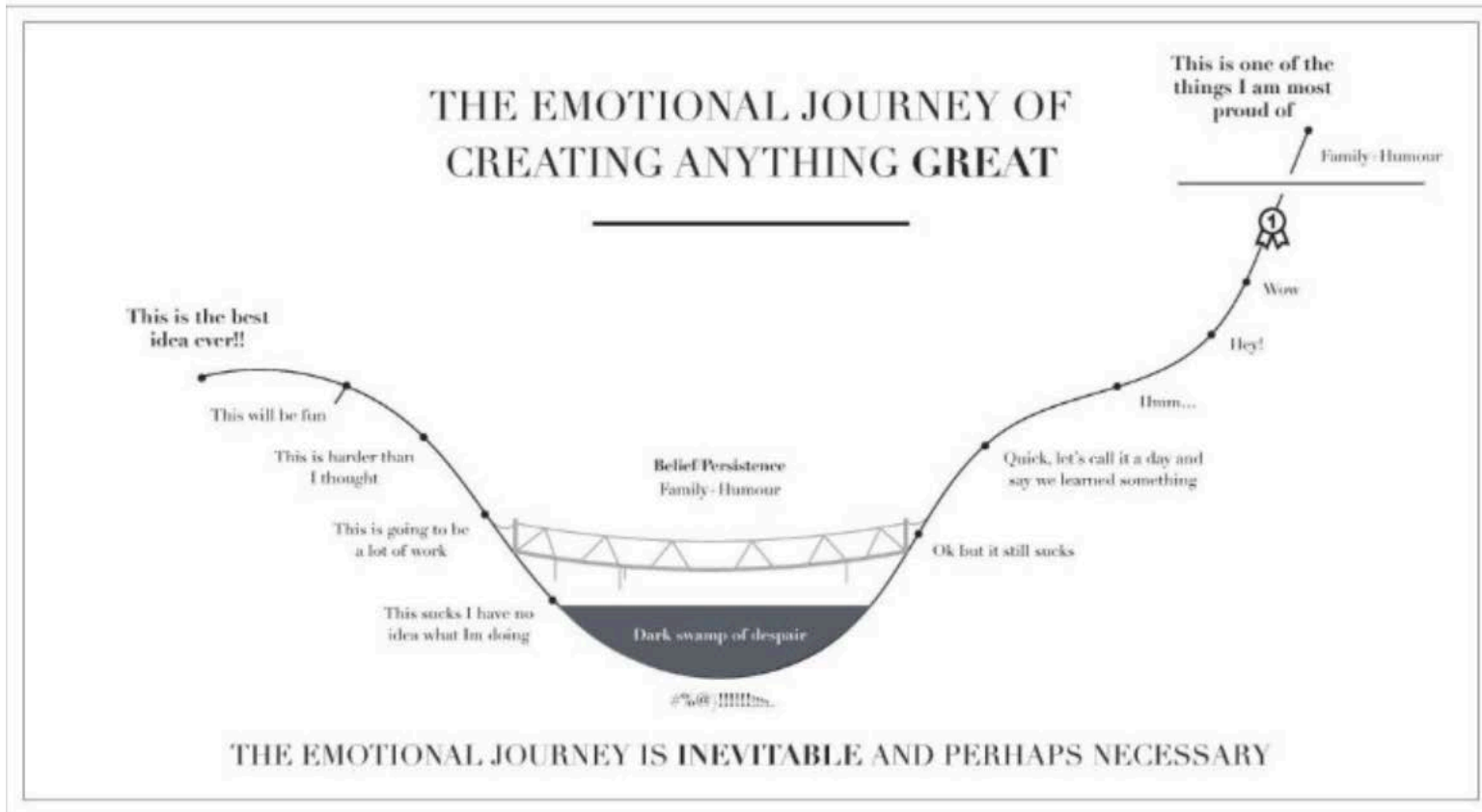
- Home of
  - MIT Sloan Sports Analytics Conference
- Greatest Hitter of All Time (Ted Williams)
  - Batting analysis from 1970
  - #4 in Career Walks

# What's the problem?

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- The IIoT world, customers demand make-to-order variety at make-to-stock price and wait times
- As a company, you still need to meet today's production and make today's profits
- How do you sequence in new technology into your “human system” without going bankrupt?

# The Journey We Are Trying to Avoid ...



# The last wave of technological change ...

**150 Extra Engineers**

An IBM Electronic Calculator speeds through thousands of intricate computations so quickly that on many complex problems it's like having 150 EXTRA Engineers.

No longer must valuable engineering personnel . . . now in critical shortage . . . spend priceless creative time at routine repetitive figuring.

Thousands of IBM Electronic Business Machines . . . vital to our nation's defense . . . are at work for science, industry, and the armed forces, in laboratories, factories, and offices, helping to meet urgent demands for greater production.

**IBM** INTERNATIONAL BUSINESS MACHINES

“No longer must valuable engineering personnel ... now in critical shortage ... spent priceless creative time at routine figuring.”



# Case Study: Tech Adoption

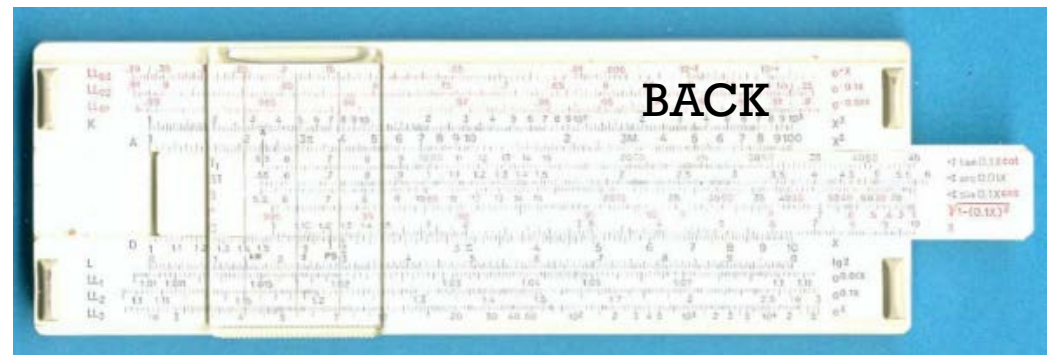
Location: Germany, 1973

The problem:

- You want to sell calculators
- Engineers aren't buying



The Innovation: Make it easier for the “customer” to make the transition



In one word ...

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# Fingerspitzengefühl

Where can a manager buy ...

- Situational Awareness
- Synchronization



# Amazing technologies that may experience slow adoption



Remember these?



Will this fare any better?

# Or in the words of Theodore Levitt ...

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People don't want to buy a quarter-inch  
drill, they want a quarter-inch hole. -  
Marketing Myopia (1974)

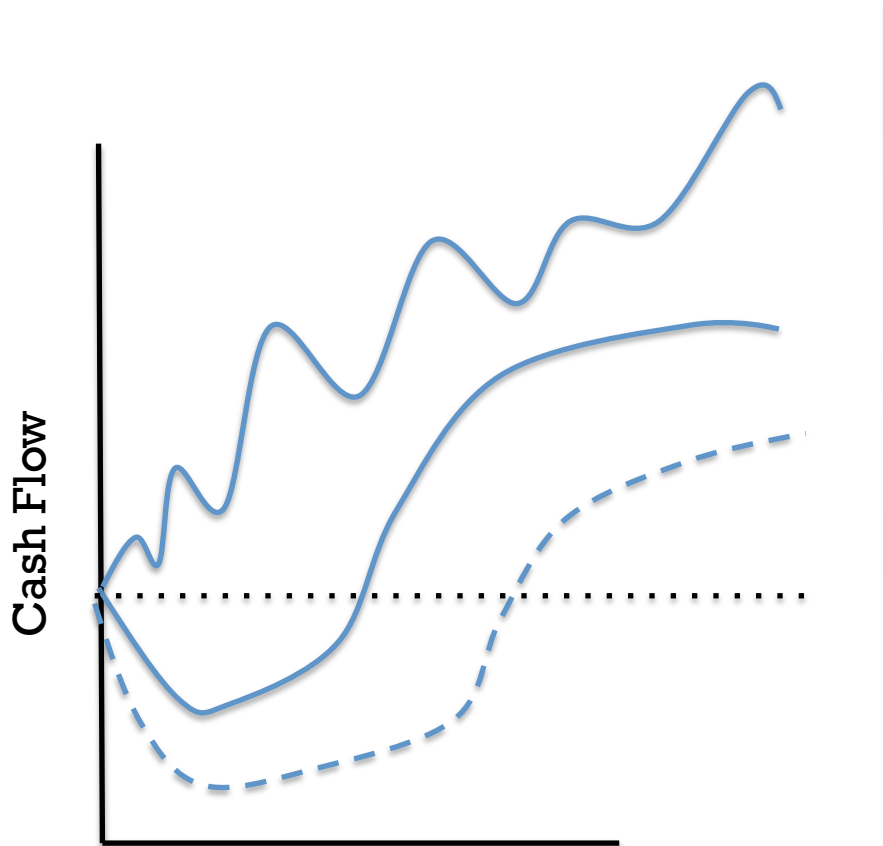
# What are we trying to buy with IIoT?

## An Analogy: The IIoT as Compared to the Human Body

Element	Human Body	Industrial Internet of Things
Sensors	Sensory Neurons	Temperature, pressure, concentration, light/camera, sound
Communication	Interneurons	Network
Command	Motor Neurons	Network
Actuators	Muscles	Robots, Pumps, Turbines, Furnaces
Quick Response Loop (feedback)	Ganglia	Fog Computing
Analysis	Brain	Digital Twin, Analytical and Statistical Apps
Synthesis and Learning	Brain	Artificial Intelligence and Machine Learning
Connectivity	Brain has over 100 <i>trillion</i> synapses	31 billion connected devices by 2020
Development Period	Several hundred million years	approximately 150 years

... what happens when you lose a sensor?

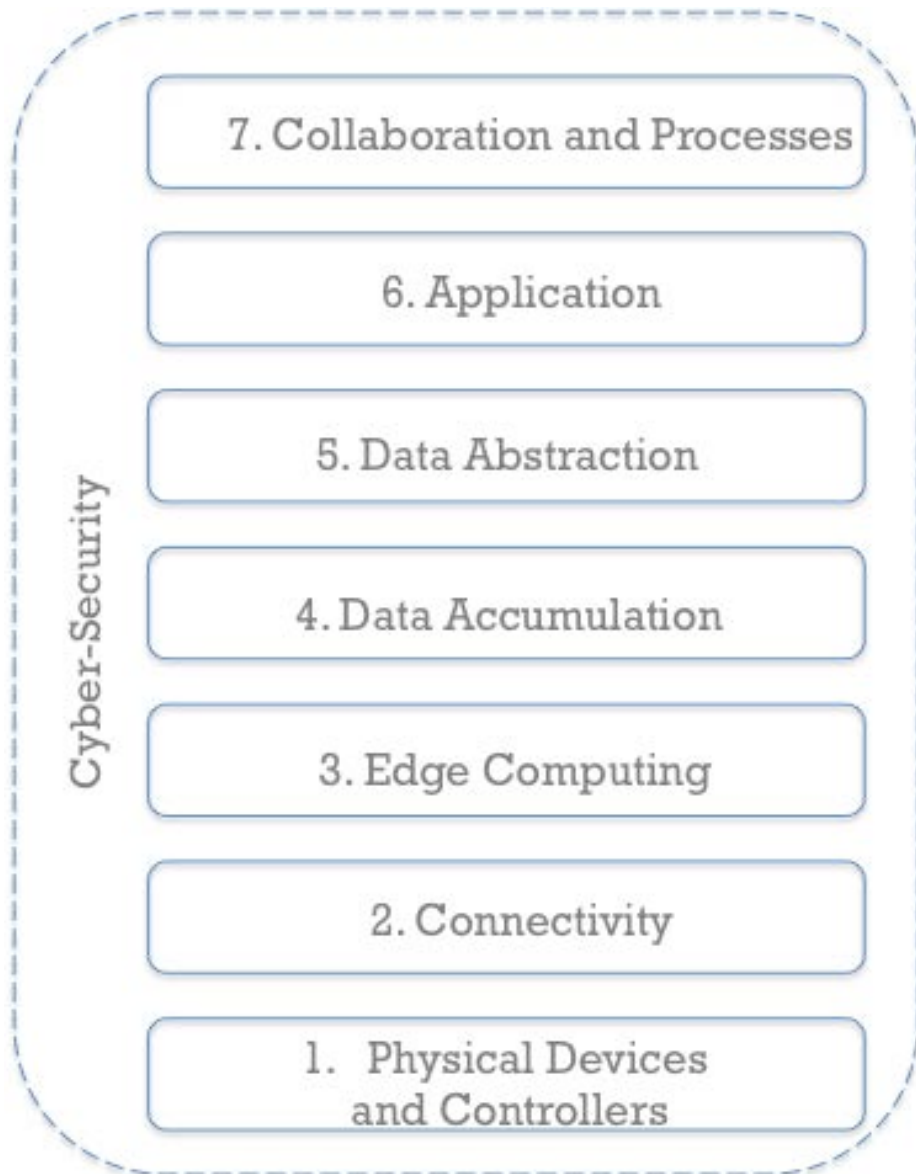
# Adoption of IIoT will be very different than in the past ...



- Traditional Investment (“buy”)
  - Large capital investment
  - Long dormant period
  - “flip the switch” moment
  - Disappointment, loss, and turnaround
- New Investment (“pay to use”)
  - Use in increments
  - Implement, correct, and make profit
  - Expand and scale to match cash flow

Risk management is key  
to IIoT adoption

# SaaS has fundamentally changed the financial model



- All elements of the stack are available on a subscription basis and fully scalable
- Simple robots can now be rented at a competitive rate to local labor
- Companies are looking to validate a real use case before committing to greater investment
- Unlike past ERP purchases, implementation of IIoT will be based on agile

# Example: From Legacy to IIoT in One Day

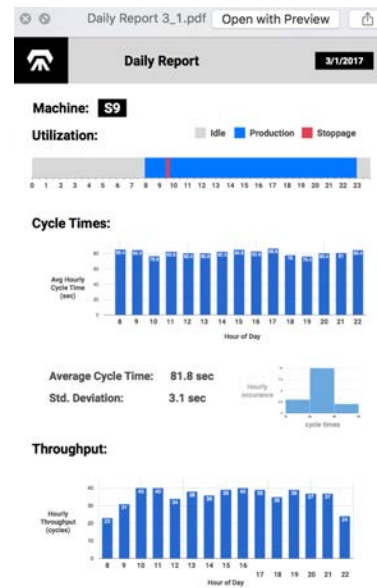
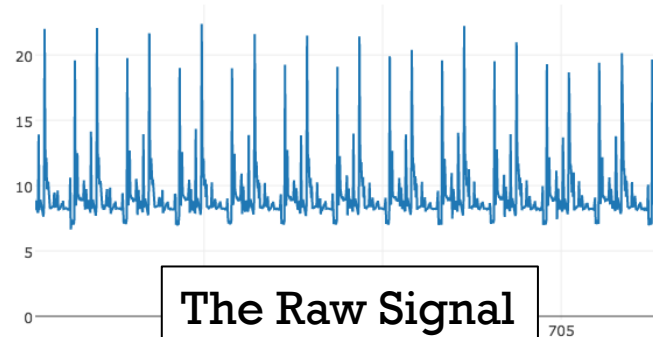


- Mid-sized US manufacturing company designs work cell for low volume, high industrial vibrators
- Investment based on reaching 90% of full production in six weeks
- Need simple way to collect, analyze, and report cycle time data in real time
- Team tests a simple IIoT device measuring current draw

# Example: From Legacy to IIoT in One Day



ds8\_s9\_03\_01



Real Time Display (via Cloud)



# Example of a “Smart” City Use Case

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**Creativity abounds, but standards are needed**

# An early example of System Improvement



- A famous engineer and an 'unsolvable' problem



# A few timeless lessons ...

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- A new business model of being paid by the result and not time on the assignment
- Even in the age of “a dollar a sensor”, you still need to know where to put it
- The original digital twin – the model of the system in Steinmetz’s brain.

# The DATA IS NOT THE SYSTEM

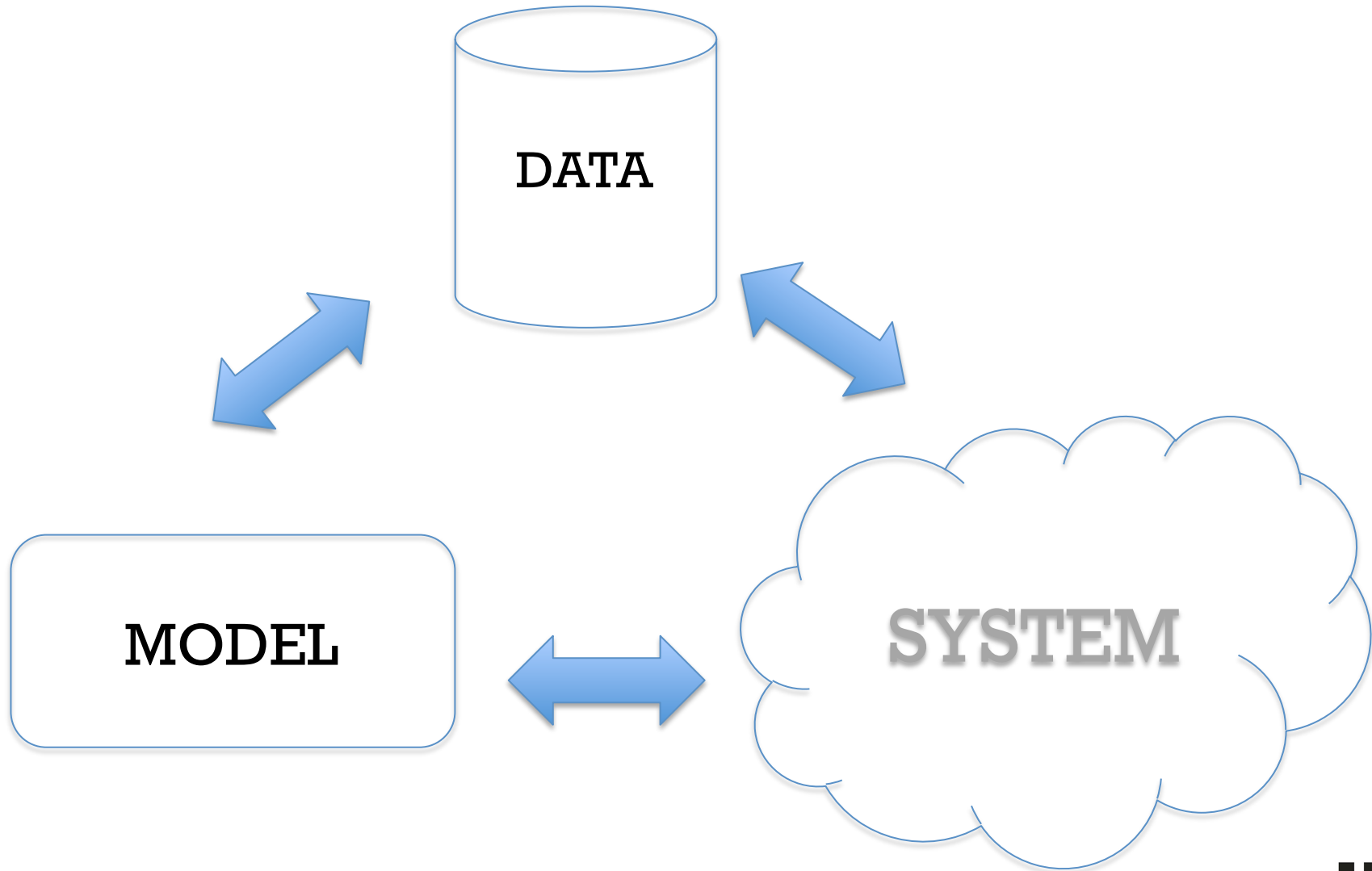
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**The Model: how we think the system works (expected)**

**The System: how it does work (actual)**

**The Data: the difference between expected and actual (also known as 'negative feedback')**

# STOP AND THINK: APPLY TO YOUR SYSTEM

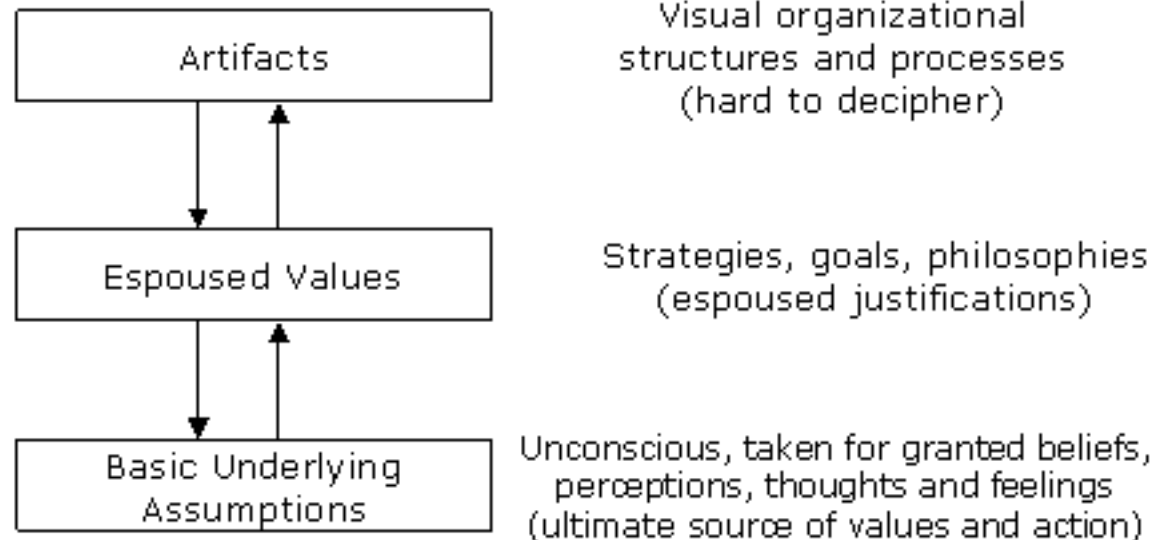


# Culture and Mental Models?



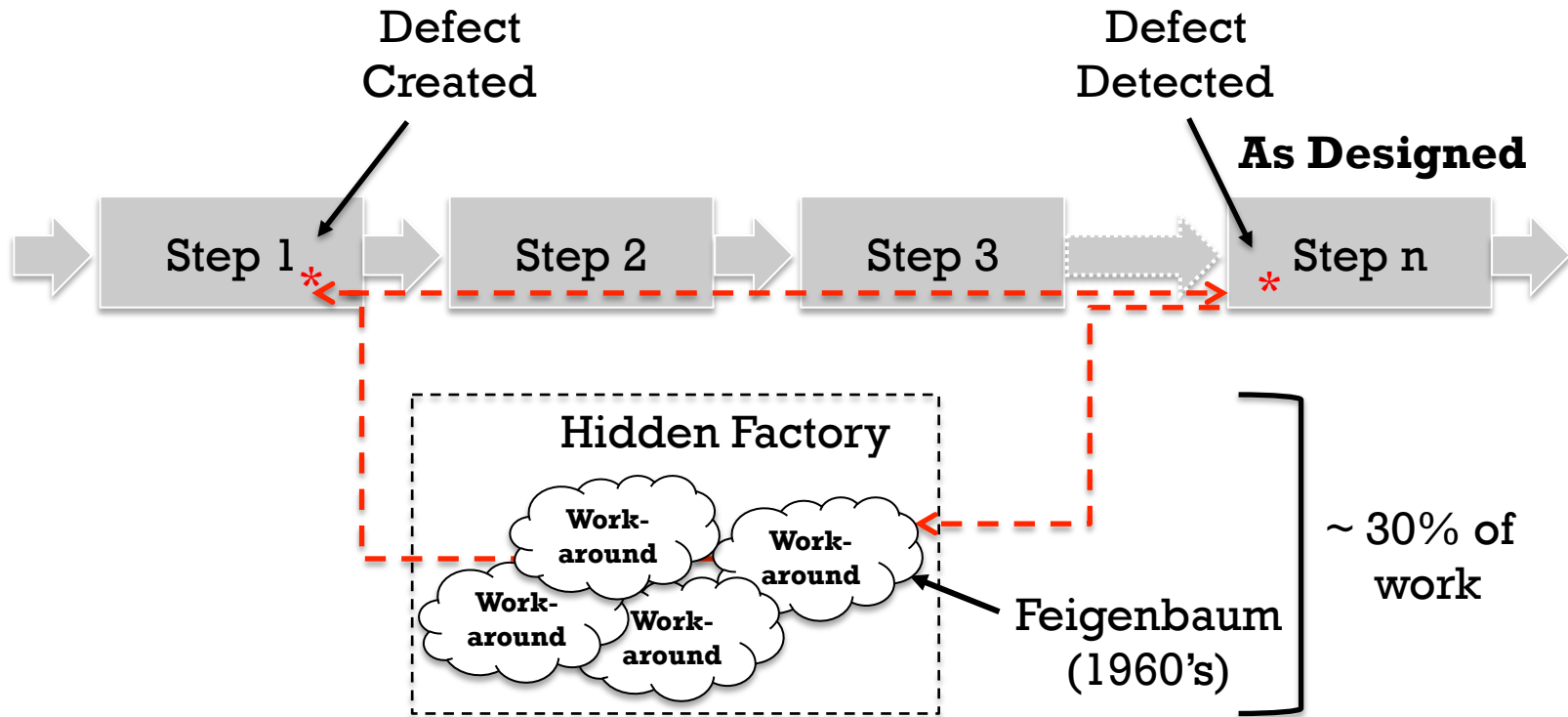
**Ed Schein**  
**Emeritus Professor**  
**Sloan School of Mgmt**

## Three Levels of Culture (Schein)



**The Spreadsheet is NOT the System**

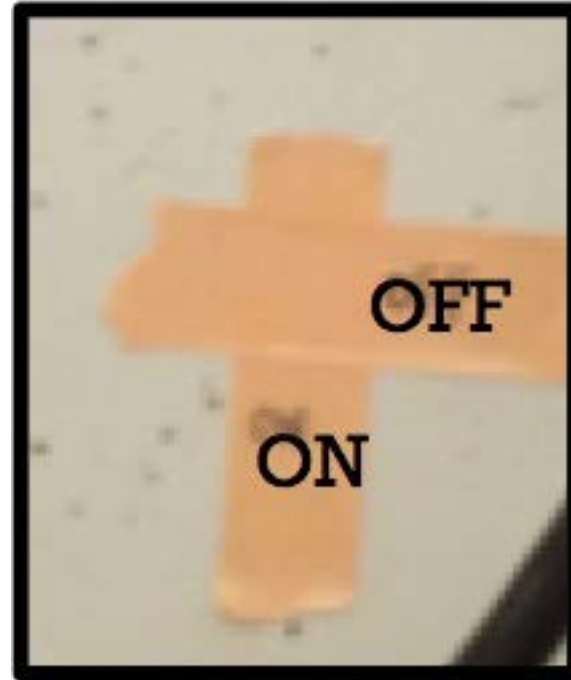
# Let's look at your system ...



**What happens when we try to introduce new technology (like IIoT) into this system?**

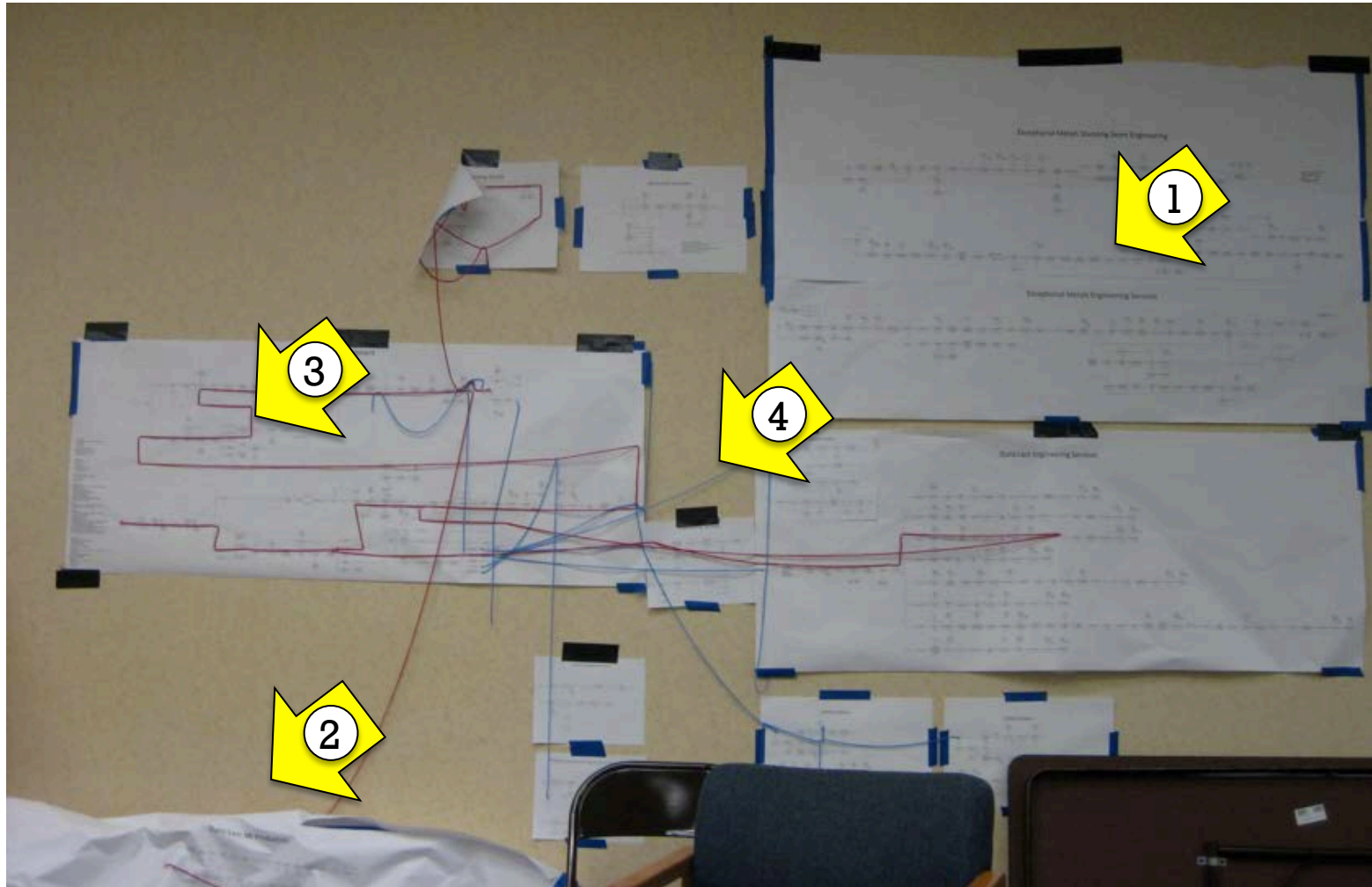


# Schrodinger's Valve: Is it open or closed?

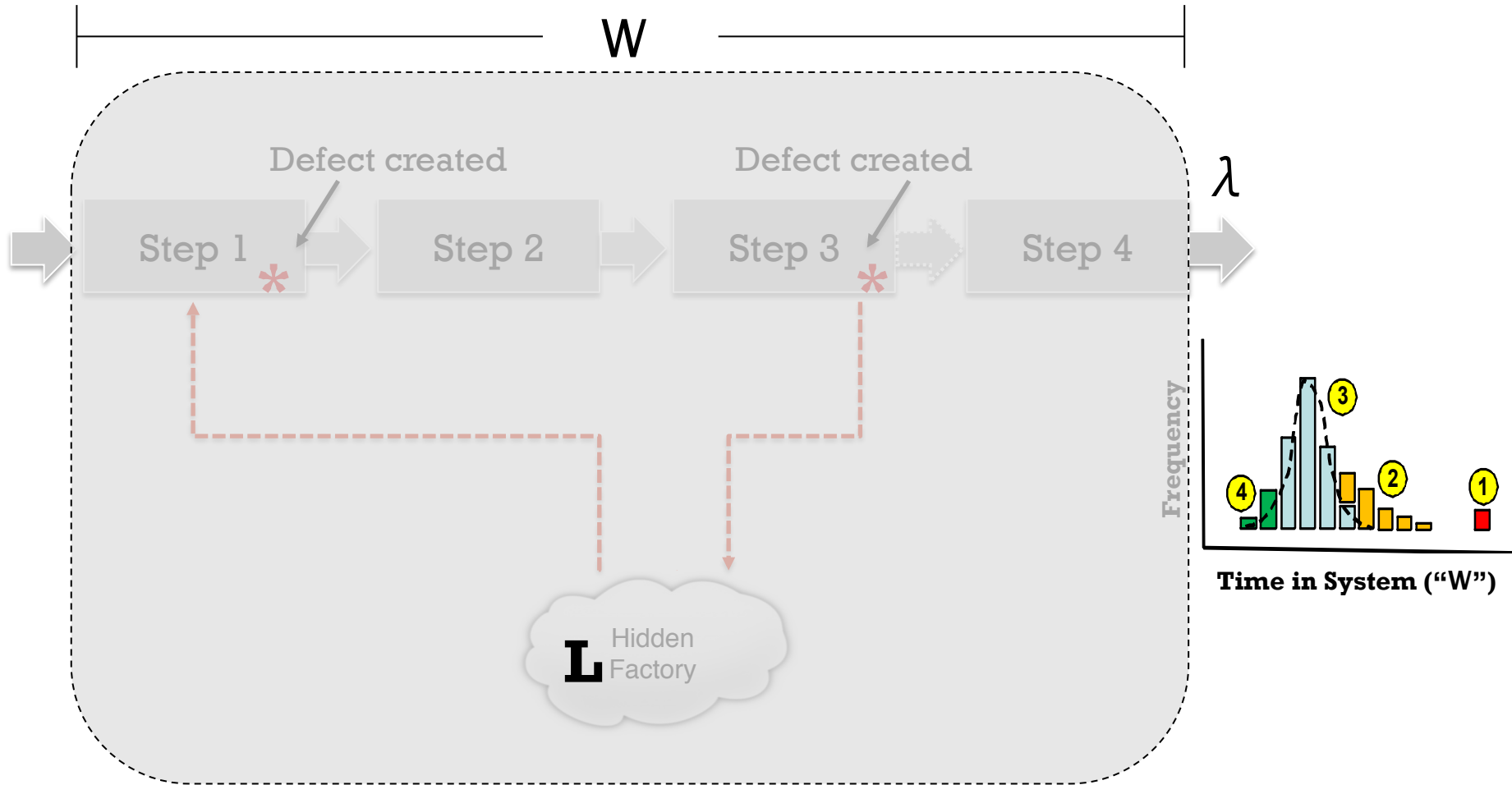


# Application to Knowledge Work

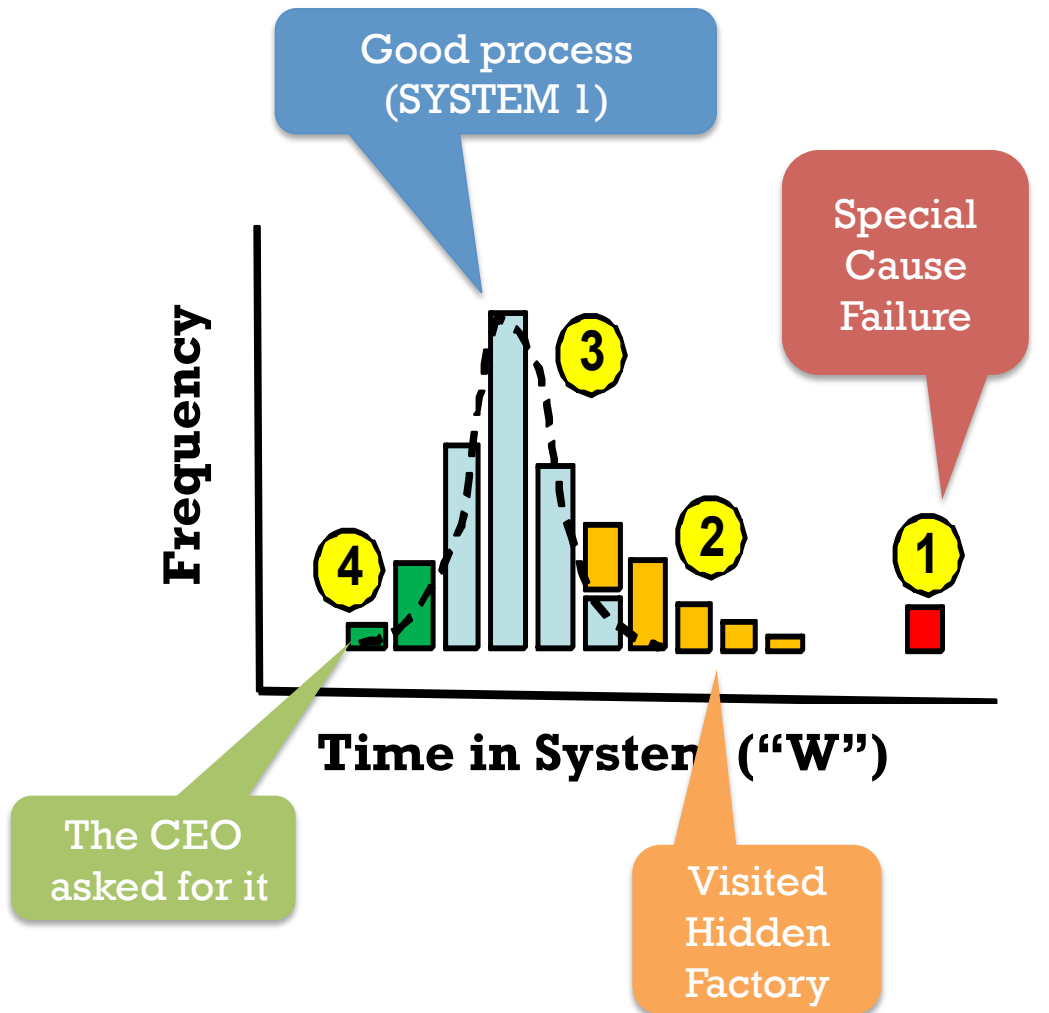
June 27, 7:10 AM



# Using LL to detect hidden factories..



# A closer look ...



Does this look familiar?

What's the value of shrinking the hidden factory tail by half?

# The Value Stream – how we value TIME

## THE 3 TYPES OF VALUE STREAM ACTIVITIES

Term	Who pays for it	Definition
Value add	Customer	<ol style="list-style-type: none"><li>1. Customer will pay for it</li><li>2. Form, fit, or function of product changed</li><li>3. It was done right the first time</li></ol>
Non-Value Add – or– Business Value Add	Business	Sustains the business
WASTE	Nobody	No one will pay for it (or we ALL pay for it)



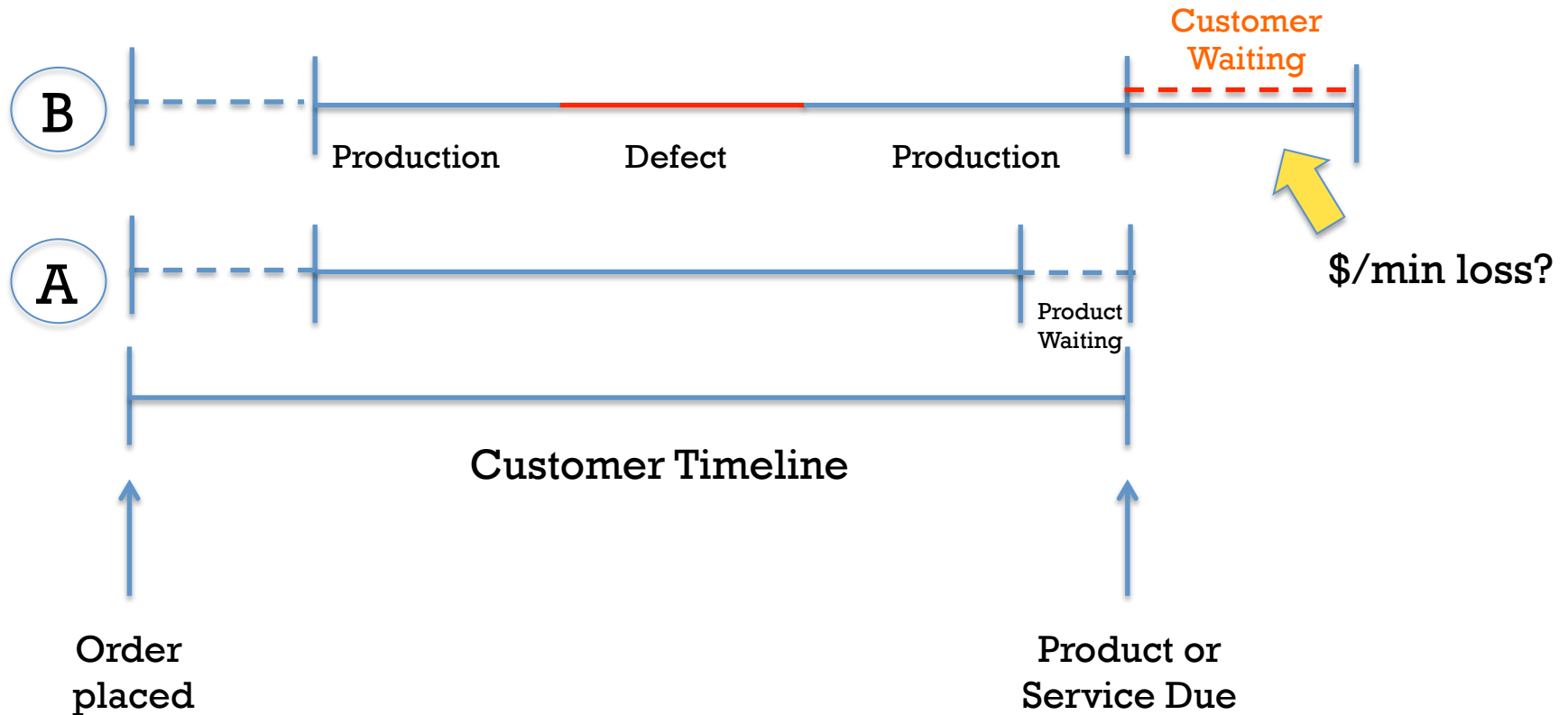
What is a minute worth in your system?

# How does this provide a business model for IIoT?



- Identify systems with valuable total assets
- Find the “clock” in the system and measure its utilization time – does it “de-synchronize”?
- Look for root causes and ways better information and preparation could improve

# This is how the business case is made ...



Look for customers with expensive wait times

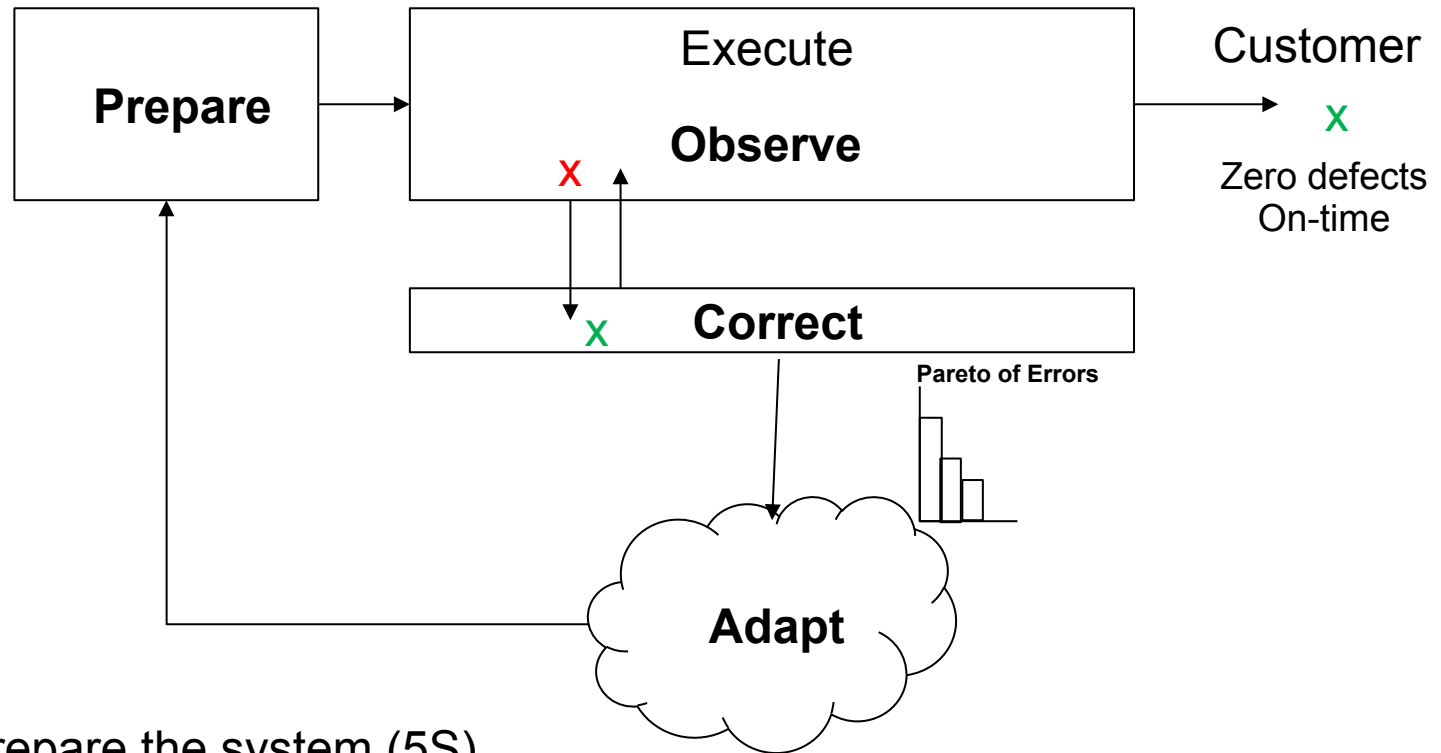


# Continuous Improvement vs. AI

Action	5S	AI
Find what is needed	Sort	Search
Identify optimal sequence	Set in Order	Optimization
Reduce external noise	Shine	"Noise"
Standardize	Standardize	[ASSUMED]
Continuously Improve and Adapt	Sustain	Adaptive Learning



# An adaptive system for implementing sustainable change (POCA loop)



Daily

1. Prepare the system (5S)
2. Let the system run (Execute)
3. Observe defects during execution (5S, Value Stream)
4. Remove and correct (Six Sigma)
5. Create countermeasures to correct defects
6. Re-set system to eliminate defects

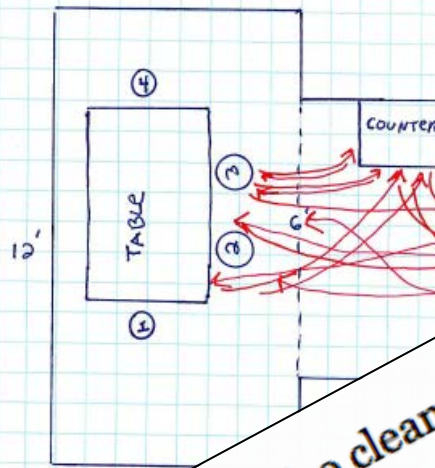
# How the IIoT Can Fit In ...

POCA Formulation for an Adaptive Operating System		
Phase	Defintion	Tools
Prepare	Organize the Workspace to Execute According to Plan	5S
		SMED (Changeover Reduction)
		Poke-Yoke (error-proofing)
Observe	Watch how the work actually flows vs. plan	Value Stream Map (Lean)
		Control Chart (Six Sigma)
		Little's Law, Hidden Factories
Correct	Pull defects out of the flow of work	Yellow Lines (quality checks)
Adapt	Re-organize workspace to reduced need corrective actions	Pareto Chart

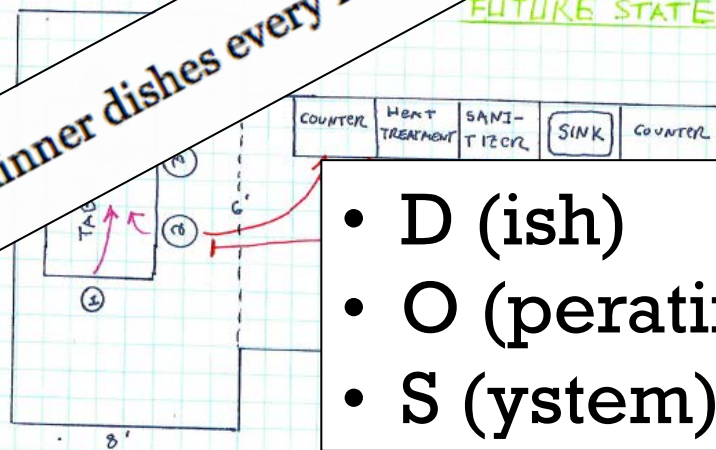
Better information, analyzed and shared in  
real time amplifies the tools

# Example: Plant 247 G

SPAGHETTI MAP  
PLANT #247 FLOOR PLAN



SPAGHETTI MAP  
PLANT #247



Gates said he also cleans the dinner dishes every night, because he likes the way he does it.

- D (ish)
- O (perating)
- S (ystem)

8 ceramic disks  
15-20 forged metal tools  
5 TO 6 CUTTING TOOLS  
2 TEFLON COATED METAL CONTAINERS

Equipment

- 8 ceramic disks
- 15-20 forged metal tools  
- 5 TO 6 CUTTING TOOLS
- 2 TEFLON COATED METAL CONTAINERS

- Workers 1-4: SORT STRAIGHTEN + STACK TOOLS + EQUIPMENT
- Worker #2: Dispose of WASTE + SET NEATLY INTO SANITIZER

ELAPSED TIME

- STRAIGHTEN + STACK 2 MIN
  - INSERT INTO DISHWASHER 5 MIN
- 7 MIN TOTAL



# The key message

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- The IIoT is a low-priced commodity
- There are virtually no barriers to obtaining the technology
- The winners will be determined not by who has the most technology, but by who knows how to best adopt it into their current system

**KNOW THY SYSTEM**