Operational Aspects of a University Microelectronics Cleanroom

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WCAM Mission

- Respond to the research needs of the faculty, student, and staff with personnel, facilities and equipment
- Maintain and improve the facilities and equipment to meet changing research needs
- Provide multi-user access to the facilities and equipment

Goals

- Provide an effective microfabrication capability to campus-wide students and faculty
  - Support research programs
  - Support teaching courses and laboratories
- Provide access to qualified extra-mural users

Approach

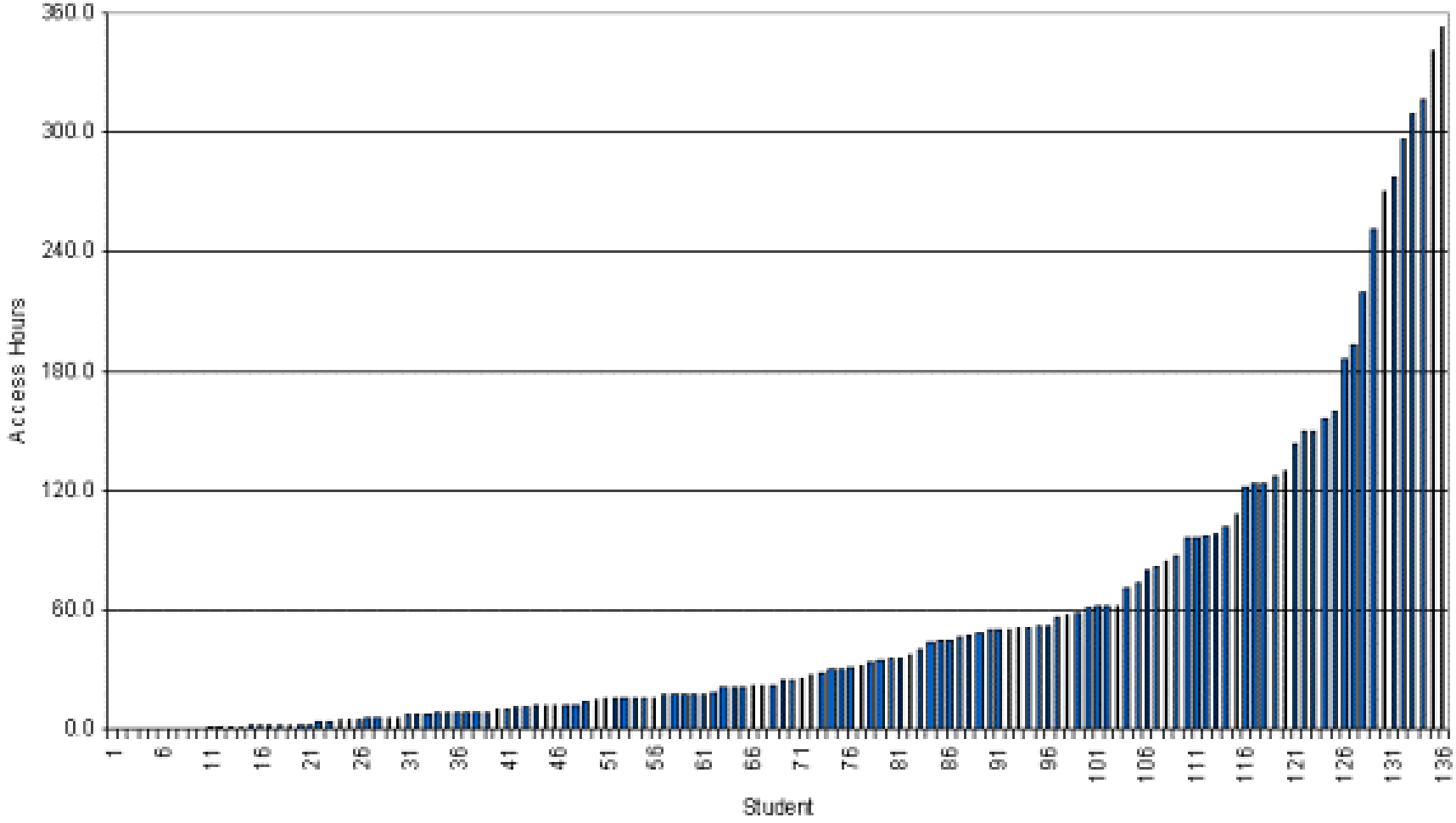
- Setup and maintain a microfabrication facility compatible with needs and available resources
- Maintain an experienced staff to support users
- Provide training and access for new users

Local Academic Users

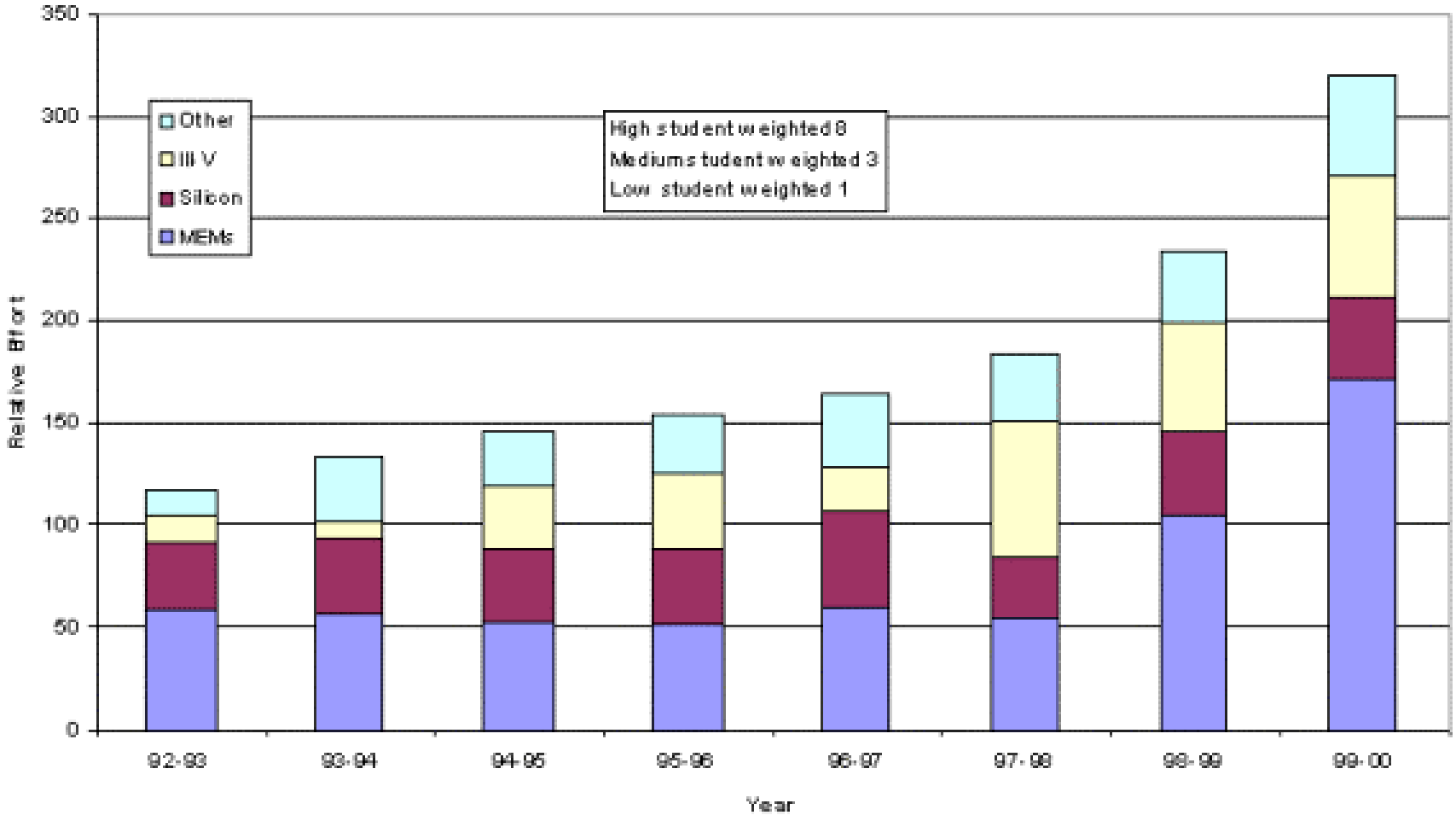
- Electrical and Comp. Eng. Dept
  - Prof. Dan Botez
  - Prof. Franco Cerrina
  - Assoc. Prof. Yogesch Gianchandani
  - Assist. Prof. Amit Lal
  - Assoc. Prof. Luke Mawst
  - Assoc. Prof. Dan van der Weide
- Bio-Medical Eng. Dept
  - Assoc. Prof. David Beebe
- Chemical Eng. Dept
  - Prof. Tom Kuech
  - Assoc. Prof. Paul Nealey
  - Assoc. Prof. John Yin
- Chemistry Dept
  - Prof. Robert Hammers
  - Prof. Robert Corn
- Eng. Physics Dept
  - Prof. Michael Corradini
- Material Science and Eng. Dept
  - Prof. Austin Chang
  - Prof. Max Lagally
- Mechanical Eng. Dept.
  - Assist. Prof. Xiaocun Li
  - Assist. Prof. Yuri Shkel
- Physics Dept.
  - Assist. Prof. Mark Eriksson
  - Prof. Dan McCammon
- Bio-Chemistry Dept.
  - Prof. David Schwartz
- Research Centers
  - CNTech
  - CPAM
  - MRSEC
  - Reed Center for Photonics

Research Student Access

2001 - 2002



WCAM Areas of Work Historical Trends



Educational Access

- Two ECE laboratory course are currently taught in the cleanroom

Non-Academic Users

- Approximately 8 companies use the facility.
- Approximately 5 FTE researchers (10+)

WCAM Budget

- Staff
  - Salaries funded by College of Engineering
  - 2 FTE engineers, 2 FTE Technicians
- Supplies and Expenses
  - Funded by recharge system
  - Approx $200,000 in 2001-2002
- Capital Equipment
  - Funded by proposals

UW Staff

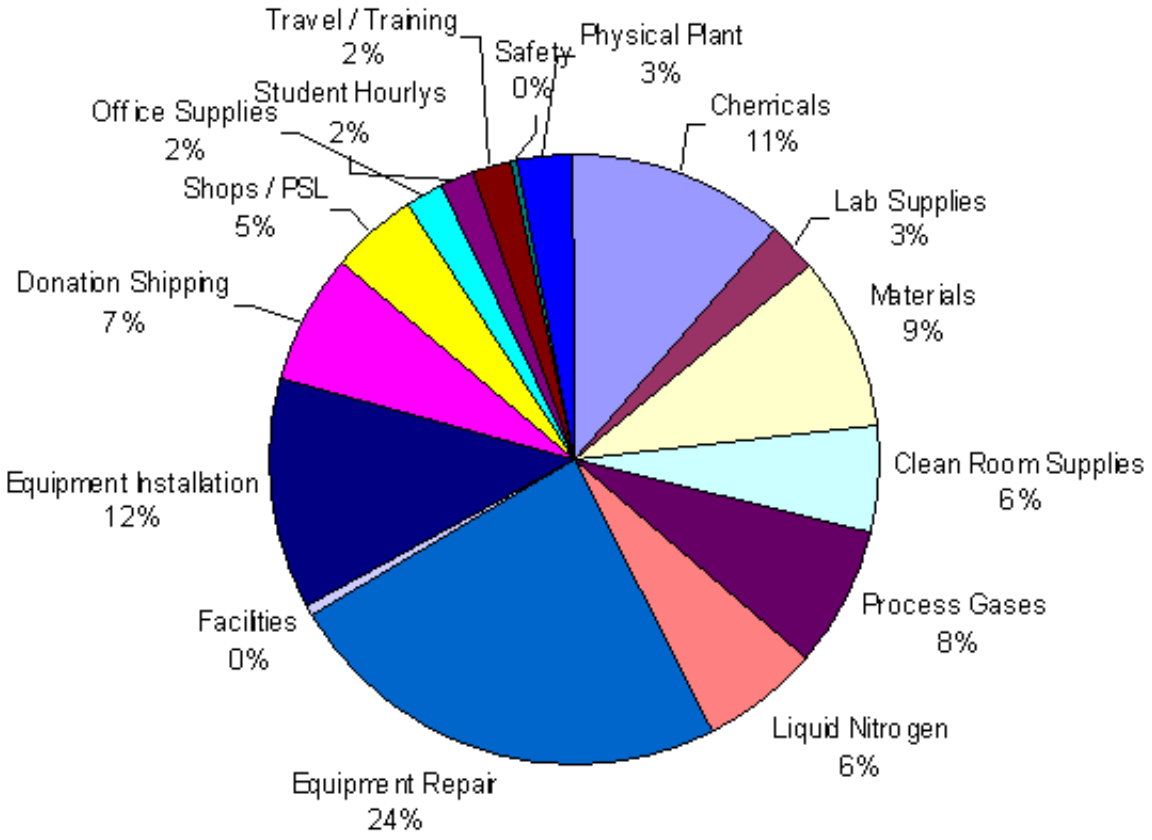
- Director
- Lab Manger
- Maintenance & Repair
  - 1 FTE Sr. level with semiconductor experience (need a total of 2 FTE's)
  - 1 FTE Sr. level with electronics experience (need a total of 2 tech. FTE)
- Processing, Training, and Safety
  - (Need 1 FTE Sr. level Semiconductor Process Engineer)
  - 1 FTE Sr. level technician, equipment operation training and safety.

Comparing University Staff Levels

University	Full Time Technical Staff
Stanford	22
Berkeley	20
MIT	15
Univ. of Michigan	13
Univ. of Minnesota	12
Georgia Tech.	8
Illinois –Champagne	7
Purdue	4
Wisconsin-Madison	**4**

Data Dec 2001

Supplies & Expenses
(FY 2000-2001)



User Charging System

- UW Research
  - Previous
    - $4500/year/student
    - Capped at $25,000
  - Future
    - Monthly key charge
    - Hourly cleanroom rate
    - Additional hourly rate on high-cost equipment
- External to UW
  - Previous – hourly rate
  - Future – same structure as UW

Comparing University Access Fees

Facility	Access Hourly Rate	Contact Aligner	SiO2 RIE	PVD Sputter	Evaporator	LPCVD	Thermal Ox	Implant
Case Western	$75/hr -> $44/hr	0	0	0	NA	0	0	NA
Penn State	$35/hr	0	0	NA	15-$30 /100	$200/hr	0	$75/hr
RIT	$100/month	$30/hr	$30/hr	$30/hr	$30/hr	$60/hr	$30/hr	NA
Purdue	??	$80-$110/use	$40/etch	$50/dep	$60/dep	$60/dep	$40/use	$80/wafer
MIT	??	$6/wafer	$5/wafer	$30+/run	$30+/run	135-$150/us	$25/use	NA
Berkeley	$82/month + $32/hr	0	$29.40/hr	0	0	$29.40/hr	$29.40/hr	NA
Stanford	$72/hr	0	0	0	0	0	0	0
		Internal Rates	(rates published on the Web dated 4/02 - 6/02)					
		0 = no charge						
		NA = tool not listed						

Capital Equipment

- List Price Replacement Value
  - $5,000,000
- Funded by Proposals

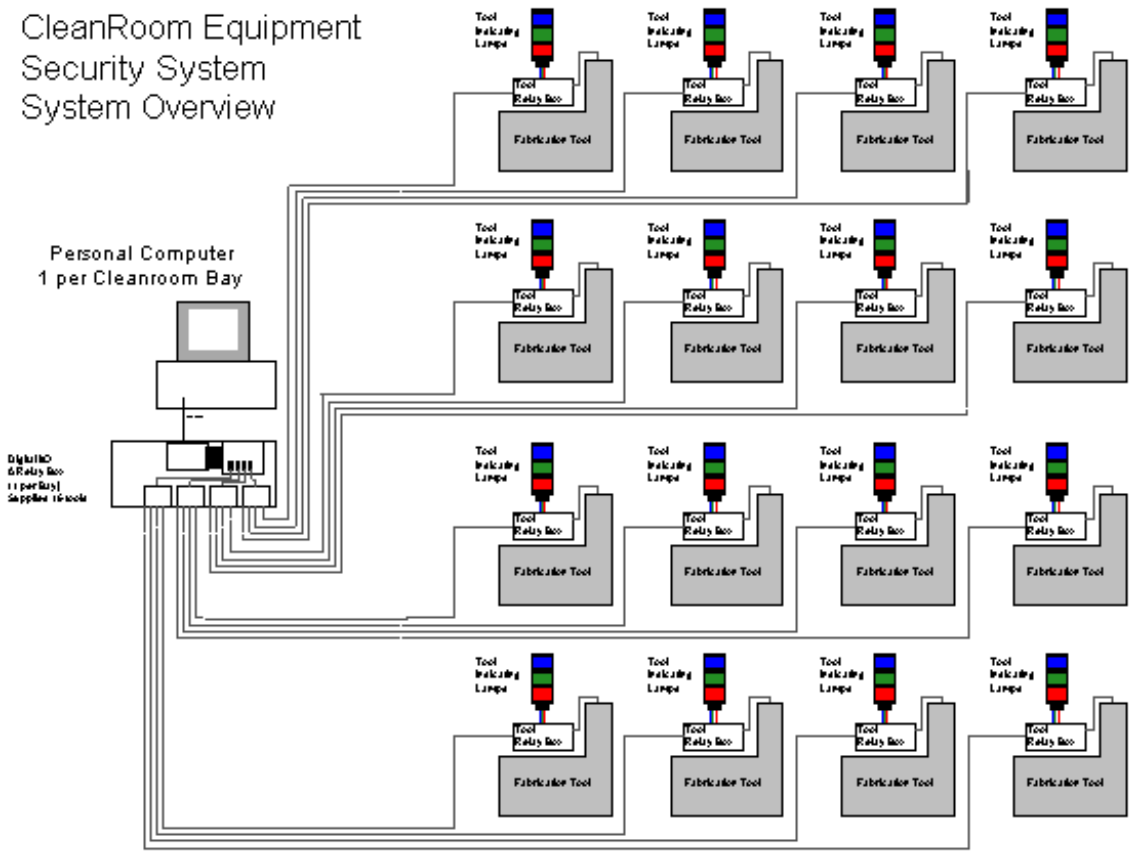
Capital Equipment Plans

Tool	Presently in WCAM	Total Planned for ECB
Photolithography stepper	0	1
Contact Aligner	5	5
Chemical Wet Benches	4	8
Furnace Tube Ox/Diff	6	9
LPCVD Tubes	2	3
PVD Sputtering	3	4
PVD Evaporation	4	4
Plasma Etch	5	8
PECVD	1	2
RTA	0	3
Analysis	3	4
Ion Implant	1	1
Wafer Bonder	1	1
Wire Bonders	2	3
Dice/Saw	2	2

Lab Computer Access and Safety System

- Interlock and ID lookup
- After hours use
- Video and audio
- Proximity reader

Computer Login
of Each Fabrication Tool



Computer Login Software

- Database of qualified users per tool
  - ID+password to “turn on” the tool
- Database Log
  - record user ID and time on each system
- Repair
  - Any user can DOWN a system
  - Only staff can UP a system
- Report
  - Invoices vs user ID and system time
  - WEB display of systems currently in use

Equipment Move

- Decontaminate system
  - SEMI S12-0298
  - Purge all process gas lines, process chambers, chemical lines, chemical vessels, and chemical drains.
  - Disconnect process piping then utility piping
  - Disconnect water, drain, and exhaust
  - Disconnect electrical

Equipment Move

- Clean in “old cleanroom” prior to move
  - Vacuum Interior and exterior of system
  - Using N2, blow out interior of system
  - Vacuum Interior and exterior of system
  - Wipe system
    - IPA/DI
    - Texclean
    - DI Water

Equipment Move

- Shrink wrap system
- Bubble wrap system (if needed)
- Shrink wrap system
- Remove from “old” cleanroom

Equipment Move (new system or moved system)

1. Move into Maint. & Repair Lab
2. Place “clean” floor covering in front of the entrance doors
3. Place “clean” moving carts on floor covering
4. Transfer system onto “clean” carts
5. Move system into equipment airlock
6. Remove outer shrink wrap & bubble wrap
7. Move to cleanroom location
8. Remove inner shrink wrap
9. Wipe down (as before)

Equipment Installation Protocol

- Electrical
  - Disconnect located in cleanroom or chase
  - System must have EPO
- Piping
  - All piping to have shutoff valves at the the equip. connection inside the cleanroom
  - Proper pipe labeling
  - Hazardous piping to be alarmed via lab gas monitor
- All process gas lines to be leak checked in accordance with SEMI F1-96
- Connect to lab computer access and safety system