

# Forum on the Future of Electronics

Led by Dr. Dennis Buss

Chief Scientist Emeritus, Texas Instruments

October 1, 2013

## Panel discussion

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- 1) Professor Joerg Appenzeller
- 2) Professor M.A. Alam
- 3) Professor Supriyo Datta
- 4) Professor Gerhard Klimeck
- 5) Professor Mark Lundstrom
- 6) Dr. Dennis Buss
  
- 7) Moderator: **Professor Tim Fisher**  
*James G. Dwyer Professor of  
Mechanical Engineering, Purdue*

## Questions for discussion

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- 1) Dennis has outlined a vision for a new era of electronics beyond Moore's Law. Do you agree that the "era of Accelerated Technology Innovation" is the future of electronics?

How do you see electronics in the 21st Century?

## Questions for discussion

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2) What type of individuals will be most successful in 21st Century electronic R&D?

How can a 21st Century device technologist acquire the all knowledge and experience they will need (as electronics is more and more coupled with MEMS, optics, medicine, polymer chemistry, quantum physics, etc.

## Questions for discussion

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- 3) What can (should) universities like Purdue do to prepare for (and shape) the future of electronics?
- How should the grad student research experience change?
  - What changes are needed in on-campus and on-line education?
  - Do we need new books?
  - Do we need more emphasis on “multi-disciplinary” research and education?
  - Do we need something beyond multi-disciplinary?

# Question 1

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1) How do you see electronics in the 21st Century?

(Dennis Buss)

Mark Lundstrom

# 4 futures (Lundstrom)

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- 1) Silicon CMOS technology continue to evolve
- 2) “Electronics everywhere”
- 3) “Era of Accelerated Technology Innovation”  
(a la Buss)
- 4) “New electronics” (flexible, stretchable, implantable, disposable, etc.)

## Question 2

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What type of individuals will be most successful in 21st Century electronic R&D?

Joerg Appenzeller (no slide available)

M.A. Alam



## Question 2 (Alam)

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### **Experience in multi-disciplinary research**

- Everything I needed to know, I learned in high school and college.
- There is no rocket science even in 'rocket science'. Divide and conquer.
- Research is not stamp collecting; taking many courses does not help. Instead, important to learn by solving problems.
- Nature's playbook has only a few tricks (e.g., phenomena described by 2<sup>nd</sup> order equations)
- Problem should be timely, but the solution timeless.
- Elegance/quality matters – science is ultimately an arts project.

## Question 3

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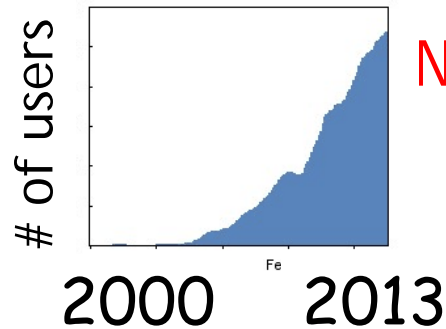
What can (should) universities like Purdue do to prepare for (and shape) the future of electronics?

Supriyo Datta

Gerhard Klimeck

# RISE OF ONLINE EDUCATION

# WHAT IS CLASSROOM FOR?



NOT a poor man's substitute:  
It is BETTER

- *Solidifying technical skills*
- *Communication skills*

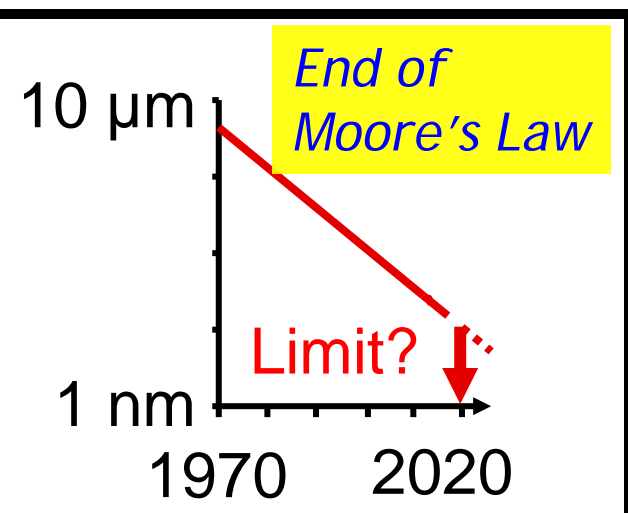
Particularly important

when there is **NO** roadmap

## DIFFICULT TO CONVEY ONLINE

- ◆ *How something gets known*
- ◆ *To what extent things are known*
- ◆ *How to handle doubt and uncertainty*
- ◆ *What the rules of evidence are*
- ◆ *How to think, so judgements can be made*
- ◆ *How to distinguish truth from mere show*

→ Adapted from Feynman



# Technologies Will Change! Expectations to Employees Have Changed! University Value Systems Change!

Times of the sole Genius are over!

What a reference letter contains:

1. Scientific Capability
2. Ability to prepare publications and presentations
3. *Independence of Judgment*
4. *Capability to work in a team*
5. *Ability to report results to the supervisor*
6. *Ability to interact / communicate with customers*
7. *Administration, General Contribution and Interpersonal Skills*
8. *Long term potential*

=> 6 of 8 are “non-technical”

University funding is evolving

- Most research efforts are team based
- Research is funded by a multitude of customers with multiple reporting requirements

Day-to-day operations evolve:

- Communication is critical
- Trust-building is critical

University values are evolving (slowly)

=> Students must be broader than their individual research topic

=> parallel development to the broadening of the technology pipeline

*Better research in more diverse groups on diverse topics is the future*

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