A Simulation Study Of 450mm Wafer Fabrication Costs

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IC Knowledge LLC

Outline

- Cost Modeling
- What the 200mm to 300mm transition taught us
- 450mm expectations
- 450mm cost projections
- Conclusion

Background

- IC Knowledge LLC produces the industries most widely used IC Cost Model
  - 9 of the 10 largest semiconductor companies
  - 5 of the 5 largest equipment companies
  - Many others
- The IC Knowledge – IC Cost and Price Model includes a bottoms-up wafer cost engine
- Using the cost engine with cost, usage and productivity factors for 450mm versus 300mm allows 450mm projections to be generated

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Cost Modeling Axiom

- The algorithms for cost modeling are easy, it is the assumptions that are hard!

What the 200mm to 300mm transition taught us

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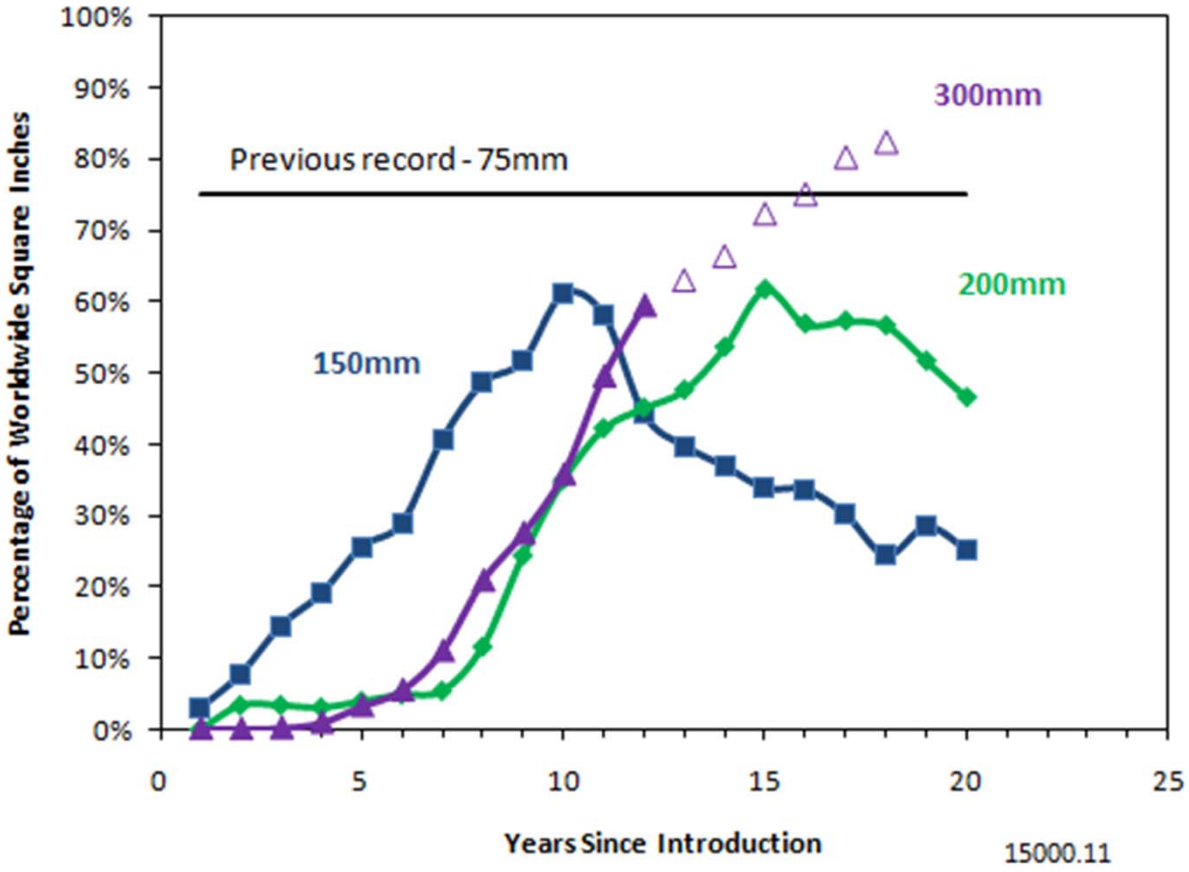
Volume Ramp



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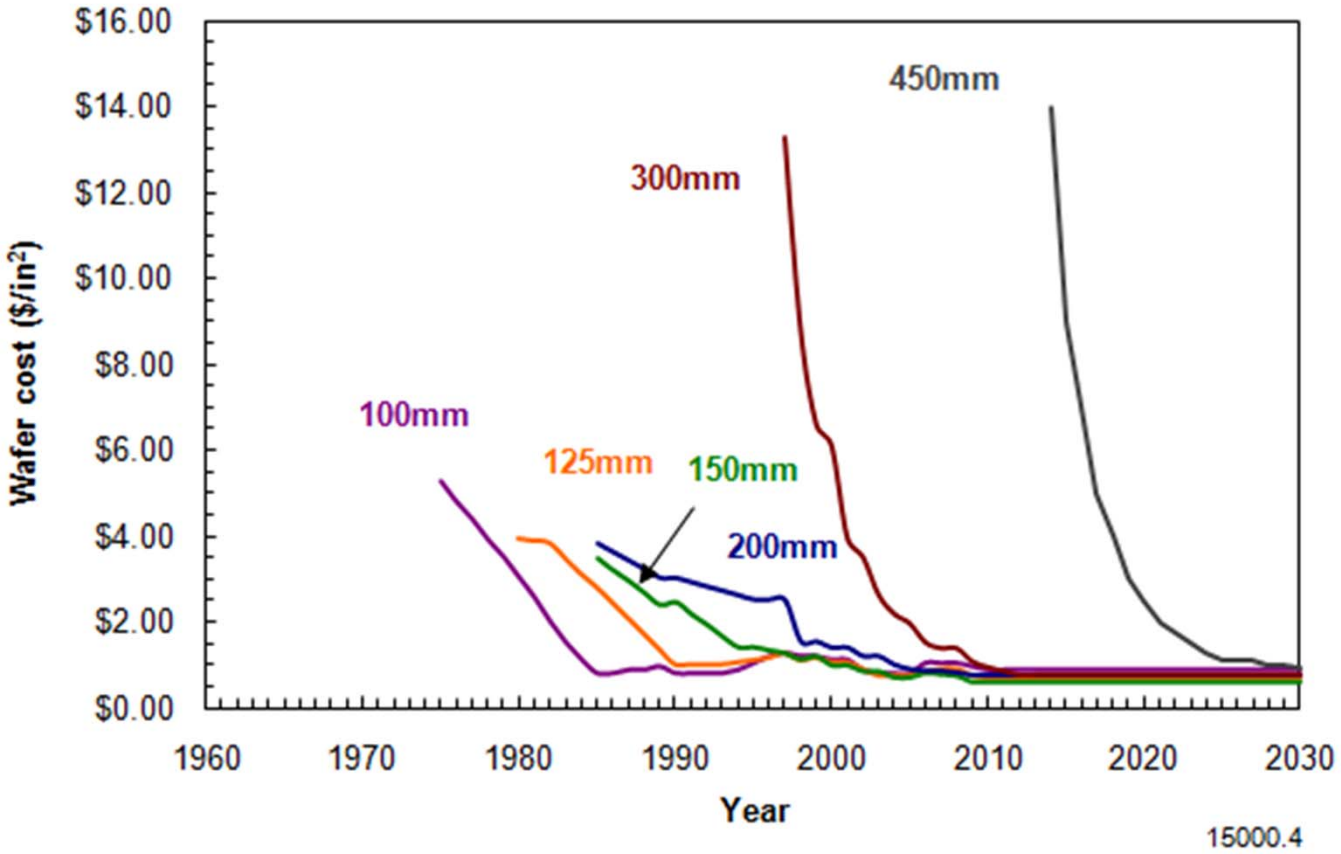
Material Cost



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Tool Characteristics 300mm Vs 200mm

Tool type	Cost	Throughput	Footprint
Expose	1.48	1.0	1.15
Track	1.25	1.0	1.13
Etch	1.18	1.0	1.23-1.50
Thermal	1.19	1.0	1.13-1.28
Implant	1.24	1.0	1.10
Wet	1.73	1.0	1.20
Metrology	1.18	0.62 – 1.0	1.20
Metal	1.40	1.0	1.32
CVD	1.23	1.0	1.30
Spin-On	1.18	1.0	1.20
CMP	1.18	1.0	1.37

200mm to 300mm "Real" Cost Savings

Wafer size	$/waf	$/cm2
200mm	$1,203.17	$3.83
300mm	$1,936.11	$2.74

Material: $/cm^2 the same for both sizes (currently approximately true)
DL and IDL: productivity equal
Equipment cost: 1.25x (assumes no technology improvements)
Throughput: 0.52 expose, 0.62 implant and metrology, 1.0x others
Footprint: actual change
Maintenance factor: same for both
Consumables and utilities: 2.25x

Conclusion: 28% cost saving from simple scale up at a wafer level

450mm Expectations

ISMI 450mm Guidelines

- Footprint should be the same for the same throughput
- Chemical and gas usage should be the same per wafer
- Utility usage should be the same per wafer

SEMI 450mm Guidance

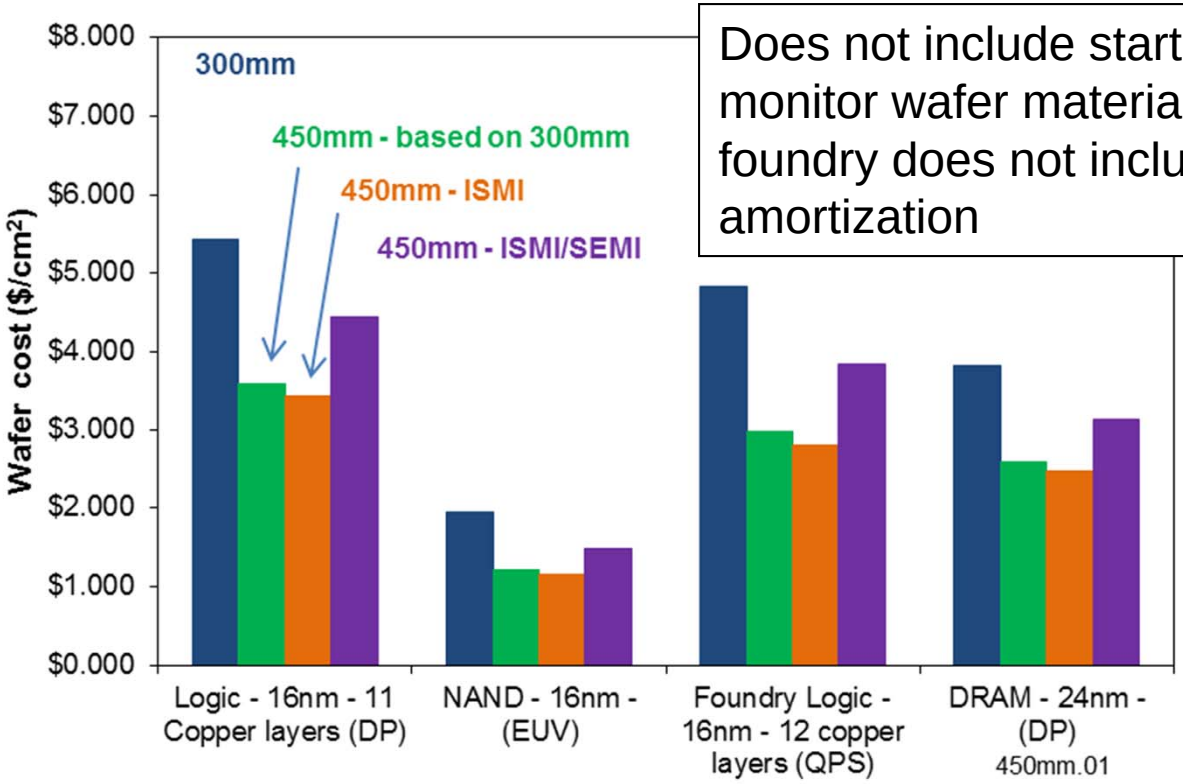
- "Beam Tools" will be slower due to "physics".

Tool type	Throughput
Exposure	0.52
Implant	0.62
Metrology	0.62

"SEMI/Equipment Suppliers' Productivity Working Group 450 mm Economic Findings and Conclusions," SEMI 2008

450mm Cost Projections

Wafer Cost Comparison



Does not include starting wafer or monitor wafer material costs, foundry does not include reticle amortization

Updated chart versus the one presented at ISMI manufacturing week

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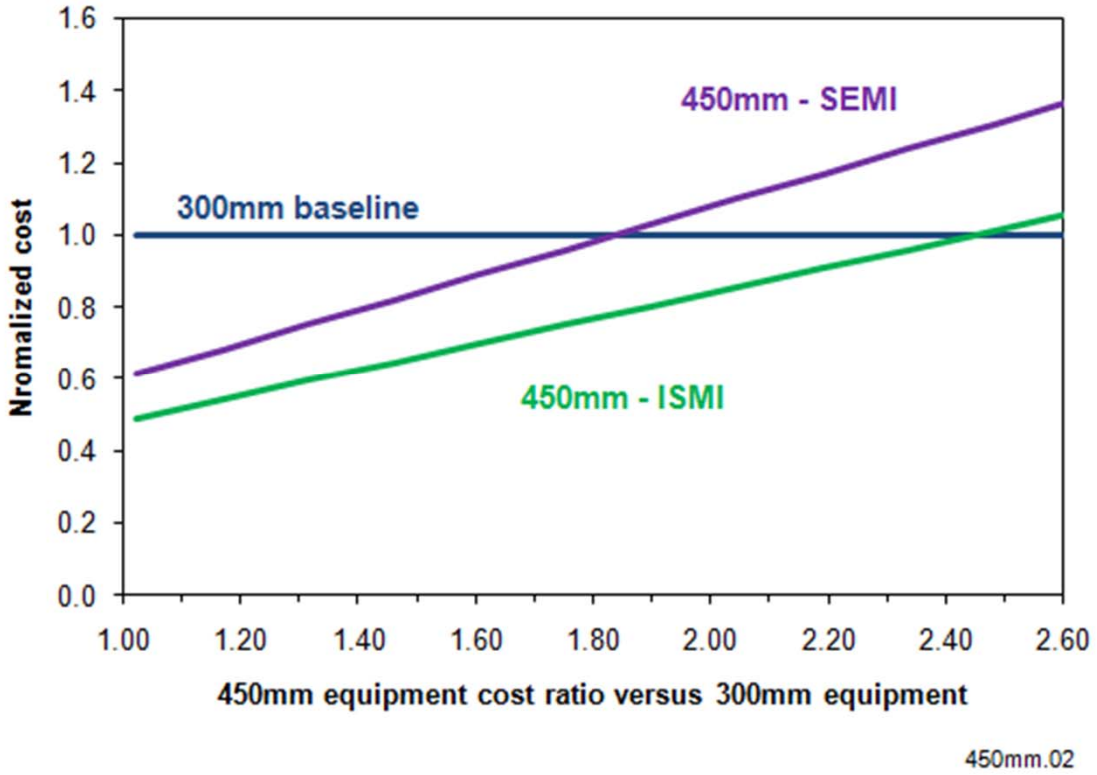
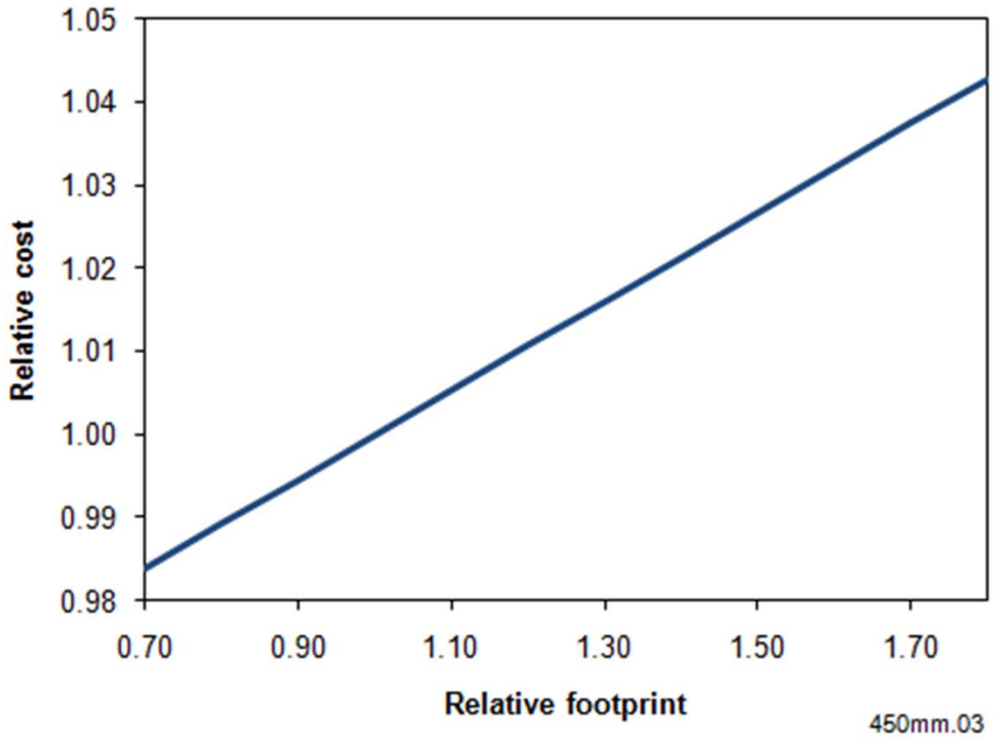
Equipment Cost Sensitivity



24nm DRAM without starting material or monitor wafer costs.

Equipment Footprint Sensitivity



24nm DRAM without starting material or monitor wafer costs.
Baseline 1.0x is based on 300mm ratios

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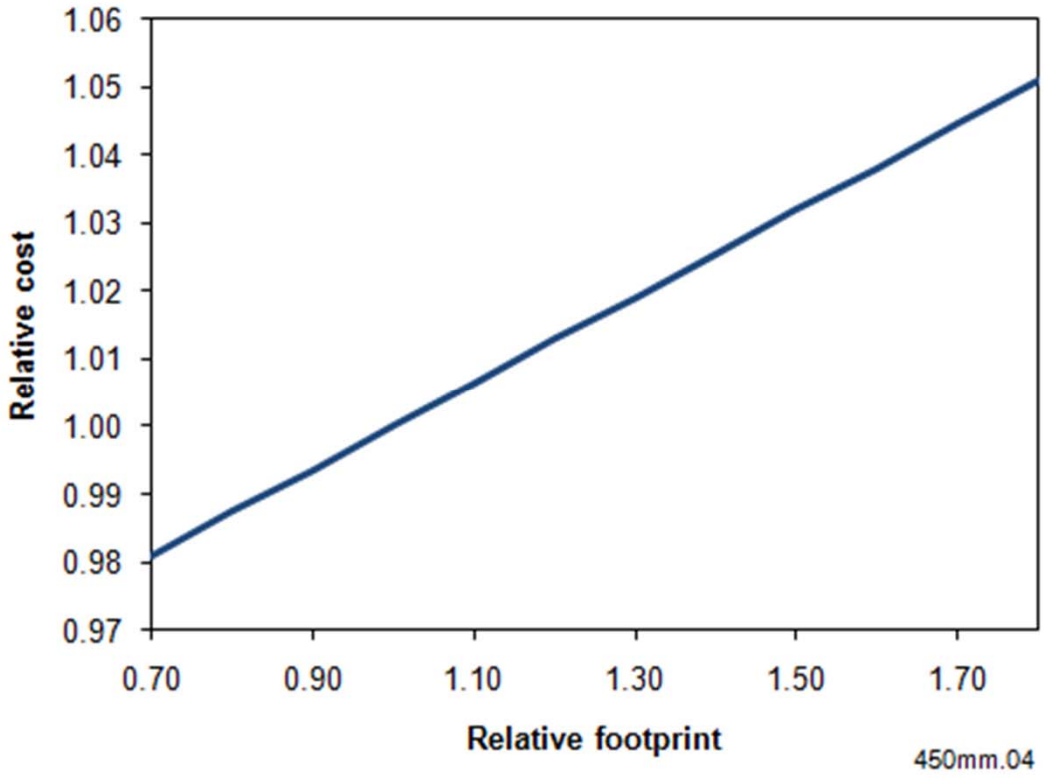
Consumables/Utilities Sensitivity



24nm DRAM without starting material or monitor wafer costs.
Baseline 1.0x is based on ISMI ratios

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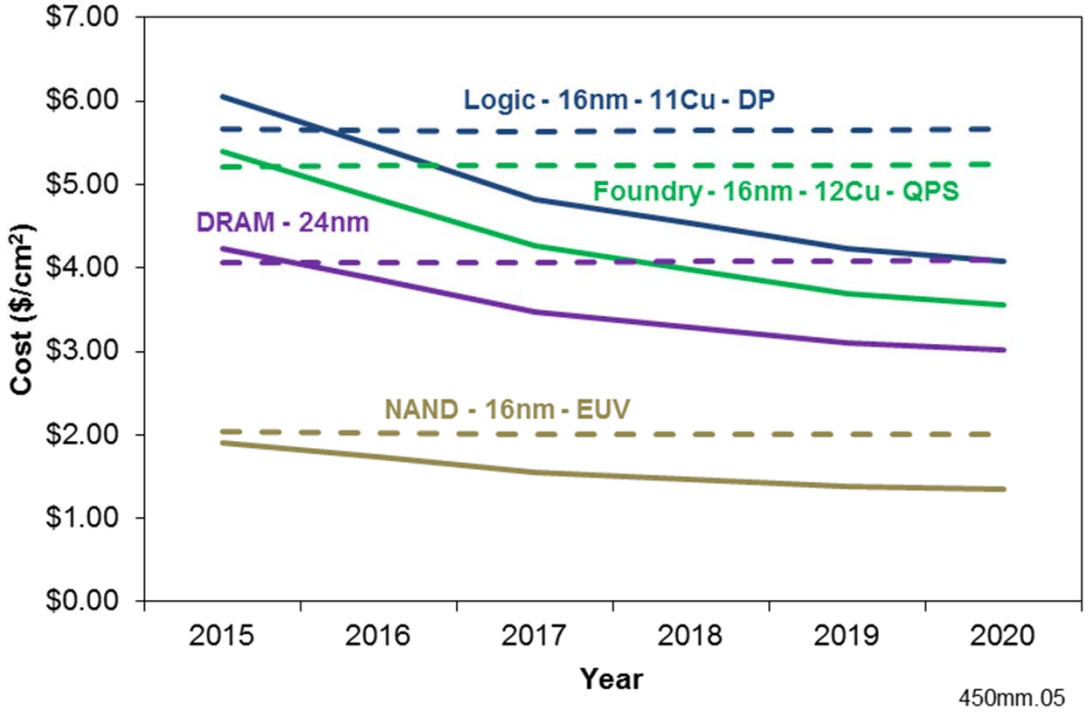
450mm Cost Versus Time



Wafer cost including starting and monitor wafer, ISMI assumptions.
Dotted line are 300mm, solid line 450mm, 20% depreciation.

Updated chart versus the one presented at ISMI manufacturing week

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Conclusion

- A model of 450mm wafer costs has been developed
- Various industry group guidelines have been assessed for their impact on cost
- Sensitivity analysis of equipment cost, footprint and consumables/utilities have been performed
- Time sensitivity due to 450mm material cost has also been assessed
- 450mm wafesr will provide a significant cost savings with the amount dependent on the specific case and assumptions