



# Planning a Smart Manufacturing Roadmap

*Jeff Shook | September 27, 2023*

## Mission

GENEDGE is Virginia's best public resource to help manufacturing and industry innovate, compete and grow.

## Vision

To be Virginia's go-to resource that accelerates the growth of manufacturing and technology industrial clusters and quality jobs.

## Our Values

- Work with integrity
- Work collaboratively
- Be inclusive
- Think creatively
- Positive results
- Always be learning and applying new knowledge

# Manufacturing Extension Partnership

- The MEP National Network™ is a unique public-private partnership that delivers comprehensive, proven solutions to U.S. manufacturers, fueling growth and advancing U.S. manufacturing.
- Last year, MEP Centers:
  - interacted with 34,307 manufacturers,
  - leading to \$14.4 billion in sales,
  - \$1.5 billion in cost savings,
  - \$5.2 billion in new client investments,
  - And helped create or retain 125,746 jobs.



## Presenter Jeff Shook

### **Automation and Advanced Manufacturing Manger**

30+ Years Manufacturing Experience  
CPI / Kaizen Master Trainer  
Lean Six Sigma  
Smart Manufacturing / I4.0  
New Process Development / Introduction  
Supply Chain Development  
Insourcing & Reshoring Analysis (Make v Buy)  
Design for Manufacturability (DFx)



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## Building a roadmap from Operational Excellence to Automation

Where is manufacturing today?

What is the current status of automation?

Why change?

What to change

What can be done for free (or less expensive steps)

Steps to take to build a roadmap



*If you don't know where you are going, you might wind up someplace else.*

-Yogi Berra

## Challenges for Small Manufacturer's (SMM's)

Capital limitations  
Workforce constraints  
Daily firefighting  
Supply chain challenges  
Commodity pricing  
Poor information or lack of...

### 2022 CESMII Smart Manufacturing Survey

***Question: What challenge(s) has your company encountered while pursuing a SM strategy?***

1. Lack of skilled talent
2. Cost required to implement
3. Complexity of system integration
4. Lack of technical expertise
5. Time required to implement
6. Lack of clear investment benefits (ROI)



# The Problem with predicting the future...

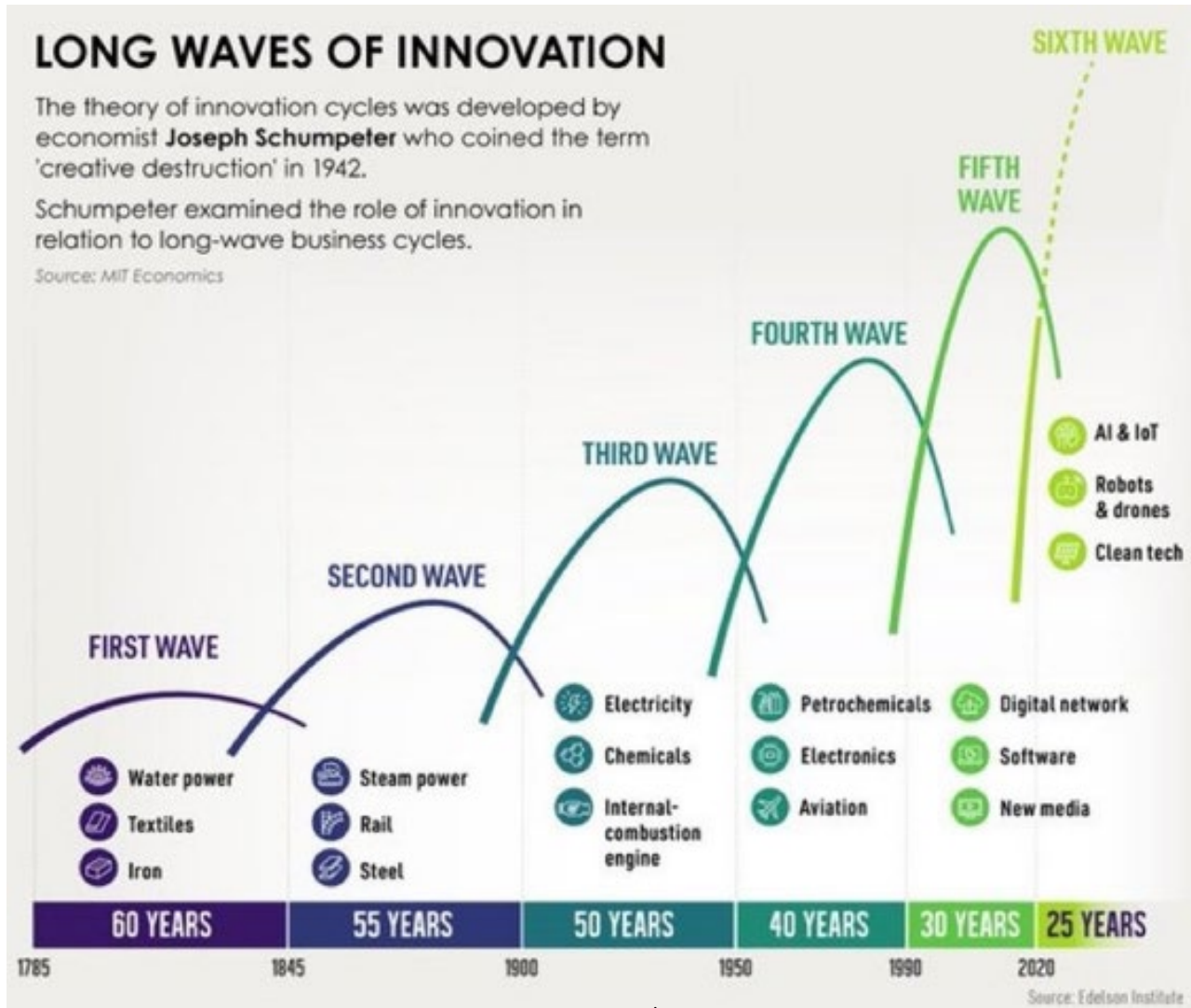
Sometimes progress is slower than expected.

How is your road trip progressing?

1969 GM Ad.



# Innovation is occurring faster and faster



Source: Visual Capitalist / Edison Institute





Motorola  
Citicorp  
Photomat  
USPS  
Indy 500

Pager  
Mortgage  
Photographs  
Mail  
Pit stop

Order-ship  
Loan approval  
Processing  
Delivery  
Car service

3 wks -> 2 hrs  
6 wks -> 15 min  
2 wks -> 1 hr  
1 wk -> 17 hr  
4 min -> 20 sec

# Manufacturing Sea Change

*Level of Investment is record setting – US funded & Foreign investment*

*Boomers are aging out of workforce*

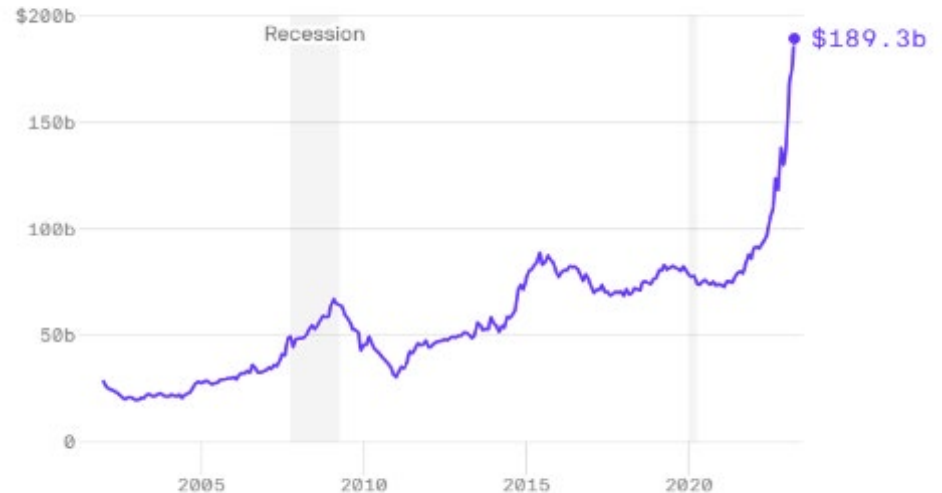
*Lack of young people interested in Manufacturing as a career*

*Automation and AI in other non-manufacturing sectors*

“Ongoing labor shortages, easier-to-use robotic solutions and new industries embracing robotics, such as restaurants, retail, construction and even agriculture, have led to record units sold here in North America this year,” said Jeff Burnstein A3

## Manufacturing construction spending

Seasonally adjusted annual rate; Monthly; January 2002 to April 2023



Data: Census Bureau; Chart: Axios Visuals

Current estimates suggest the semiconductor industry will add 115,000 jobs in the next seven years. Can the U.S. workforce meet the demand? – Semiconductor Industry Association (SIA)

# Automation Definitions

*Automation Vs. “Smart Manufacturing”*

*Process industries or Discrete manufacturing*

*Types of Robots ( Industrial vs. Collaborative)*

*Robots as a service*

*Automation / Vision Systems / (Machine learning & Artificial Intelligence)*

*Incorporating all 3 technologies will disrupt traditional manufacturing in the next 5 years!*



Teach Pendant



Tablet

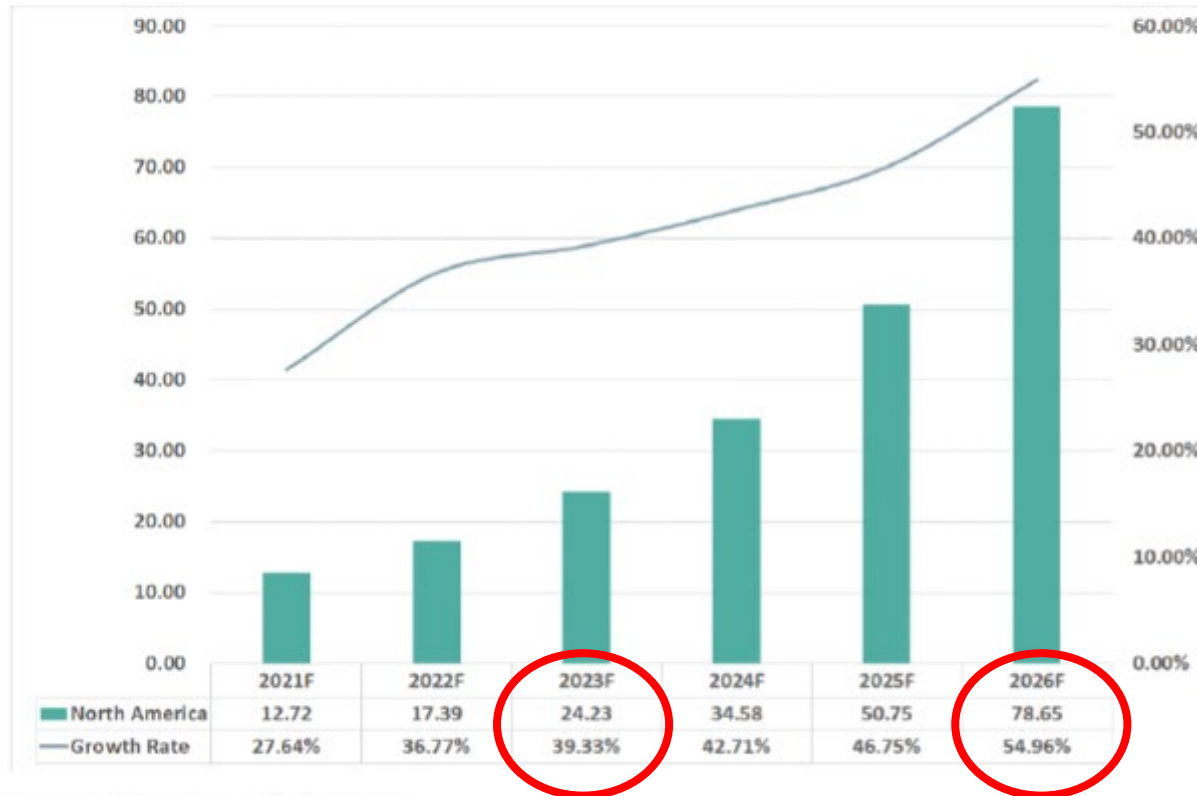


Phone App

How will these changes affect you?

# Automation Trends Cobot Market

Figure North America Collaborative Robot Consumption (K Units) and Growth Rate (2021-2026)



Source: Maia Research Analysis

- All Robots: 35,804 units Jan-sept 2022 \$1.875B (A3)
- 24% increase over 2021 same time period

## Cobot Capability and Application growth



September IMTS – UR announces  
20kg Cobot



October – Yaskawa announces  
30kg Cobot (66 lbs!)

# Keyence

A wide range of detection tools for various targets and applications



## New built-in tools



## Tools



Outline



Color area



Area



Color average



Brightness average



Edge pixels



Width



Diameter



Edge presence



Pitch



OCR



Color/  
brightness prohibit

## Position adjustment tools



Position adjustment



High-speed position adjustment



**NEW** Multi-position adjustment

## Examples of machine vision



Juice bottle labels



Temperature of  
meat products



Number of pills  
in a pack



Number of cigarettes  
in a pack

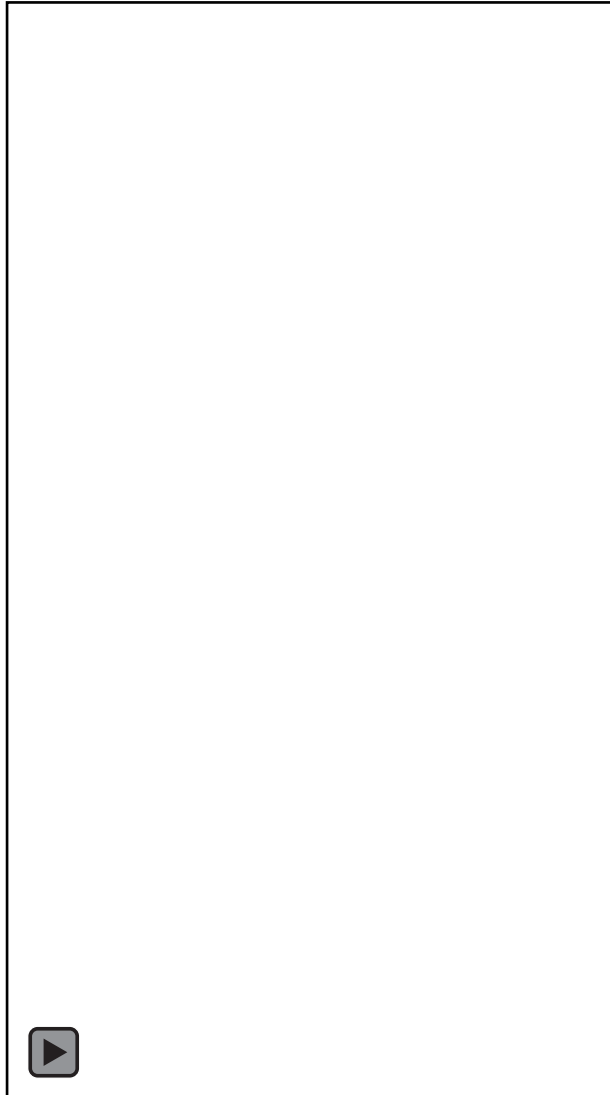


Roundness of a  
pizza

# What does AI, Vision, and Robotics look like?

*Robotic poultry handling.*

*Automates an unpleasant and fast paced job*





# Where is automation being deployed?



Greet travelers, usher them to ticket counters, bag claim, gate assistance, and carry baggage.



Agriculture applications allow for labor savings of mundane tasks. Can operate longer hours.



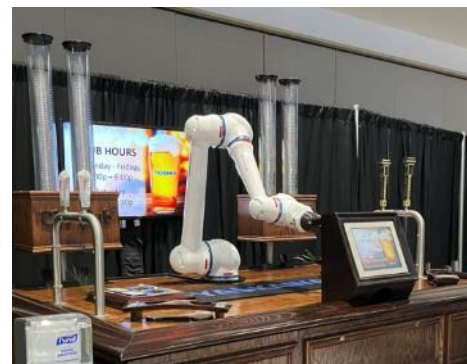
## 'They're awesome': Golden Corral restaurant has two robotic workers



A restaurant in West Virginia has two robots who help out with the dishes.

## Where are cobots being applied?

- Human food service professional
  - Each staff member can require months to teach and train
  - Have many “re-teaches” to hundreds of staff each time you wish to update or change recipes
  - Turnover / finding employees
- Collaborative Robot
  - Update menu / prep procedures / recipes whenever you want
  - One “training” / new recipe can be implemented across all restaurant chain immediately



## Where are you currently? Traditional Performance monitoring

No Cadence or measurement to operations

Lack of validated measurement system makes best practice a matter of opinion

Maintenance of equipment coincides with reports of smoke

Improvements difficult to detect due to no baseline performance

No clear tie between operational performance and financial results

Resources are often used to fight fires reflexively

End of Month results

Manufacturing & Quality engineers crunch performance metrics

Accountants tally the hours

Results are combined and reviewed

*“A problem well defined is a problem half-solved.”*

*John Dewey*

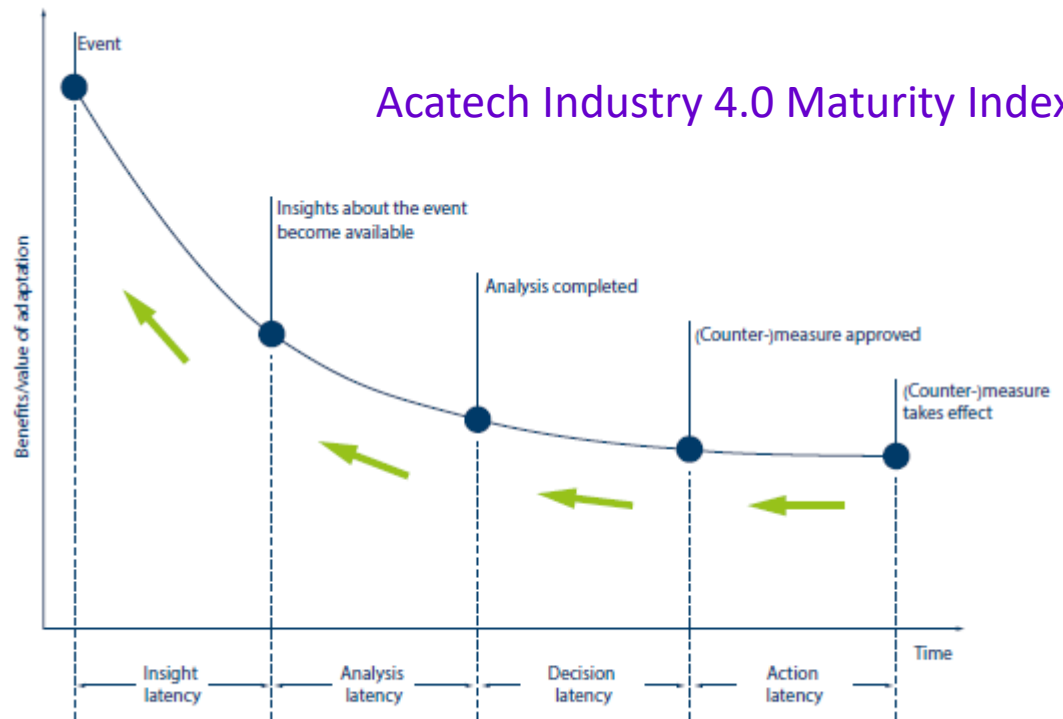
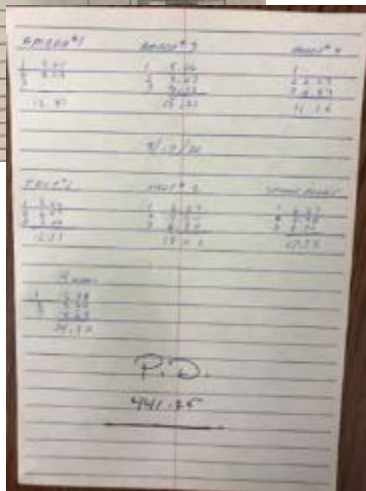
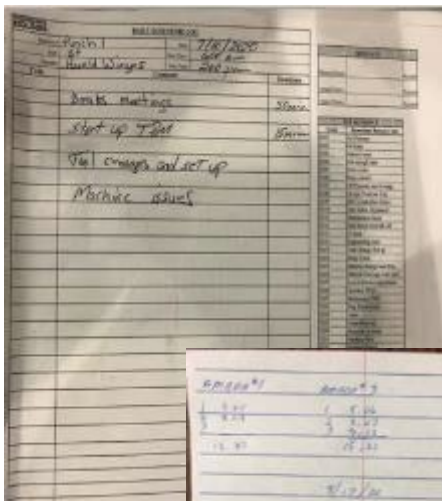
# What is your current response process?

An event occurs..

Diagnose to identify what has happened

Triage, sort, rework...

Full Counter measure



# What is the Time to Resolution?

*How much effort is extended?*

*How many meetings and discussions around potential resolutions*

*Scrap, rework, MRB???*

## Acatech Industry 4.0 Maturity Index

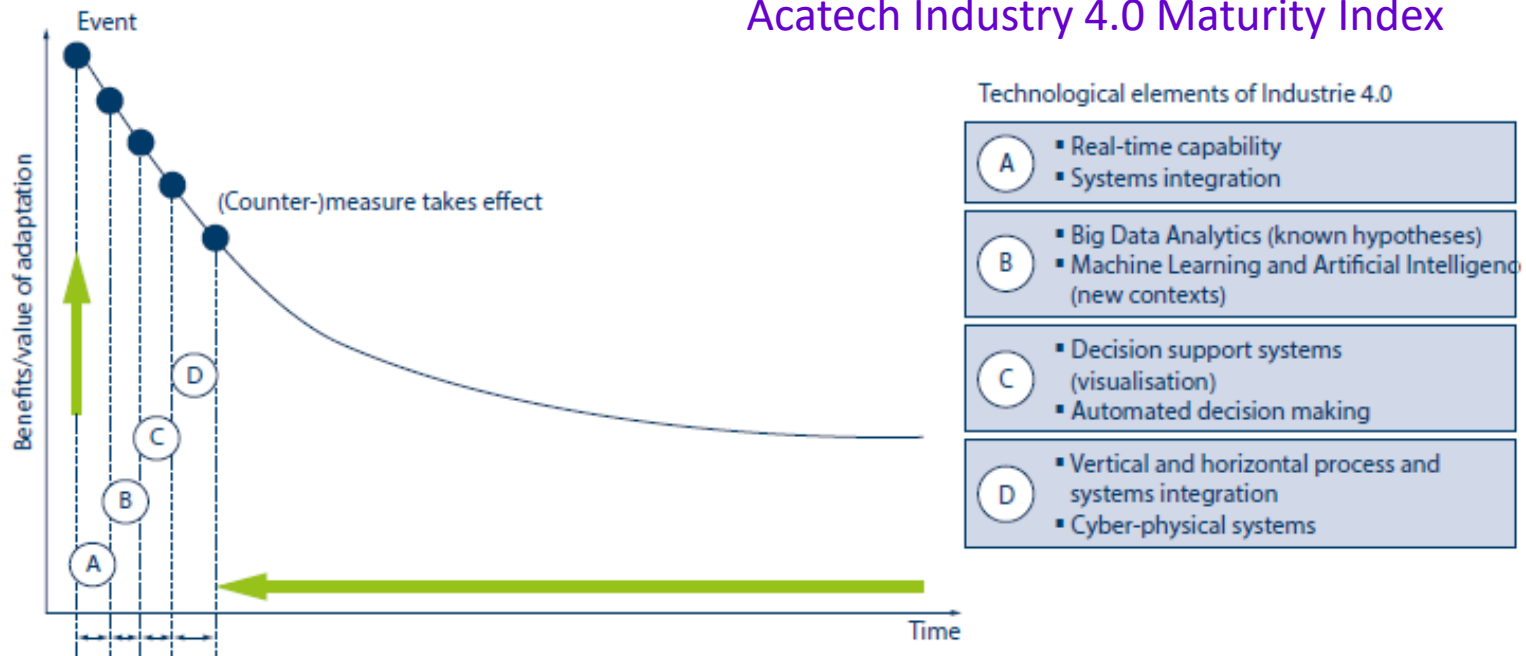


Figure 3: How organisational learning increases the value of an adaptation (source: FIR e. V. at RWTH Aachen University)

# What does Industry 4.0 look like?

*An overview*

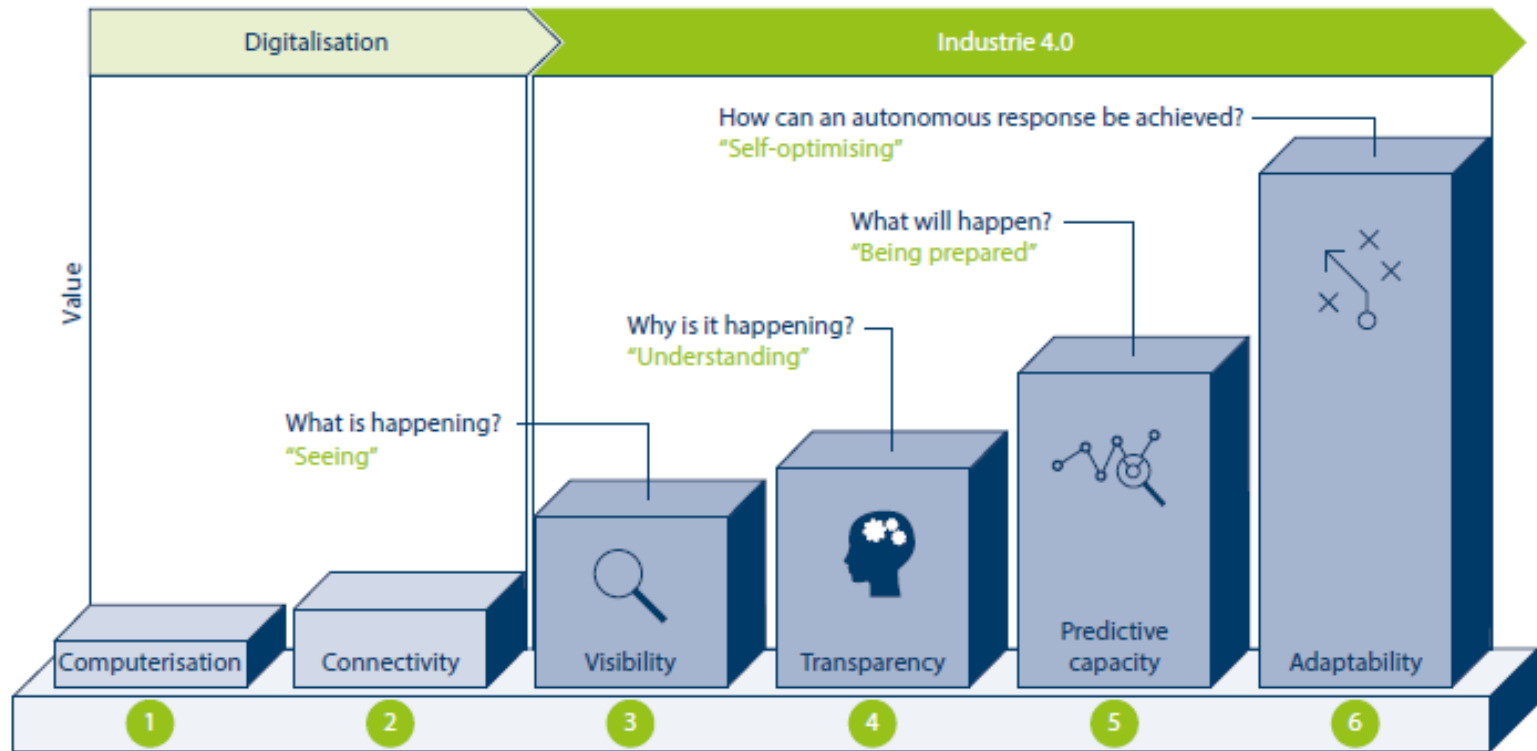


Figure 6: Stages in the Industrie 4.0 development path (source: FIR e. V. at RWTH Aachen University)

# Where is the opportunity? – Understanding the Current State

*Revisiting the problem – How to identify the opportunity?*

*Data collection – What data do you have?*

*Timeliness – When is it collected / analyzed ?*

*Data visualization – Can it be interpreted?*

*Data integrity – Accuracy of the data?*



Helpful sources of data:

*Routings / Labor standards*

*Process maps*

*Value stream maps*

*Quality system data*

*Maintenance requests*

*Customer feedback*

KPI's:

OEE

FTY / FFT

Production Downtime

On-Time Delivery





## Where is the Waste?

*We tend to focus our improvement attention on the work that we “see”*

*Example: a manual assembly operation, or a machine.*

*Because that is where the “work” is.*

*We desire to make an operation more efficient*

*We tend to ignore material moving, sitting, waiting...*

*Often new equipment and processes only deliver small impact.*



*We could work on making the soldering process faster, or more efficient.*

*It may be the correct thing to improve the process, yet it did not improve customer lead times.*

*Focus on the Non-Value Added!*

*By identifying the Waste!*

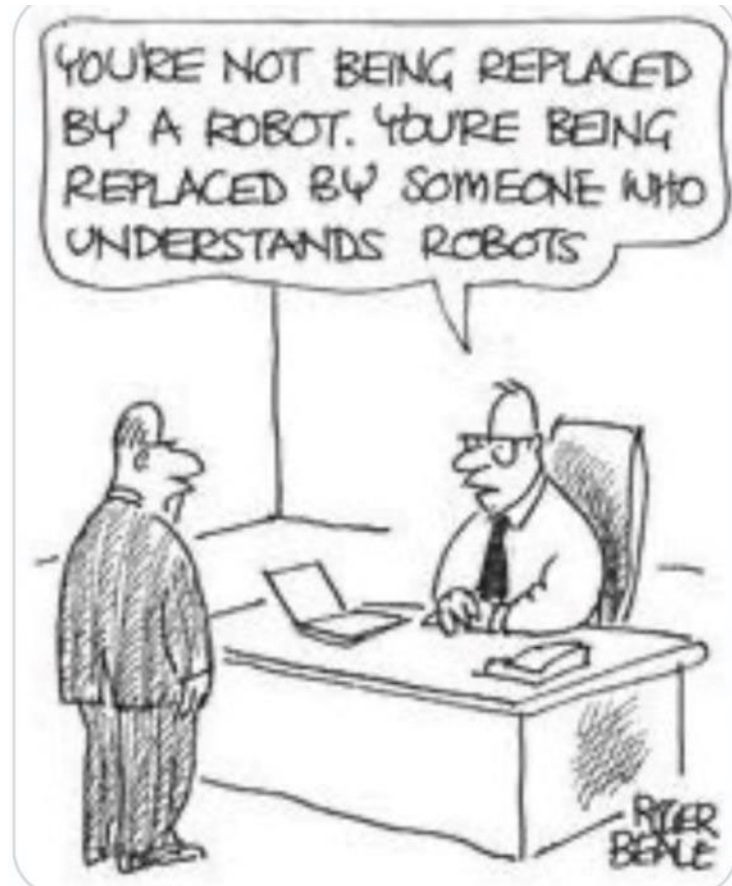
## What about the workforce?

We will need to think about and plan for training the workforce for this new technologies.

Creating a learning culture will help adoption when investing in newer technologies.

Examples include: standard work, team based, 5S, adaptable

Lean tools and Process Improvement are foundations for building successful automation.



# Where to start the journey to Automation?

*Leadership Commitment!*

*Identify champions (Jonah's)*

*Understand the commitment*

*Understand the goals and common vision*

*Be realistic about the journey*



## Where to start? - What can be fixed for free?

*Address what you can control – A few examples*

*Involve your team!*

*Communicate, communicate, communicate!*

*Attitude is free!*

*Sort, Set in Order, Shine, Standardize, Sustain!*

*Implement visual management & Standard work*

*Teach, Train, Lead*

*Become a learning organization.*

*Involve your people, Grow your champions*

*Establish a culture of continuous improvement*

*Build a culture that can support automation*

*Be open to change*

# What are some of the ways SMM's improve their bottom line?

*Employee engagement Through:*

*5S or 6S culture*

*Lean training*

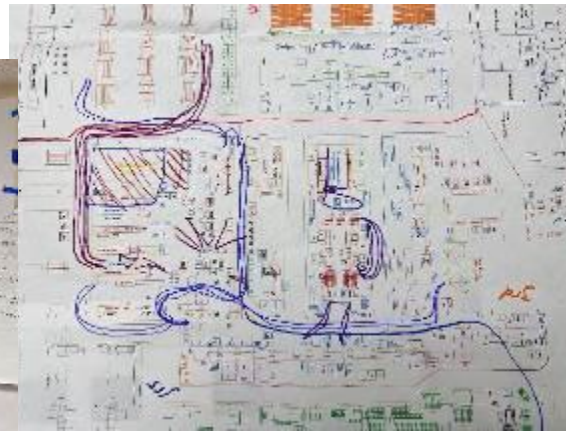
*Value Stream Mapping*

*Waste out / 2 second lean*

*Waste walks*

*Employee suggestion system*

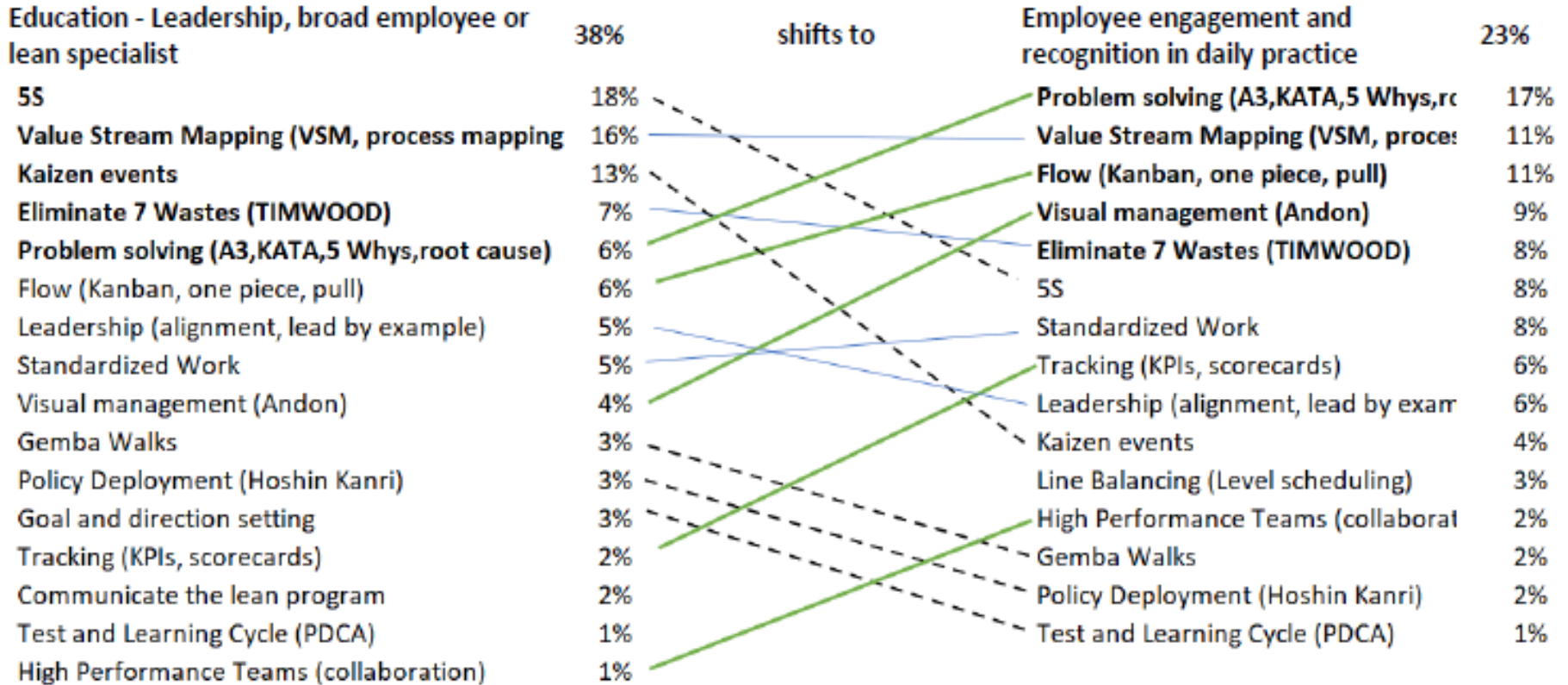
*Kaizen or rapid improvement events*



# How Lean Organizations evolve

## First Steps

## Longer-term



*Lessons from Lean Reimagined*

## What comes next?

*Identify the value stream*

*Listen to VOB and VOP*

*Alignment of KPI's*

*Match current manufacturing processes to latest technologies*

*Use assessments and benchmarking to help identify best practice*

*Build an ideal (perfect) future state map*

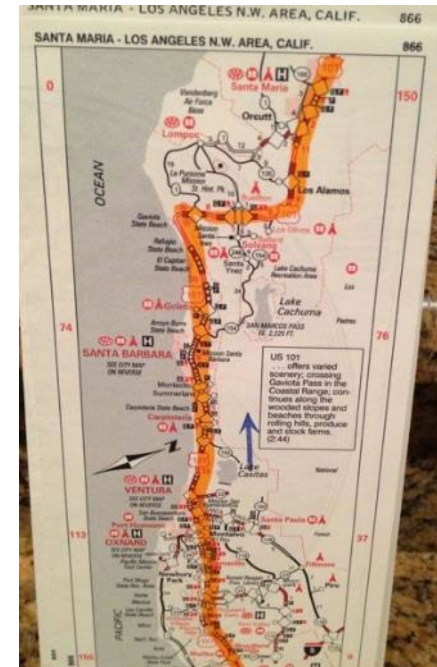
*Estimate the ROI*

*Create a plan*

*Assemble a team*

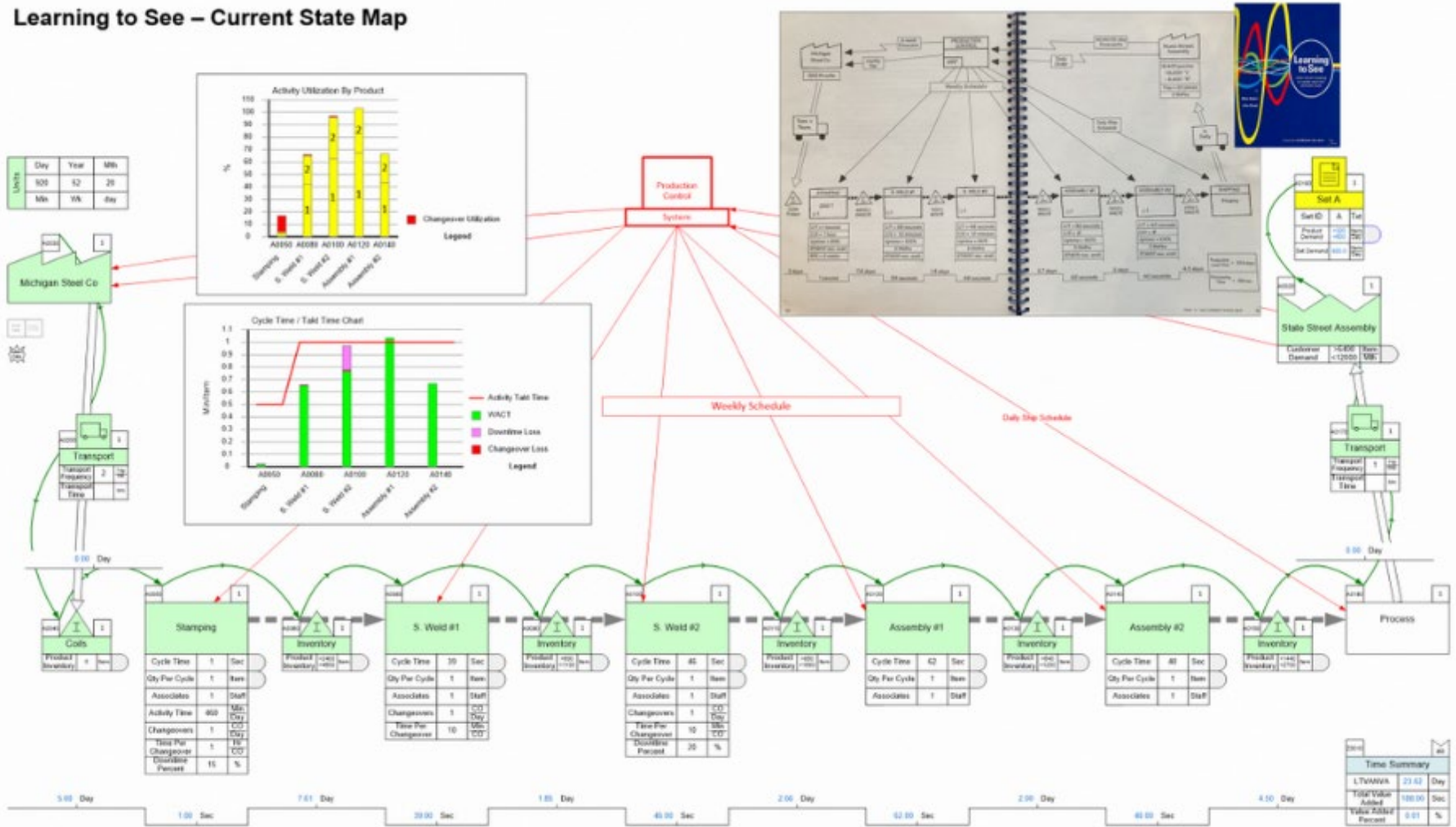
*Create specifications for automation equipment*

*Remain flexible!*



# Map the Process

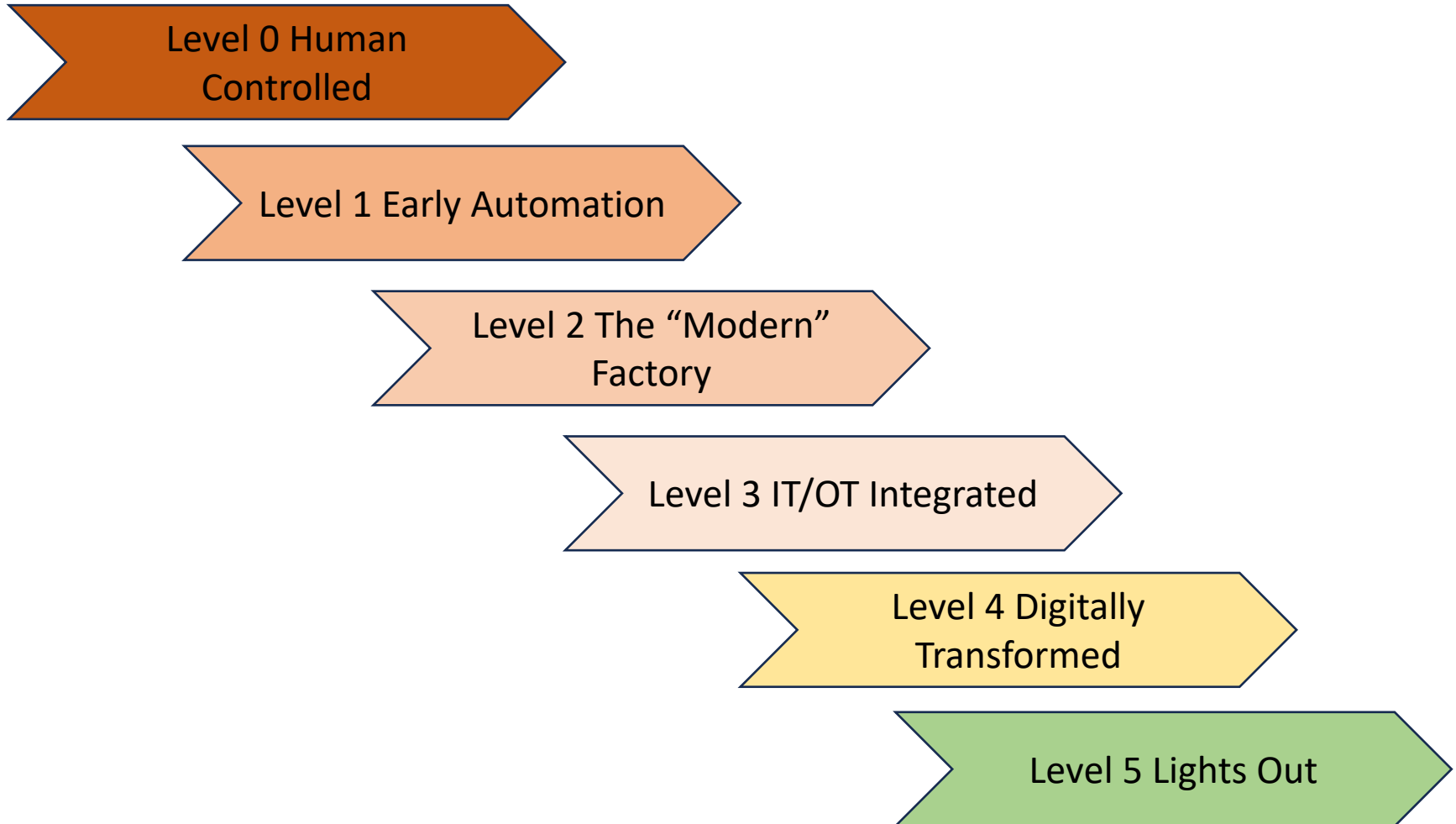
## Learning to See – Current State Map



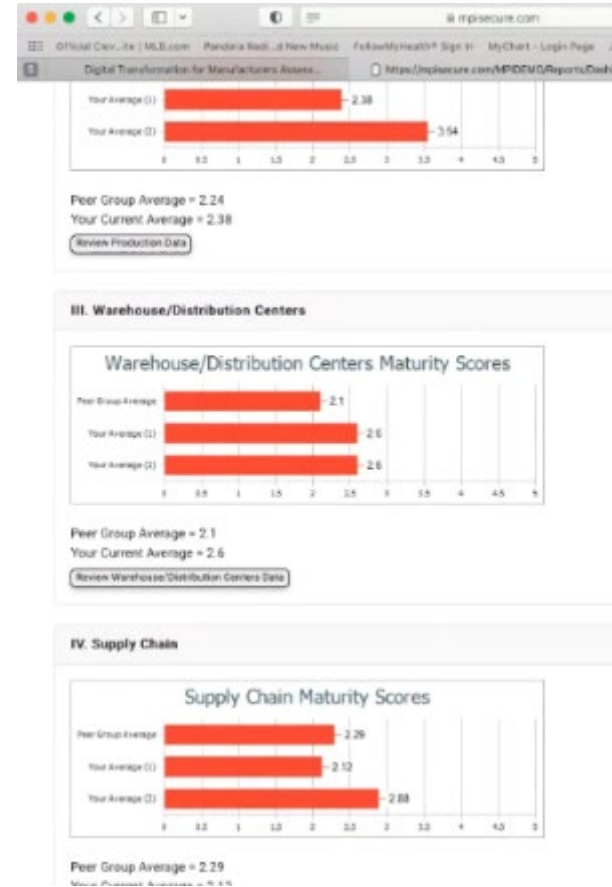
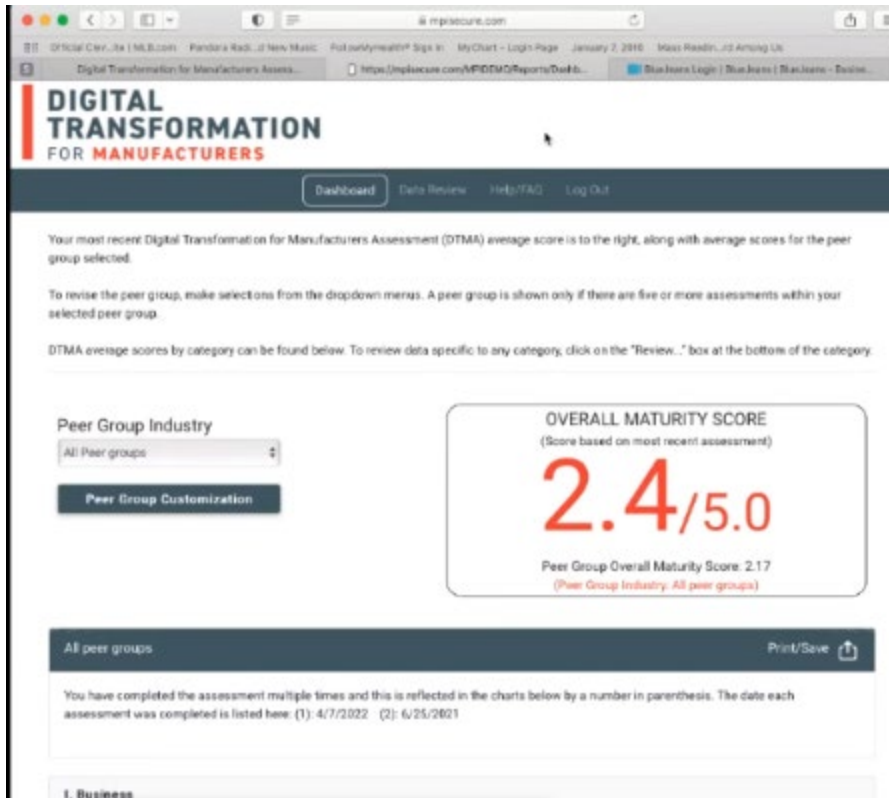


# Benchmarking tools

*Benchmarking tools to help evaluate where we may look for opportunities.*



# Benchmarking Tools DTMA



- Level 0 — No maturity.
- Level 1 — Awareness of digital technologies and processes and their applicability
- Level 2 — Trialing digital technologies and processes
- Level 3 — Some application of digital technologies and processes
- Level 4 — Substantial application of digital technologies and processes and achieving operational benefits
- Level 5 — Full maturity with widespread application of digital technologies and processes and achieving operational benefits and significant competitive advantage

\* Caveat. Occasionally, it is ok to jump directly to automation

*Replacement for old equipment or safety*

*Clearly a jump in process throughput or step in quality*

*When specifying new equipment be sure to address the technology features.*

*Does it fit your strategy?*

*Will you incorporate the new features?*

*Like buying a new car and not using the latest technologies.*

# Edge Computing

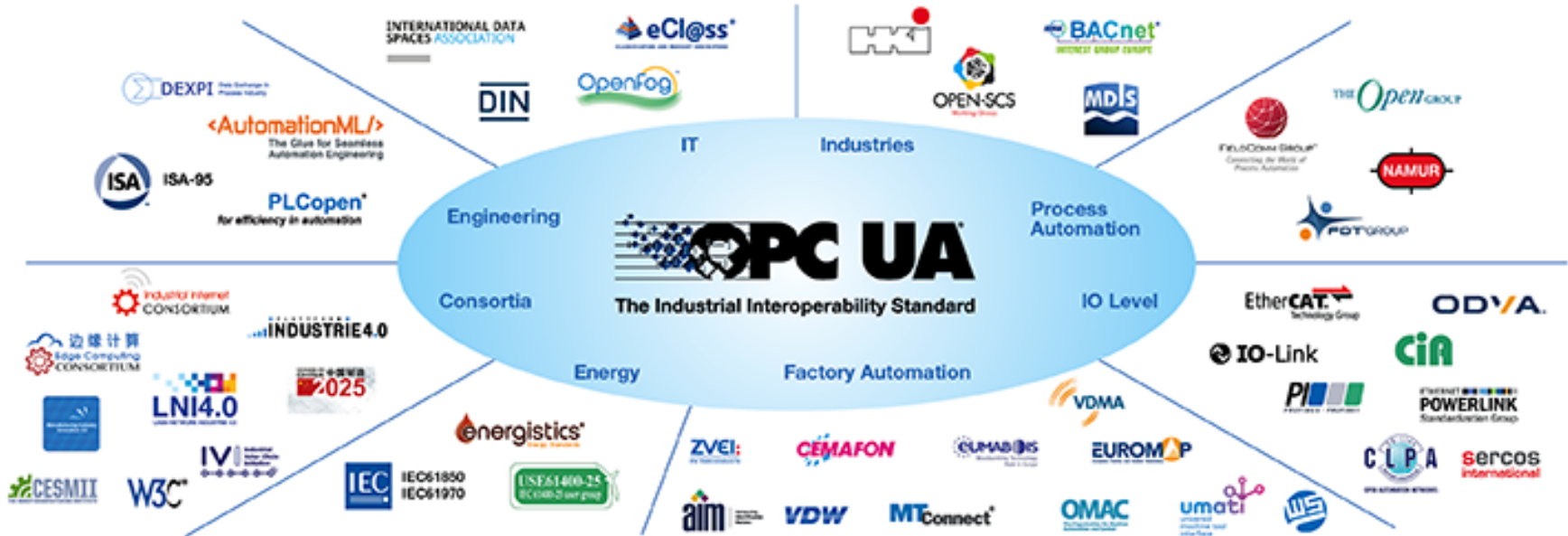


Part of the roadmap may include how to tie equipment together.

# Open Platform Communications Unified Architecture

## Collaboration Domain Specific Information Models

The OPC Foundation closely cooperates with organizations and associations from various branches. Specific information models of other standardization organizations are mapped onto OPC UA and thus become portable.



## Questions regarding IOT / Cloud

- Standard in the hardware and sensors underway. But how is the software compatibility to run dashboards, notifications?
- What data should be captured? What should be stored on cloud?
- How do you tie data back to ERP?
- Do you allow and share access to internal sensors?
  - Equipment company monitoring your equipment for maintenance?
  - Allow customers to track their orders, or download quality measurements?
- What is the open software architecture for the current to next 5 years look like?
- Will it merge with hardware to provide efficient, low-cost shopfloor data, and connection of entire business and supply chain?

## Implement the roadmap

*By this time, you have addressed waste in the system  
Workforce has transformed to a learning organization  
Clearly understood goals and objectives  
Choice automation is identified, and ROI is understood  
A project team manages  
An implementation plan is followed  
Training and start up is part of the deliverable!*

*Update your maps!  
The future state becomes the current state.*

*Identify next opportunity!*



**Thank You!**

