

# Semiconductor Engineering Workforce Challenges, Industry and Academia!

Rob Pearson – RIT Microelectronic Engineering

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**RIT** | Kate Gleason College of  
**Engineering**  
Microelectronic Engineering

**SIEMENS**

## The “Perfect Factory”

- Consists of one man and one dog – the man to feed the dog and the dog to keep the man from touching anything and screwing it up.
  - Warren Bennis



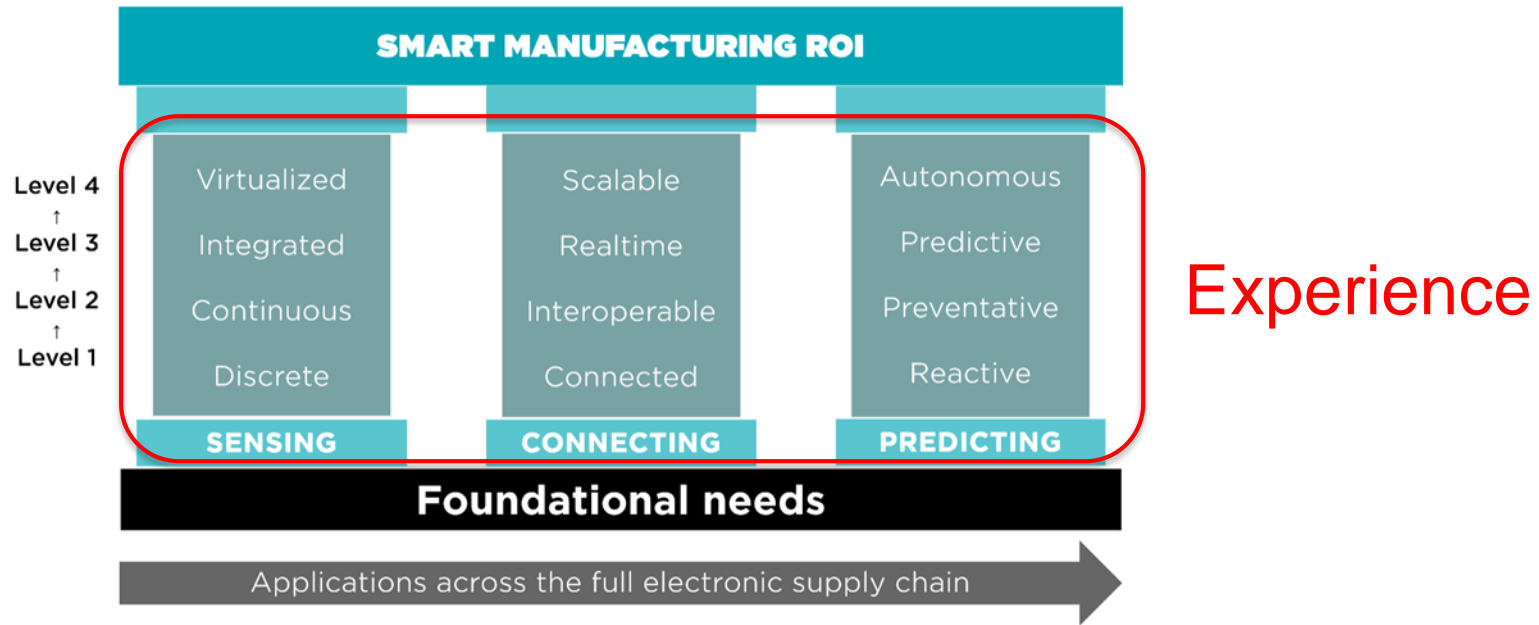
... in the future a typical factory will host three workers: a man, a computer and a dog. The computer will do all the work. The man will feed the dog. And the dog's job? To bite the man - if he touches the computer.

— Todd G. Buchholz —

AZ QUOTES



If the dog is a robot we won't need a man to feed it!

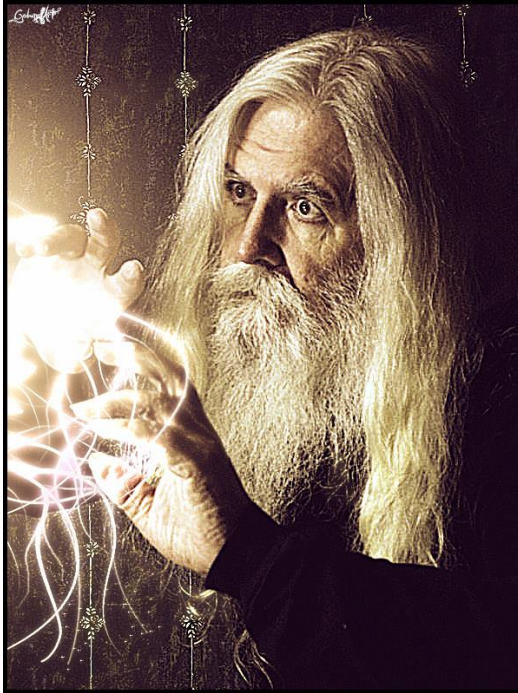


Assessing smart manufacturing ROI by evaluating a facility's sensing, connecting predicting capabilities.

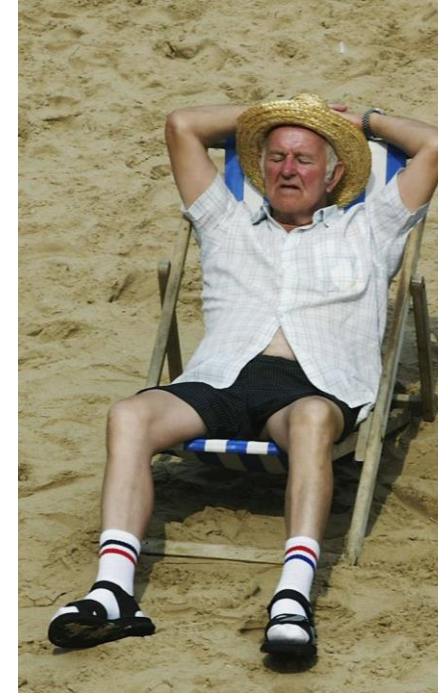
<https://semi.org/en/industry-groups/smart-manufacturing/IRAM>

Andrew Seward (TEL) and **David Gross (Siemens)**

## Experienced Workforce!



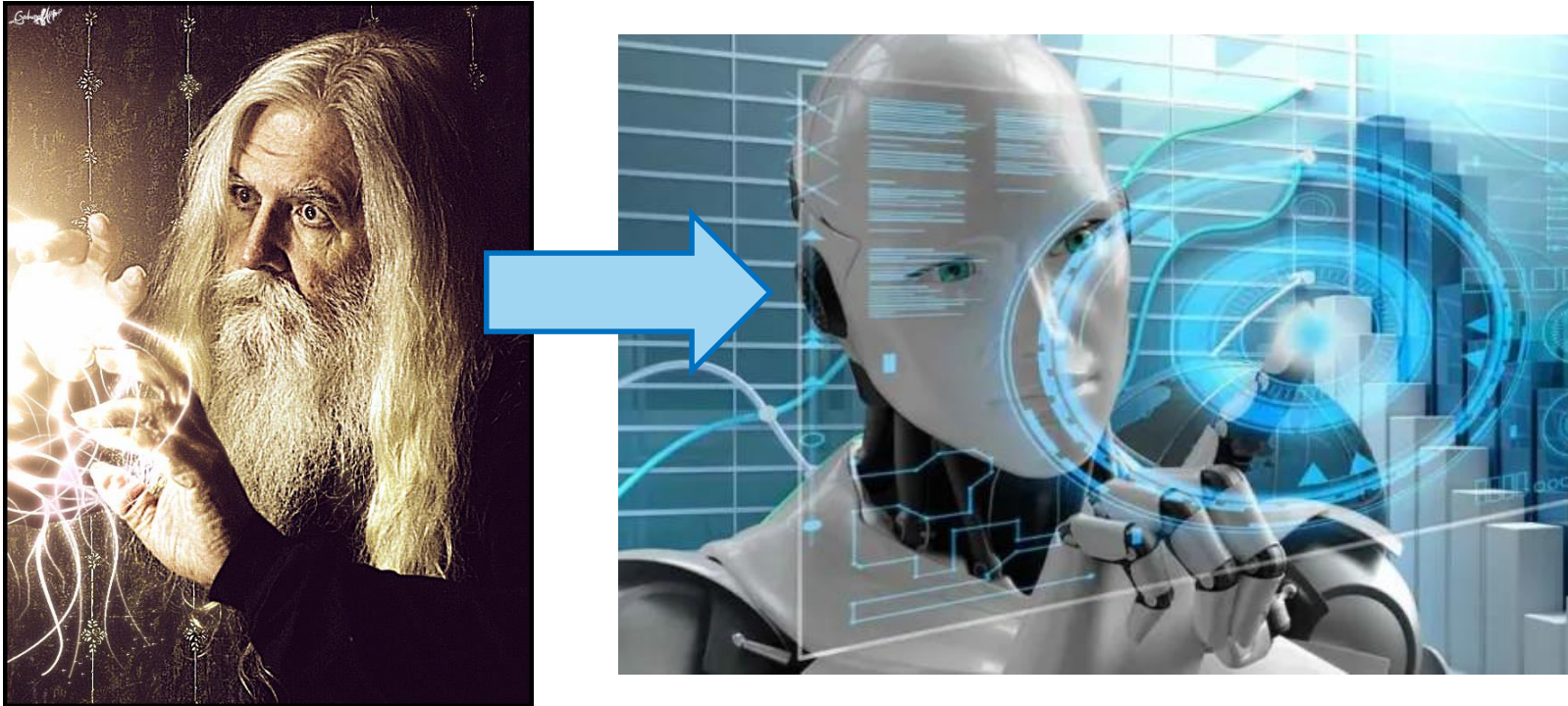
- Plasma Etch Wizard



- Retired on the Beach!



# Is Artificial Intelligence Going to Save You?



- You need real intelligence somewhere

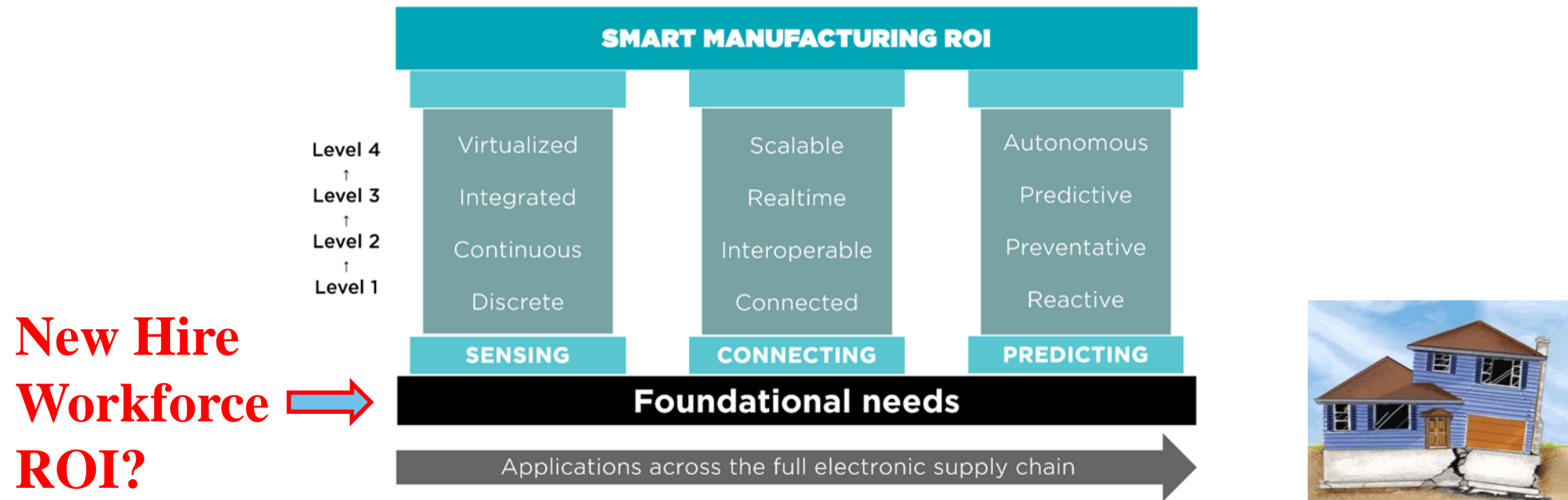
# And Your Competitor is Raiding Talent from You!

- You raid from them
- Who is winning?



## Where does Workforce Fit in?

- You need to pay attention to your workforce Supply Chain!



- Upscale for everyone and the supply chain! Joint & Collaborative

# Semiconductor **Engineering** (BS/MS) Workforce Issues

- What does the pipeline look like?
  - If you can't get more students (parents) interested you have already lost!
- Demographics and K-12 outreach
  - Less students are going to college
  - Less students are studying engineering
  - Competition from other high-paying tech jobs
  - Increased Diversity is desired
  - Solving the workforce issue with overwhelming numbers is not going to happen
- University Courses, Majors, Degree Programs
  - Tell K-12 students where to go to best prepare for this career



# You can't Open a Factory in the US!

- The Weather-Tech ads on TV
- Visualize What is Made Here!
- Is this a Car Plant?
- Not too exciting but at least you see some cars



- Is this a Chip Plant?

# How do you perceive Craftsmanship and Quality?





# Visual Quality Metrics & Craftsmanship in other industries!

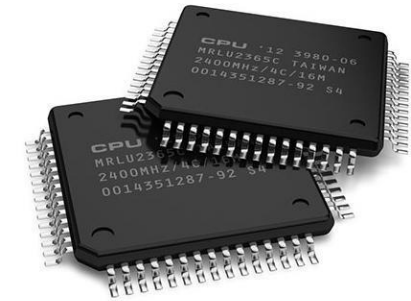
Customer can see it!



Put a number on it!

Seam tolerance  
 $2\text{mm} \pm 0.2\text{ mm}$

Yield Metric



Can you get a student  
excited about making  
what you can't see?

## How does a Semiconductor Engineer Take Pride in Their Craftsmanship?

- Last Week's Yield was 91.2%
- This Week's Yield was 92.8%



## How do we sell this as a Career?

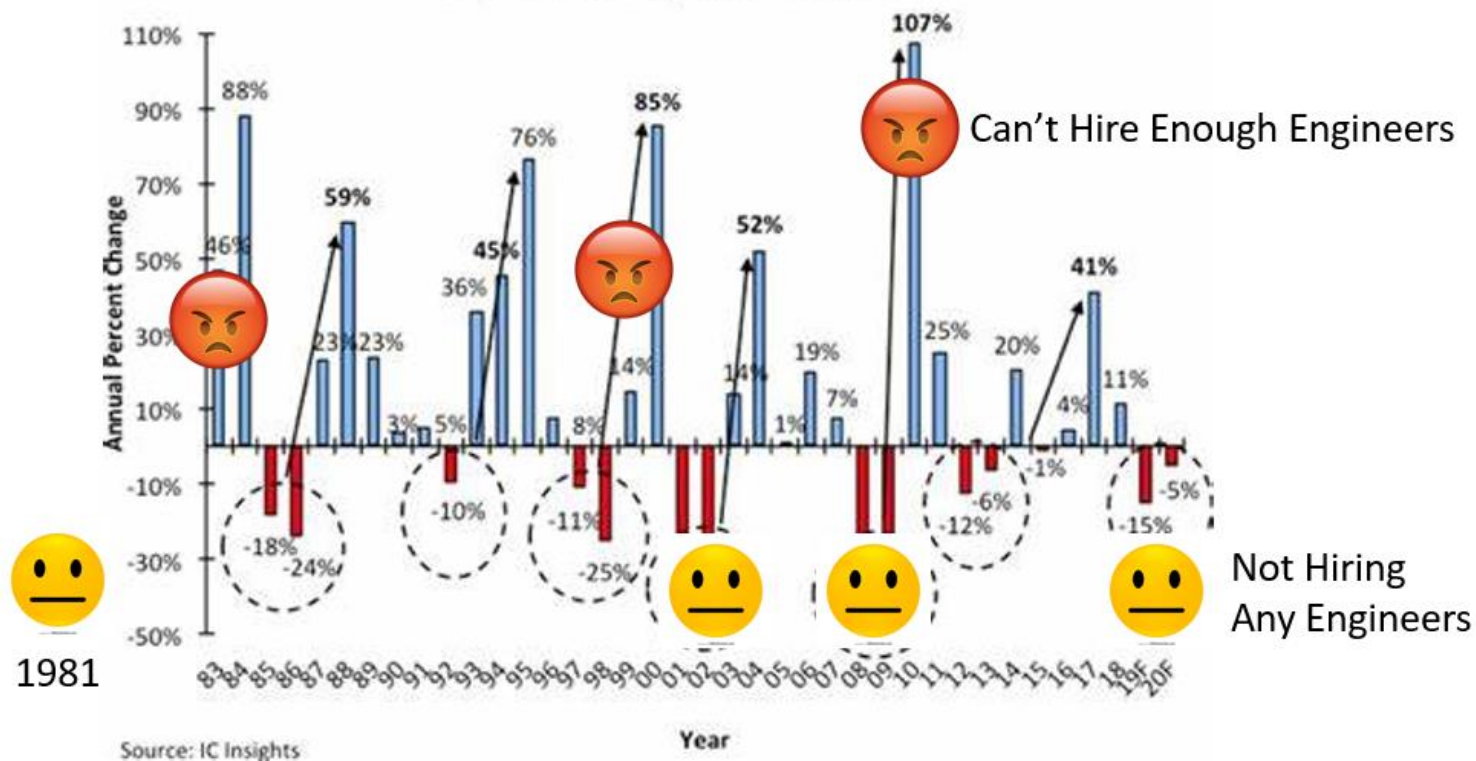


# Start-Stop-Start!

- One year you can't get enough
- Next year, no hires
- Last In – First Out

## Industry Cycles

1983-2020F Semiconductor Industry Capital Spending Growth History and Forecast



# Industry View of Academia on the Workforce Issue

## Semiconductor Company Purchase Order

Obtain From: **Top 10 Universities**

Quantity Entry Level Engineers: **1,000**

Desired Billable Cost: **FREE**

Delivery Date: **4 to 5 years\***

\* Dependent on Supply of Interested High School Students

# The Academic View of Industry Considering the Workforce Supply Issue!



## So New Hires!

- What's a Silicone Wafer?

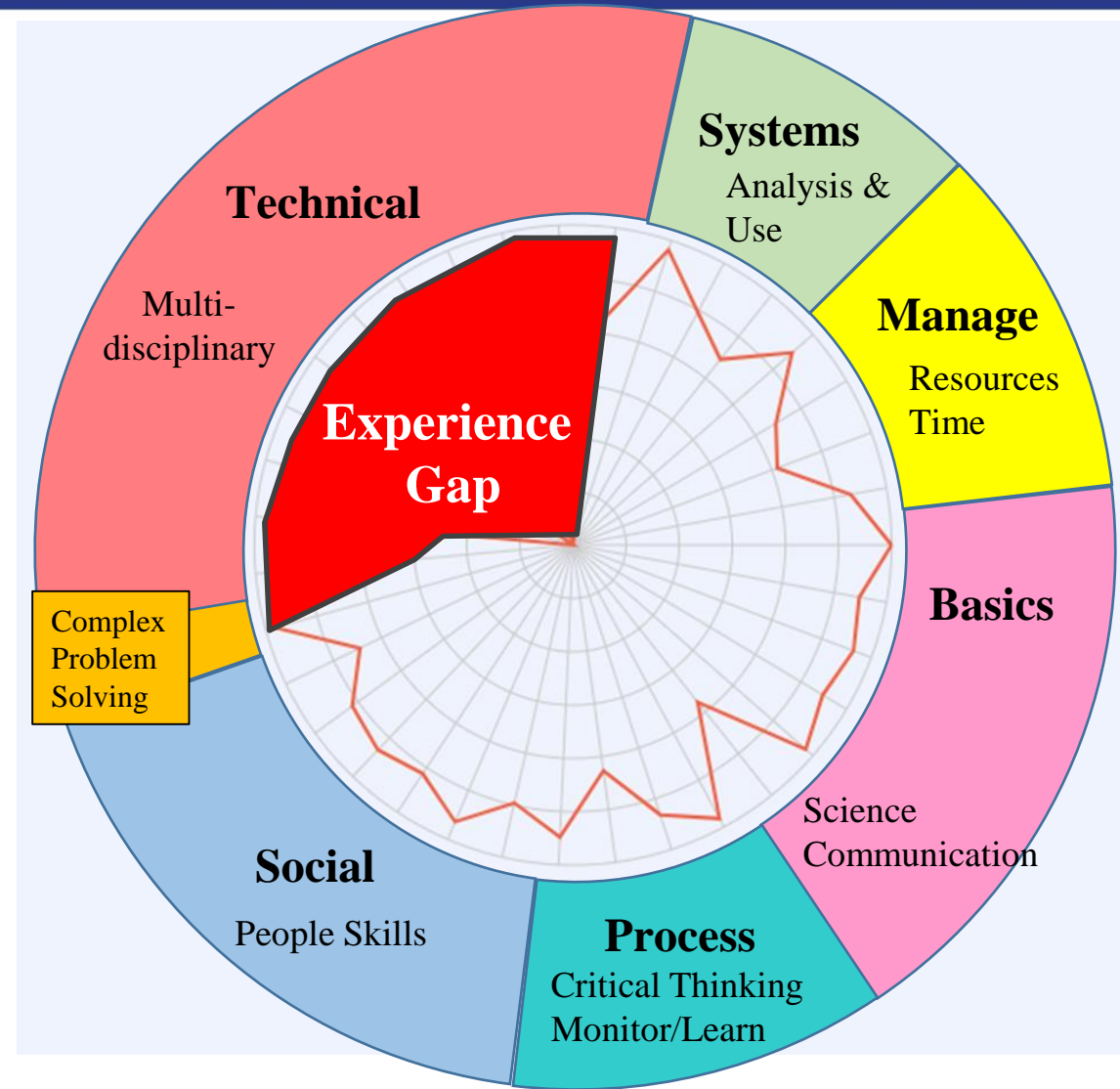




# Hire a good new engineer who knows nothing about Semiconductors!

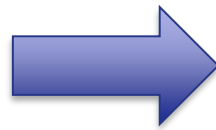
How much does it cost you to bring them “up-to-speed”?

How much do their mistakes cost you during this time?



# Educating the future Engineer at College

- What can colleges teach? At the undergrad and grad levels?
  - Basic Engineering
  - One fabrication class
  - Comprehensive curriculum
- Research integration
- Industry and the New Hire



- Current Engineer needs some updating (internal training, online?)



Industry

## Engineer - Furniture Analogy

- The perfect new hire with experience!
- What you might be willing to settle for
- What you did settle for



College



Delivery in 4-5 years



High School student



# Industry Pays to Finish the Engineer

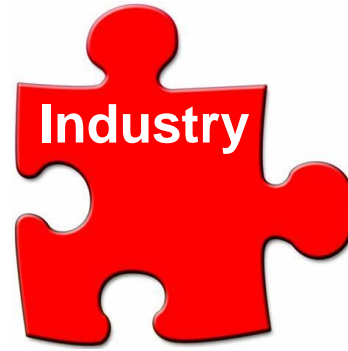
- Good for the student
  - Gets a good salary while learning how to do the job
  - How long does that take?
- Good or Bad for Universities
  - Good, we just teach the basics and the rest is on industry
  - Bad, if we teach more but we don't get anything for doing it.
- Good or Bad for Industry
  - Eventually you get exactly what you want
  - How long and how much does it cost you to get there?



Finish the Engineer You Hire – 1-2 more years in your fab (you pay)



# Mismatch



Ignore  
Workforce  
demands

Trained to fit to R&D funding



Academia

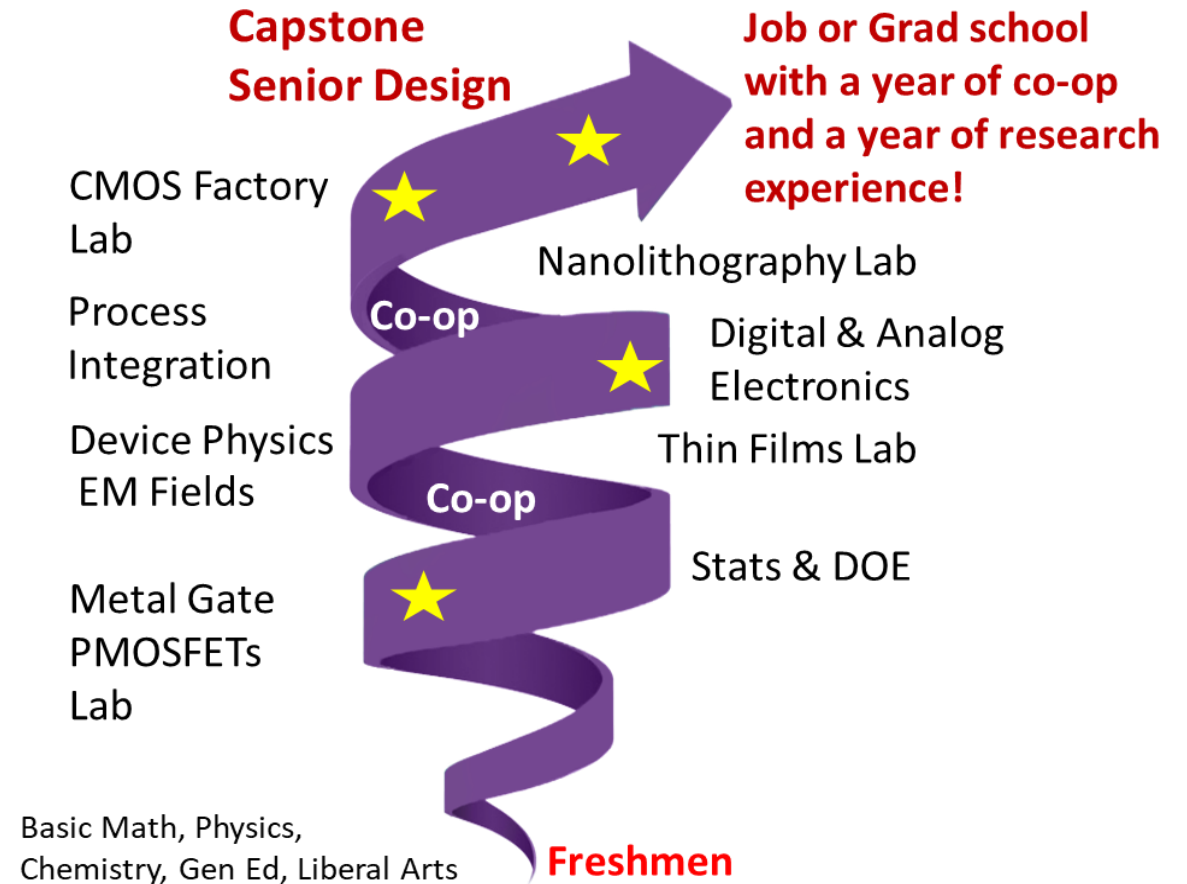
Far too many employers report a mismatch between what engineering students learn in school, and what graduates need on day one of the job. Building a more heterogeneous, job-ready labor force demands that higher education, private industry and the federal government coalesce and act at an unprecedented level and pace.

How do we solve this problem?

# 1980 – Japanese Challenge Problem Solved 40 Years Ago!

- RIT Microelectronic Engineering Curriculum
- Engineering Fundamentals
- Tiered Academic/Lab Experience
- Experiential Learning Component
- Targeted Multi-course curriculum
- Senior Capstone
- Manufacturing thrust

The Upward Learning Spiral!  
Learn, Apply, Evaluate and Repeat

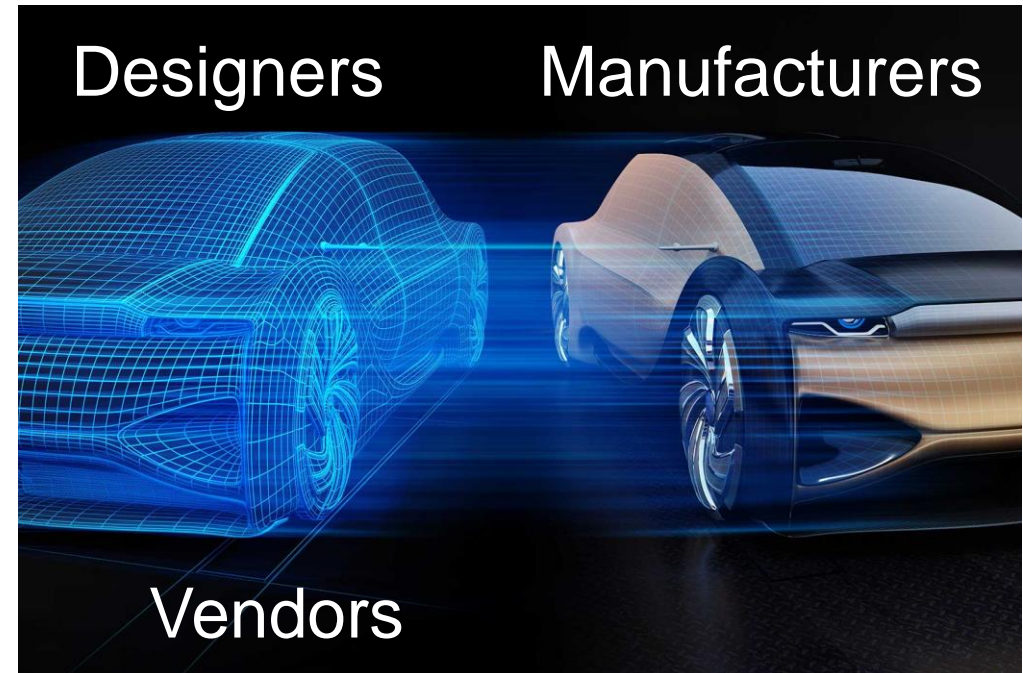


## With over 50 Good University Cleanrooms across the country, why has the workforce issue not gone away?

- University Cleanrooms are research funded not tuition driven
  - Limited Chip Manufacturing Research Funds
  - Research funding “stays away” from what mainstream semiconductor manufacturers are investigating
- Most Universities can’t keep up with tool maintenance and upgrades
- Cleanrooms are expensive to operate
- We can’t sell our students

## It will take efforts at hundreds of Universities!

- How we will get more universities to accept this teaching challenge?
- Digital Twin of a small volume fab (research lab)
- Teach Simulated Manufacturing at the University Level
- Simulated CMOS Student Factory!





# Student Pays to become an Engineer

- Cost to student



- Private vs Public tuition
- Scholarships, loans, CC route, coop employment
- **Good paying job upon graduation**
  - Is this enough of a recruiting draw?

- Good for Universities

- But is it tuition or research dollars they want?
- How good of an engineer are they producing?






- Great for Industry they don't have to pay anything

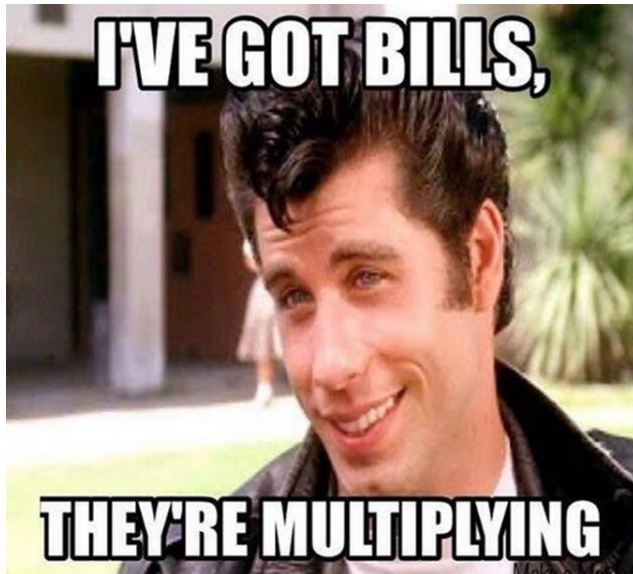
- But, you can't complain about the number or quality of the people you hire.



# University Funds Engineering Students

- Good for the student
  - Get good students
  - Increase diversity
  - Can bribery alone fix the numbers?
- Bad for Universities
  - Model for PhD Researchers (out of research dollars)
  - No funding for BS Manufacturing Engineers.
- Great for Industry they don't have to pay anything
  - But, you can't complain about the number or quality of the people you hire.

## What Needs Funded?



**Scholarships!**



**Endowed Faculty**



**Teaching Lab Costs**

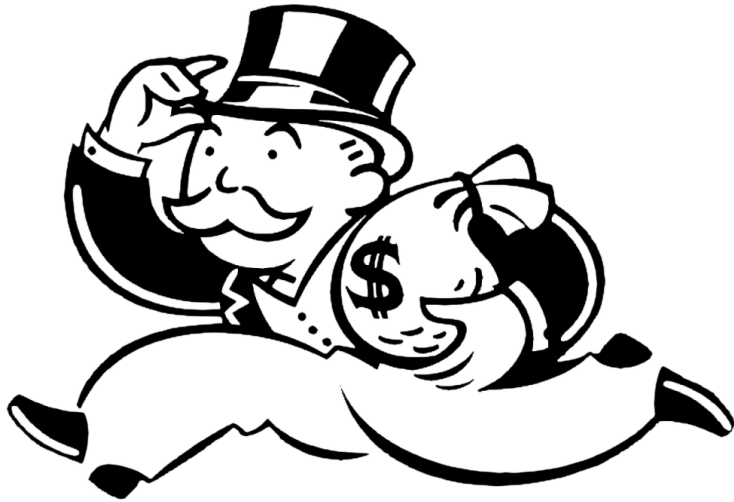
## Are Your State Taxes the Answer?

- What state?
  - NY students to Ohio?
  - Ohio to AZ, etc.
  - Indiana?
- How is that money spent (scholarships?)
- Is there any Industry oversight or feedback?
  - Are they solving the problem?





## Mr. Chips Act Pays



Pays who?

Companies

Students

Universities

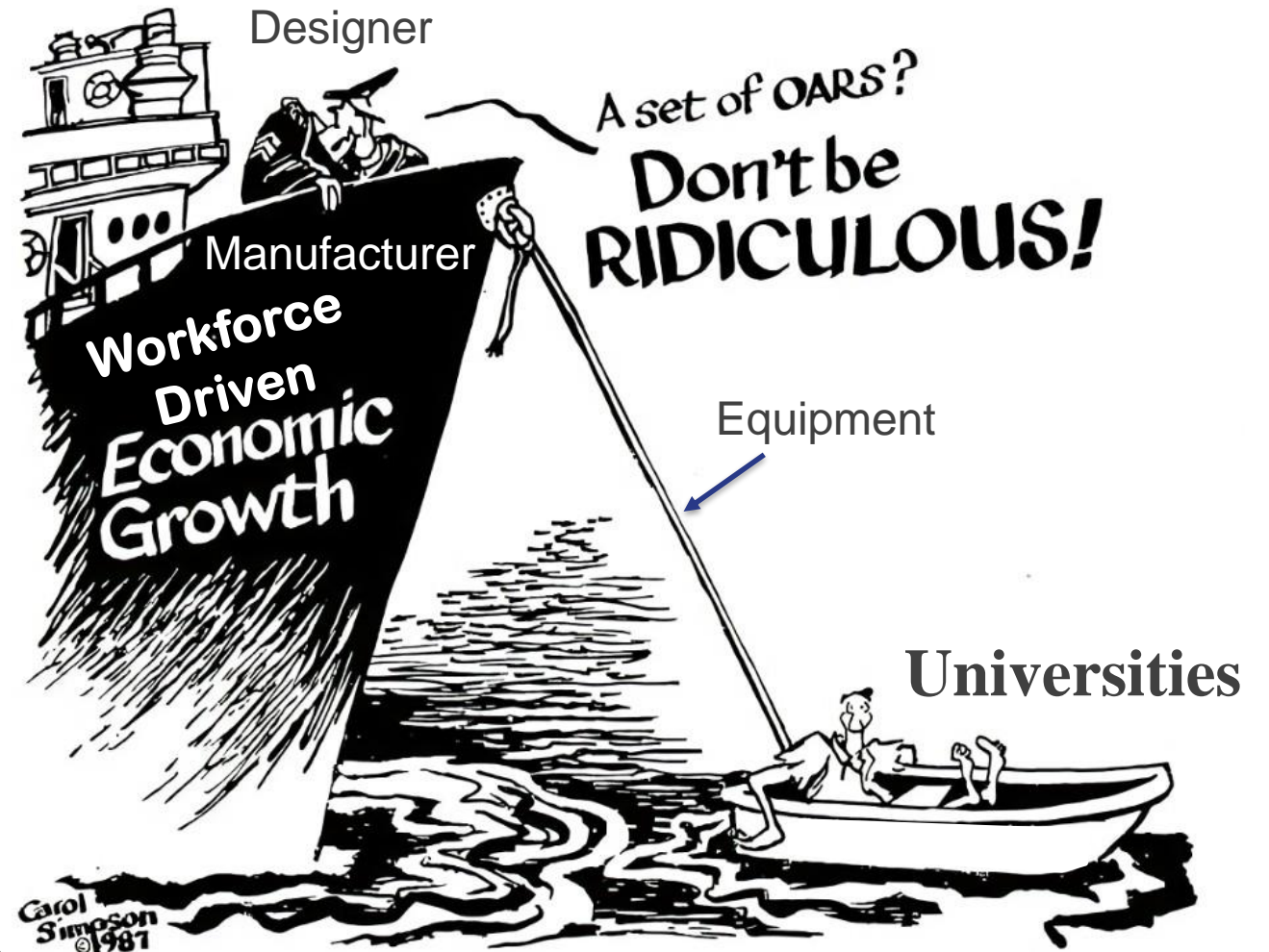


How did SEMATECH and the G450 Efforts end up?

Which horses are we betting on?

## The Workforce Problem

- Universities
- Equipment/Materials
- Chip Manufacturers
- Fabless
- Designers



Original Artist