Welcome to MATEC NetWorks Webinar

Industry Expectations for Our Graduates: What We Can Do In Our Education Programs Now

MATEC NetWorks is an NSF funded ATE Center supporting faculty in Semiconductor, Automated Manufacturing, and Electronics education

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MARICOPA COMMUNITY COLLEGES

NetWorks is a part of MATEC, a member of the Division of Academic and Student Affairs at the
Maricopa Community Colleges.

National Science Foundation

Funded, in part, by a grant from the National Science Foundation.
DUE-0501626

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ASU

Webinar Procedures

- If you are listening by phone, please mute your phone by pressing #5.
- If you have questions during the presentation, please submit them in the Chat Window.
- At the end of the session we will answer as many questions as we can. Please type your questions in the Chat Window.

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Poll

Participants

Name

MCCD-ADMIN (Moderator, Me)

Raise hand/smile/clap

1 Participant

Direct Messaging

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Chat

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NetWorks Webinar Panel

Michael Lesiecki, Executive Director Maricopa Advanced Technology Education Center (MATEC)

Roger Melcher Microchip Technology, Inc. Manager of the Process Technology Group

John Robertson, Arizona State University Professor, Engineering Technology Department

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Industry Expectations for our Graduates: What We Can Do In Our Education Programs Now

John Robertson, ASU
Roger Melcher, Microchip
Michael Lesiecki, MATEC

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Industry Advisory Boards

MTF Board	
R Melcher	Microchip (Chair)
G Doyle	Premier Mechanical
G Gardner	Intel
J van Wagoner	Medtronic
J Holtzclaw	ASML
J Weihmeir	Freescale
L Brown	International Rect.
M Lesiecki	MATEC
P Callaghan	Intel
S Verhaverbeke	AMAT
S Shastri	ON Semi
V Drobny	TI (Tuscon)

+ Personal interactions

EST Board	
P Vaney	Chair
B Soloway	Tomar Electronics
B Scott	Medtronic
G Palomino	SRP
H Song	Intel

1. Largest manufacturing sector in AZ ~ 30,000 employees. Revenues ~ $15 B pa.
2. Most UET students already employed in the industry.
3. It is the engine for change in all sectors of the world economy.

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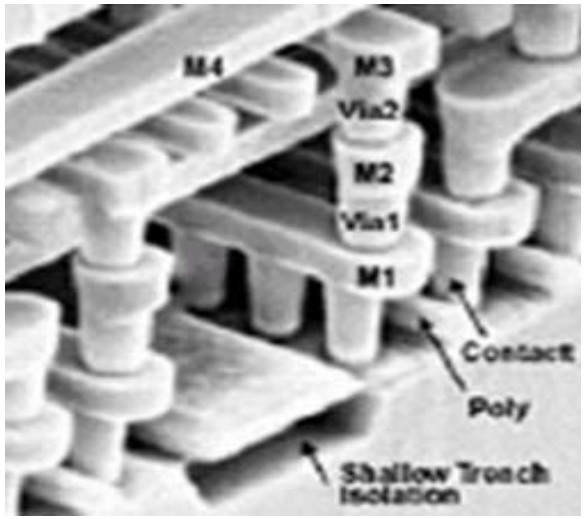
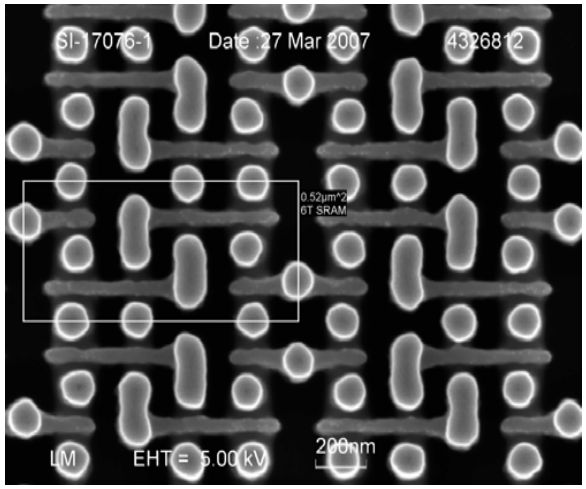
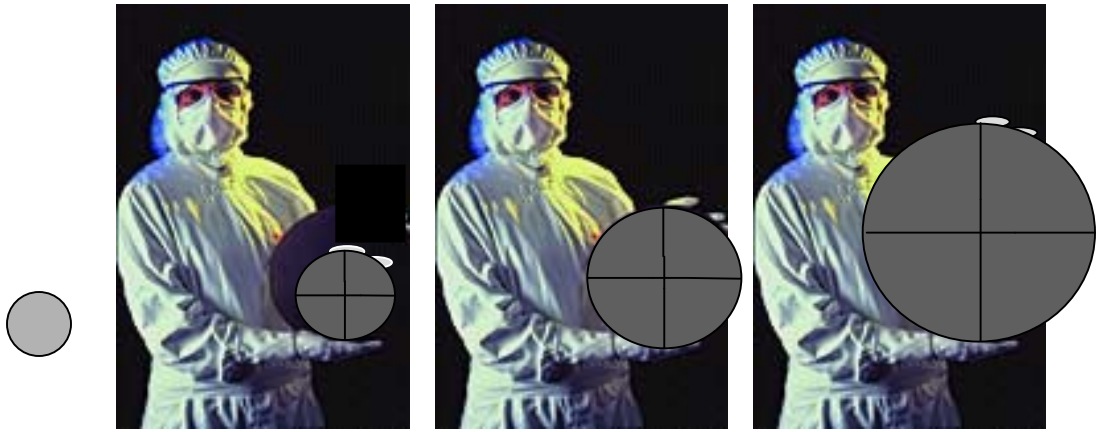
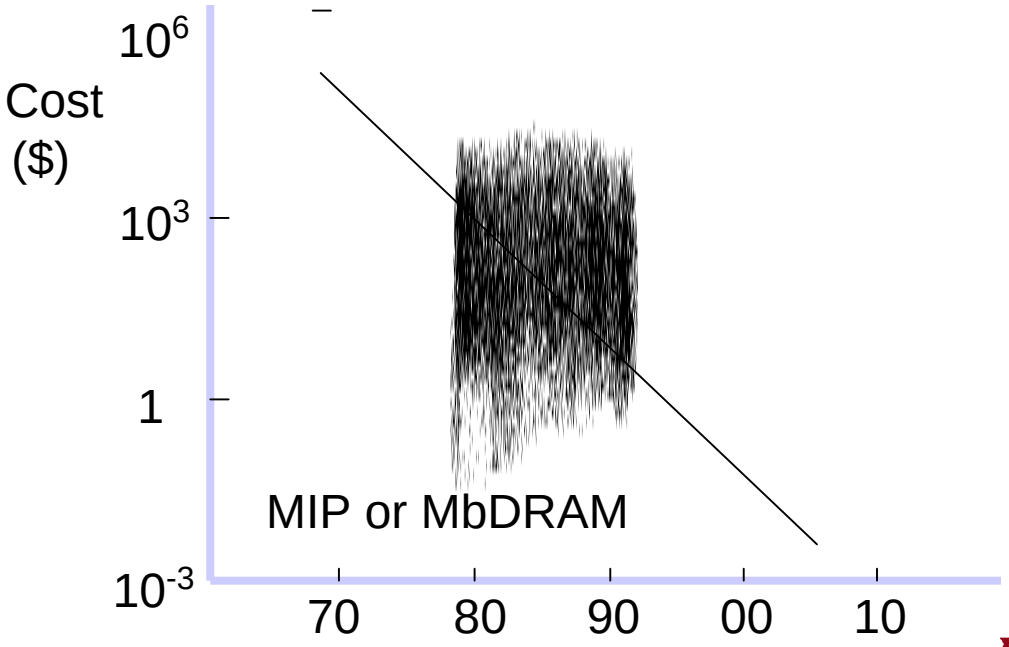
The Impact of Technology









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Engineering Process & Technology solutions

Physics
Chemistry
Mechanical Eng
Civil Eng
Electronics
Power systems
Product optimization
Finance
Marketing
Global business

Academic disciplines

Prepare students for any application.

Technology is the solution that:

- Operates at the limits
- Combines ALL disciplines
- Keeps delivering

- Cost
- Size
- Performance
- Reliability
- 2 Yr generations

Jobs are Changing

Engineer + technician assistant
Labor-intensive jobs
Wide range of skills in toolbox

Engineering design
All computer-based
No assistants.

System architect & integrator
Wide range of skills
Assistance is sub-contracted

Service & field support
Routine is automated. Rest needs creativity.
Range of skills + experience needed

Target Outcomes for Program

Inputs from industry, global developments and research activities

IAB stakeholders

"How"
- Process
- Control
- Tools

"Language"
- Science
- Math
- Materials
- Engineering
- Analysis

Technical

Personal

Business

SKILLS

Design

"What"
- Product life cycle
- Global operations
- Service life

Ready for the job

Commitment to continuous improvement

Policy for Concentration Development

Address current and future industry skills.
Have a process to understand what these are.
Match to:

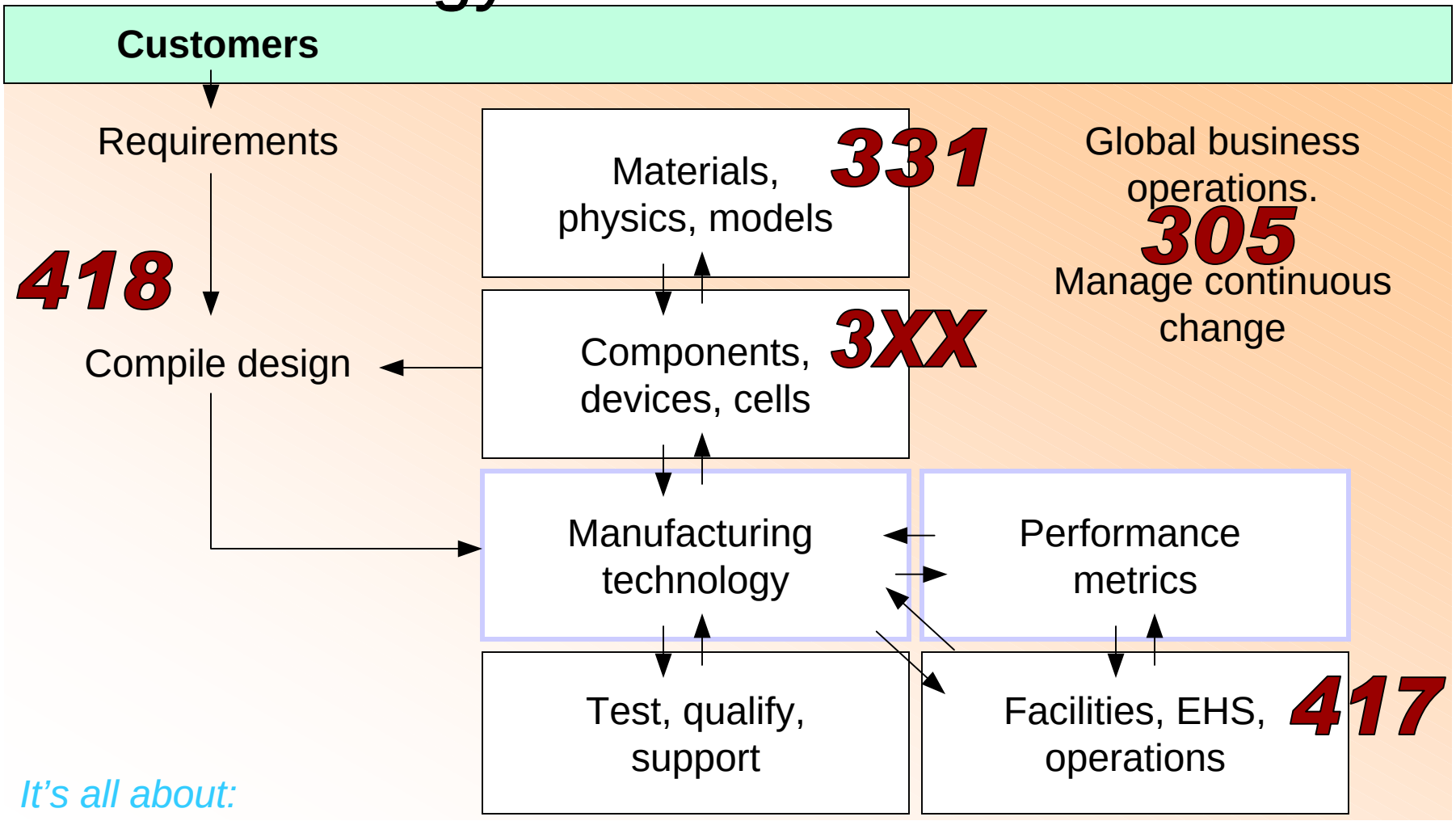
a. Individual student career plans
b. ABET criteria
c. Dept. strategy
d. Interactions between courses
e. Learning hierarchy
f. Essential skills
g. Variety in study
h. Business needs

Strategy for course structure

Tactics - content

Technology is a solution.
Explain how it works and where the limits are.
Complement industry – establish a unique role.
Courses change ~ 30% every delivery.

Strategy for Course Structure



It's all about:
Components, computing, communication, control, complexity, customer-focus, cost.

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Tactics for Fab Treatment

Manufacturing processes

416

1. Wafer preparation
2. Diffusion
3. Ion implant

424

4. Maskmaking
5. Printing
6. Wet etch/cleaning
7. Dry etch

411

8. Oxidation
9. LPCVD
10. APCVD/epi
11. Metallization
12. CMP

432

13. Wafer finishing
14. Packaging

Performance metrics for each

1. Business need
2. Process flow conditions
3. Impact on product
4. Evolution
5. Underlying physics
6. Underlying chemistry
7. Recipe examples
8. Tool design
9. Tool operations
10. EHS
11. Services and facilities
12. Process validation
13. Control and reproducibility
14. Models and simulation
15. Impact on other processes
16. Capital management
17. Cost of operations
18. Future development.

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Delivery innovations

A number of delivery features have been introduced to assist the majority who have full-time employment.

- Heavy use of Blackboard
- Concentrated whole-day class sessions
- Preparation assessed before class
- Class is for dialog on problems
- Many simulation activities
- Integrated lab demonstrations
- Team projects wherever appropriate
- Visiting (IAB and alum) speakers
- Use industry-derived materials
- Emphasis on personal accountability

Outcomes – Skills Measurement

Perceptions of skills emphasized in the course

Score:

0. Not significant
1. Mentioned
2. Routinely used
3. Strong emphasis

Ratings for:

- Personal skills (14)
- Communication (11)
- Career preparation (12)
- Business impact (17)
- Systems realization (10)

Personal skills		Class	Faculty	IAB
1	Accountability for outcomes	2.3	3	2.7
2	Time management	2.6	3	1.8
3	Team working	2.6	3	2.4
4	Vision beyond short term	2.1	2	2
5	Safe working - mindset	1.9	1	2.4
6	Ethical working	2.6	2	2.6
7	Accurate working	2.3	1	2.6
8	Available and responsive	2.3	3	2.4
9	Problem formulation	1.9	2	2.6
10	Problem solving	2	2	2.5
11	Able to prioritize	2.1	3	2.6
12	Develop effective solutions	2	2	2.2
13	Commit to life-long learning	2	3	2
14	Role in the global economy	1.6	1	1.1
	Totals	[illegible]	30.2	31	31.9

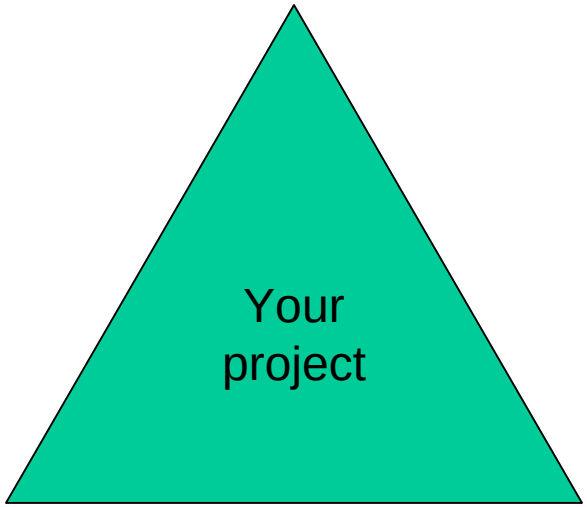
Emphasize Industry Success Criteria

Knowledge	***Interpersonal***
Broad technical competence	Communications
Desire for continuous learning	Ability to read people
Technical curiosity	Constructive criticism give & take
Creative problem solver	Arbitrate and negotiate
Character	***Strategic Thinker***
Work ethic	Vision, big-picture thinker
Integrity + accountable	See quickly who has to be involved
Open-minded and curious	Identify directions with poor data
Stress handling – internal & external	Balance long and short-term
Thorough, attention to detail	Manage and resolve ambiguity
Leadership	***Tactical Execution***
Team-builder	Multi-tasking, especially for risk
Judgment and common sense	Process focused
Incisive & decisive	Speak the local language

The Technology Challenge

Deliver an optimized point solution
Expect it to evolve
Always be competitive

Deliver all the " … ilities"



- Manufacturability
- Testability
- Reliability
- Cost
- Maintainability
- Serviceability
- Usability
- Trainability
- Understandability
- Capability
- Availability
- Functionality

- Extendibility
- Reconfigurability
- Certifiability
- Flexibility
- Scalability
- Recyclability
- Disposability
- Sustainability
- Frugality
- Global interoperability
- All interactions

Root cause analysis of poor team performance in UET305 & 598

Symptoms:

1. Only 1 report from 4 teams
2. Little Blackboard traffic
3. No dialog or chatter
4. Queries only create silence
5. Few personal initiatives

Summary:
Far too little communication

Possible causes:	Don't understand requirements	Information overload	No time to do anything	Haven't defined how team will operate	Misread JR's expectations
	WHY ?				
Contributing causes:	Can't read – OK so it is clear	Can't select content till it is understood	Don't know what time is available	No meetings and no activity	Not the usual course style
	WHY ?				
Deeper causes:	Don't take on implications	No ASU experience of operating this way	No time priorities	Blank	You mean we do what we say .. ?
	WHY ?				
Root cause	Don't buy into program mission + Procrastination + No personal time management				
Corrective action	Make personal commitment to contribute to team	Apply external experience	Organize time every week and learn what works for me	Allocate tasks and deadlines. Rotate reporting	Map time commitments needed

JMR 10/2/07

Yield Categories

$$\text{Yield} = \frac{\text{What we can sell}}{\text{What we produce}}$$

There are 3 major factors contributing to < 100%

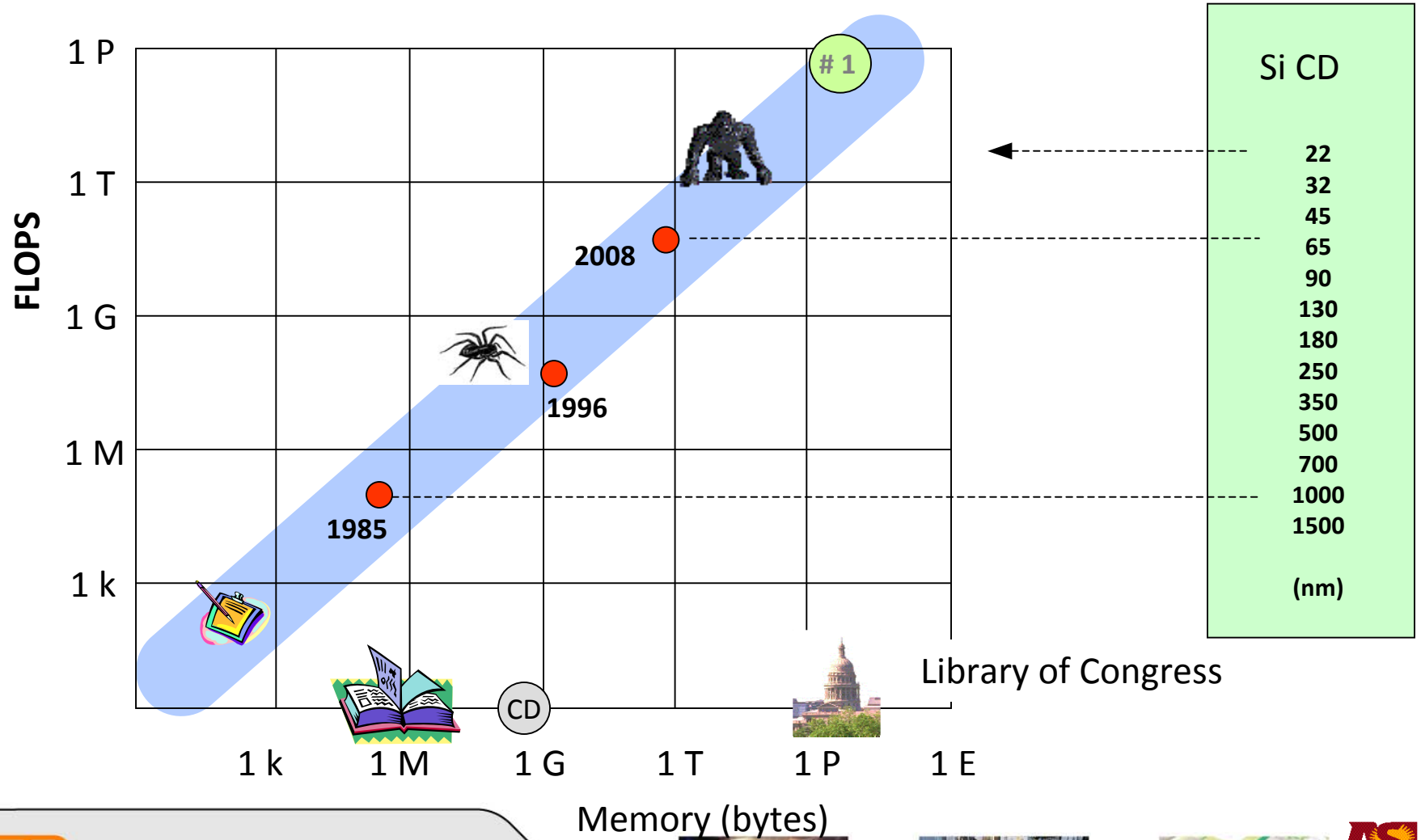
"If we measure it, it improves"

1. Engineering yield = meet parametric specs
2. Operations yield = max throughput
3. Defect yield = loss due to particles

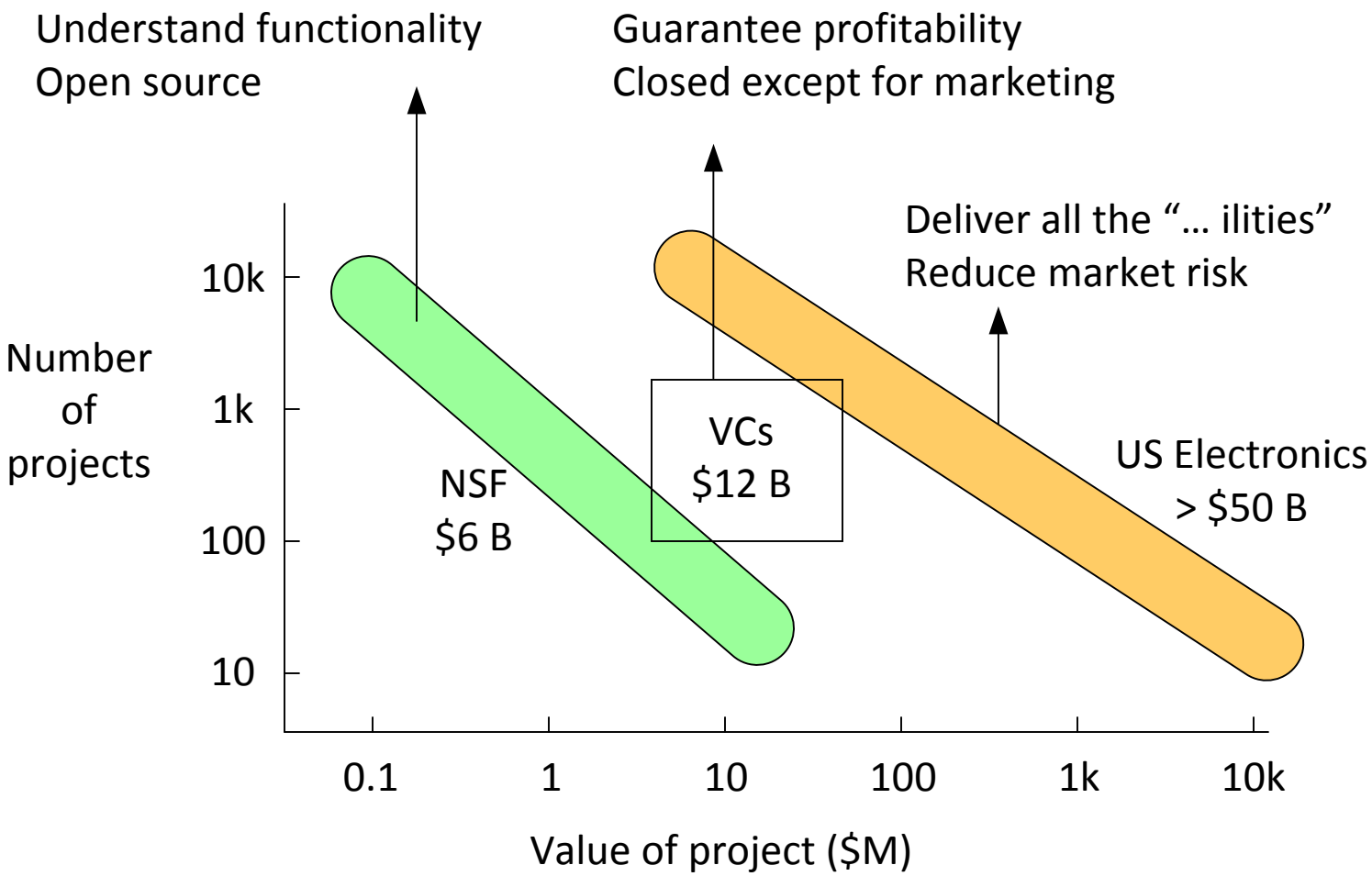
- Separate causes
- Identify ownership
- Validate with data

Computing Technology

All computing requires flops AND bytes

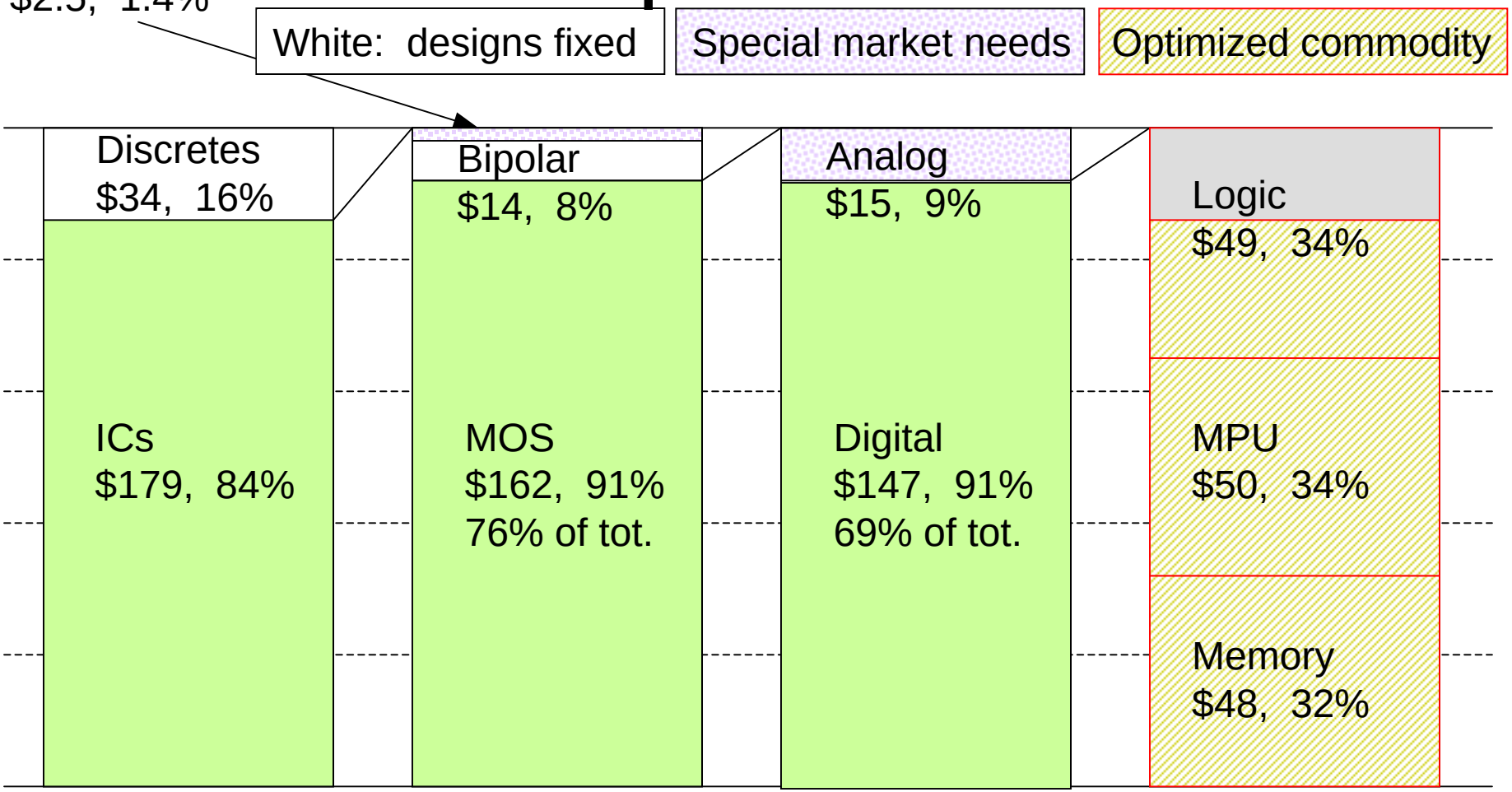


Goals of R & D



They all use hype. How do we get a more complete picture ?

The Ubiquitous CMOS



All $ sales numbers in B, 2004.
Sales for 2007 are $279B, up 31%. The % shares have hardly changed.

Company Culture Example – Intel

Performing to values	Effective meetings	Constructive confrontation	Problem solving	Decision making
Customer orientation	Purpose	Address issues to be:	Define	What is decision
Discipline	Agenda	Direct	Document	When is it required
Quality	Roles for all	Objective	Identify causes	Who participates
Risk-taking	Preparation	Positive	Develop solution	Who makes the decision
Great place to work	Timed actions	Timely	Execute on solution	Approval process
Results oriented	Who gets results	Accountable	Institutionalize solution	Who needs to be informed

The words vary from company to company – but the message is the same.

Comments on why each is there.

Program Targets

Professional skills ← → Awareness of major change agent

Strong IAB.
Common structure.
Heavy BB activity.

Working students.
They know ‘what’.
We explain ‘why’.

Increase BAS numbers
More self-paced labs
‘Distance with dialog’.

MS is more about
culture change.

UET concentration

- Cost
- Size
- Performance
- Reliability
- 2 Yr generations

Schools
Community Colleges
Other Departments
ESDept.

None are experts but
they have to exploit the
technology to succeed
in a competitive world.

Course Activities

One of the primary goals of the program is to produce work-ready graduates. We have 2 approaches:

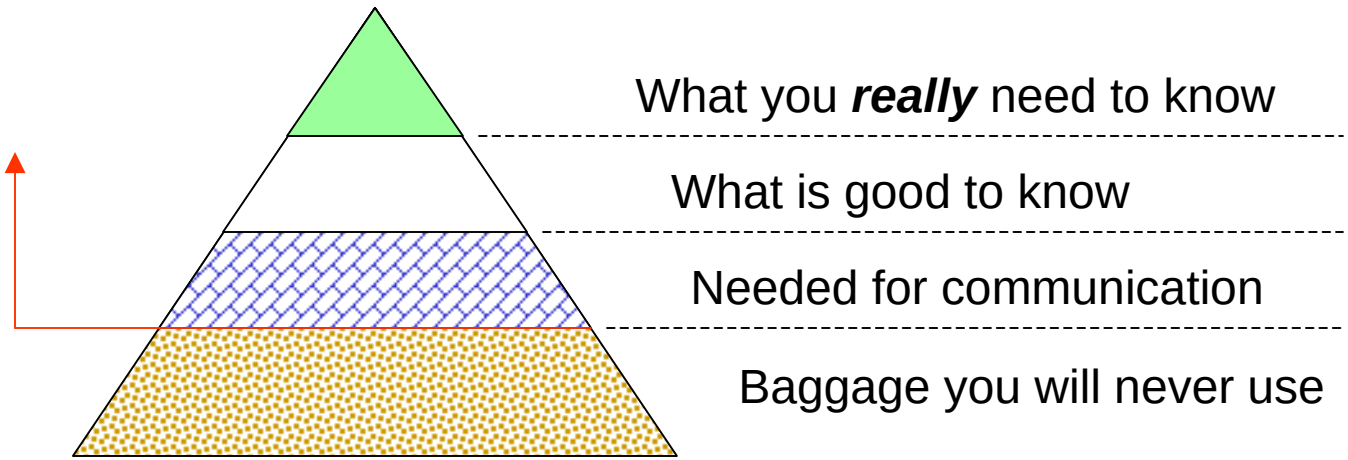
Activity diversity	Personal skills
Web-based materials Self-study Class dialog Group working Lab experiments Simulations Industry links	Learn how YOU learn Be accountable for your results Effective time management Manage overload & uncertainty Know what you don't know Be insatiably curious Balance constraints and change

Warning – it may be necessary to THINK.
However, be reassured. There are no known cases of this being harmful.

Learning Utility

By now, you should have realized that there is an awful lot to know.
All classes pile it on.
How much do you think you'll ever have to use in the real world ?
Depends on your job – so allocate your own priorities.

Work on the pyramid principle:



Industry Expectations

Here's a short list of features that an employer looks for:

- Convert fuzzy issues into clear activities
- Understand the customer perspective
- Deliver solutions in teams
- Demonstrate ethical behaviors
- Communicate clear competitive solutions
- Be able to focus, prioritize and set in context
- Use all appropriate tools and skills
- Quantify and attribute sources - always
- In the end it all reduces to $$$$

Read this list from time to time.
If you can cope with that list, you'll do well in this course and outside.

Skills – the Simple Version

The specific objectives for individual courses (or even unit modules) are given at the appropriate locations.

All EST courses endeavor to emphasize 2 skills:

1. How to define a problem. The specification is likely to be vague or incomplete but the representation should be appropriate to the application and lead to a practical solution.

2. How to communicate a solution. In real life, one person's solution is another's starting point. It is therefore essential to be clear about how the solution was obtained, what assumptions were made and that all be easily understood by others.

Think about why this is important - and what you'll do to comply

Desired Skills

Personal

- P1 Accountability for all outcomes
- P2 Time management
- P3 Team working
- P4 Vision for role beyond short term
- P5 Safe working - mindset
- P6 Ethical working
- P7 Accurate working
- P8 Available and responsive
- P9 Problem formulation
- P10 Problem solving
- P11 Able to prioritize
- P12 Develop effective solution strategies
- P13 Capability for life-long learning
- P14 Personal role in the global economy

Communication

- C1 Understand requirements
- C2 Information selection & priority
- C3 Structure to suit time and audience
- C4 Effective format for presentation
- C5 Computer use - select software
- C6 Written fluency and precision
- C7 Effective technical voccabulary
- C8 Dialog in all settings
- C9 Effective listening
- C10 Understand and use body language
- C11 Demonstrate value added

Career management

- F1 Baseline - have a relevant resume
- F2 Interview behaviors
- F3 Role to technologists in companies
- F4 Typical career paths
- F5 Know drivers for change - technical
- F6 Business drivers for change
- F7 Changes in skills needed
- F8 Know what you can (not) do well
- F9 Know what you (do not) like
- F10 Know when you (do not) work best
- F11 Know how hard you can(not) work
- F12 Work on the skills that don't change

Technical

- T1 Electronic system architectures
- T2 Component design, function
- T3 Component selection
- T4 Design and realization of tools
- T5 Role and limitations from materials
- T6 How all parts of system are made
- T7 Technology roadmaps & bottlenecks
- T8 Data acquisition
- T9 The technical basis of safe practice
- T10 Design for X
  - Manufacturability
  - Testability
  - Reliability
  - Maintainability
  - Usability
  - Sustainability
  - Cost
  - Extendibility
  - Flexibility
  - Scalability

Business operations and processes

- B1 Professional culture in industry
- B2 Team working to deliver better
- B3 What drives technology
- B4 What is driven by technology
- B5 Global business operations
- B6 EHS processes & disciplines
- B7 Data structuring and effective use
- B8 How to specify requirements
- B9 Project management
- B10 Product life cycles
- B11 Advocacy for task outcomes
- B12 Quality processes
- B13 Root cause and field management
- B14 Validation & qualification
- B15 Costs of all operations
- B16 Supply chain
- B17 Legal & ethical issues

Find More Resources on Needs of Industry

- www.matecnetworks.org
  - “Industry”

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December 12: Communicating with Today's Generation

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