

Tool or Facility – What Should it Be?

**Reconciling differences between production
equipment needs and facility support**

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Goal of Presentation

- Present a substructuring model with which one can simplify between tools and buildings
- We can use the model to
 - define how vibrations (or other contaminant) travel from the outside to the wafer
 - define how limits at wafer can be worked backward through tool to become requirements for environment
 - define how ITRS facility and tool teams can interact

Notion of “Isolation from Environment”

- Most fab processes have one or more aspects of environmental sensitivity
- Most tools have some sort of enclosure and/or support system
- How might we quantify the manner in which a tool needs to be “isolated” from the room environment?
- Where should this isolation “live” – the tool, or the facility?

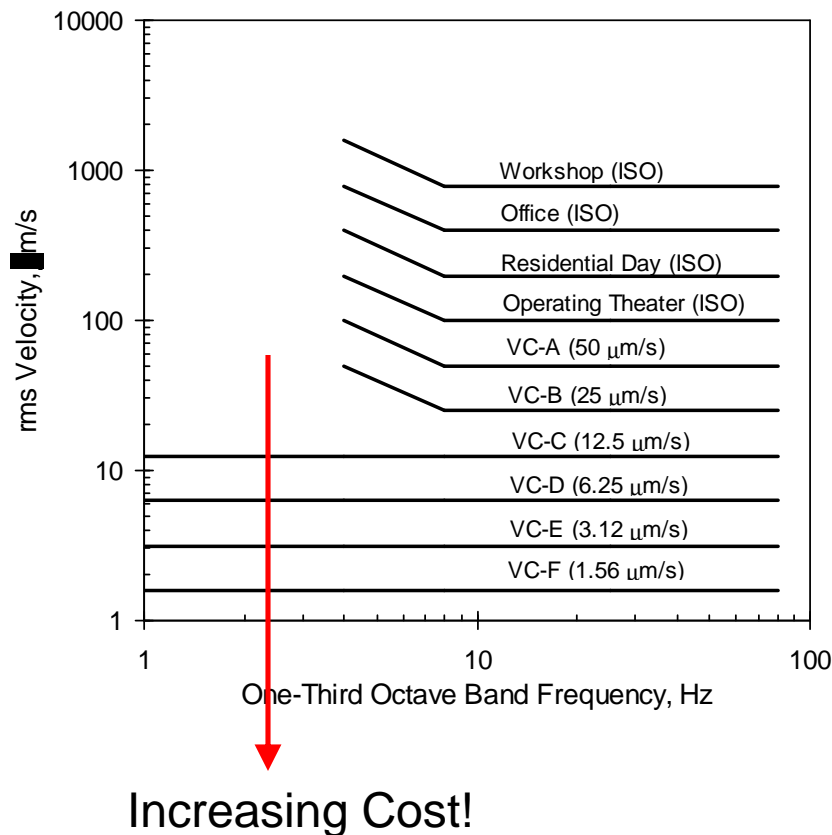
Applications

- Tools themselves often are expected to mitigate “contaminants”
 - The facility design usually attempts to control these contaminants, as well.
- Contaminants ...
- Vibration
 - Noise
 - EMI
 - Particulates
 - Minienvironments
 - Temperature
 - *Etc.*

Overview

- Is contaminant control the responsibility of the facility designer or tool designer, or both?
- If both, how do we coordinate how much is required from each?
- Two things are necessary to formalizing an answer to this ...
 - A means of two-way communication of requirements
 - A means to establish priorities

Consider vibration, for example



- Vibration leads to defects at the wafer
- We have generic floor vibration criteria that govern how a facility is built (see left)

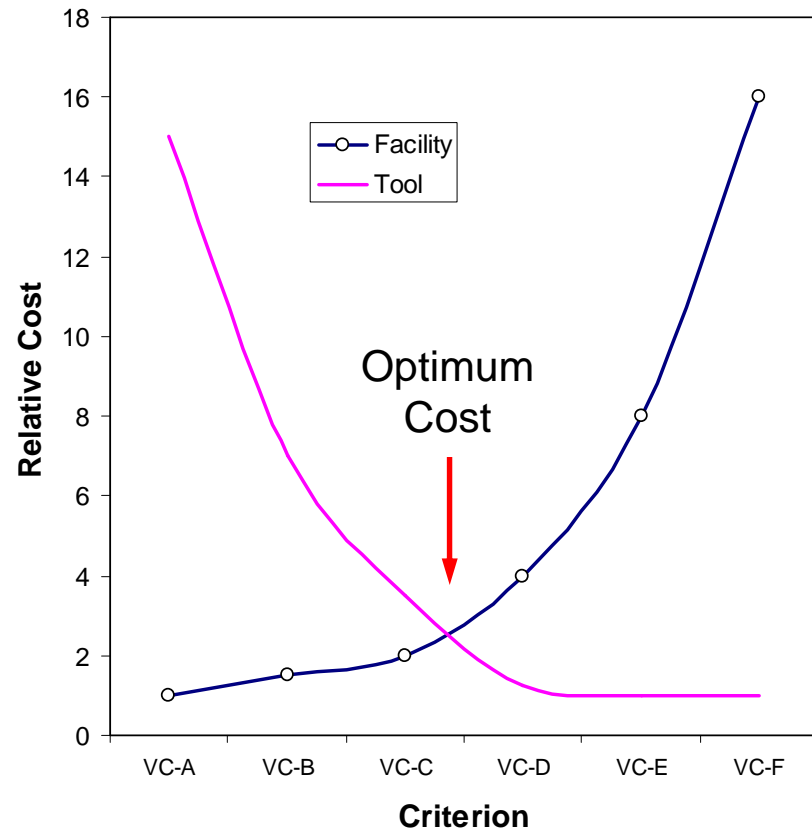
Questions ...

- How do we relate vibration limits at wafer to floor vibrations?
- How do we account for the vibration isolation inside the tool?

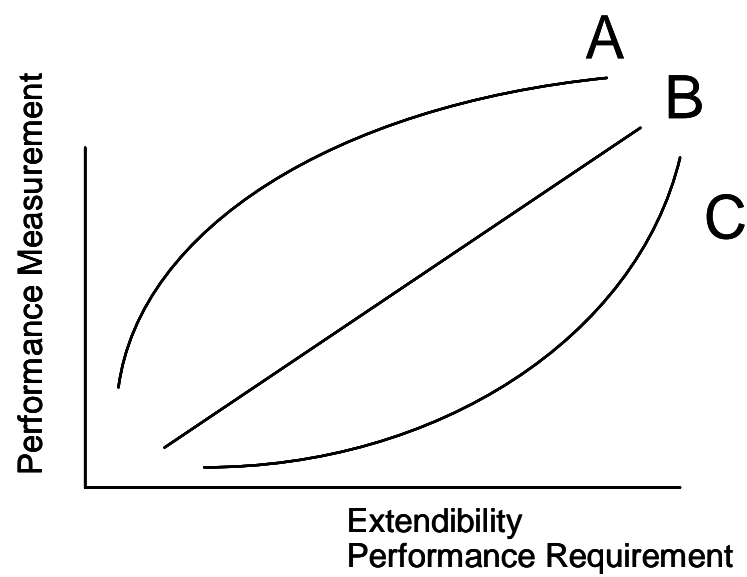
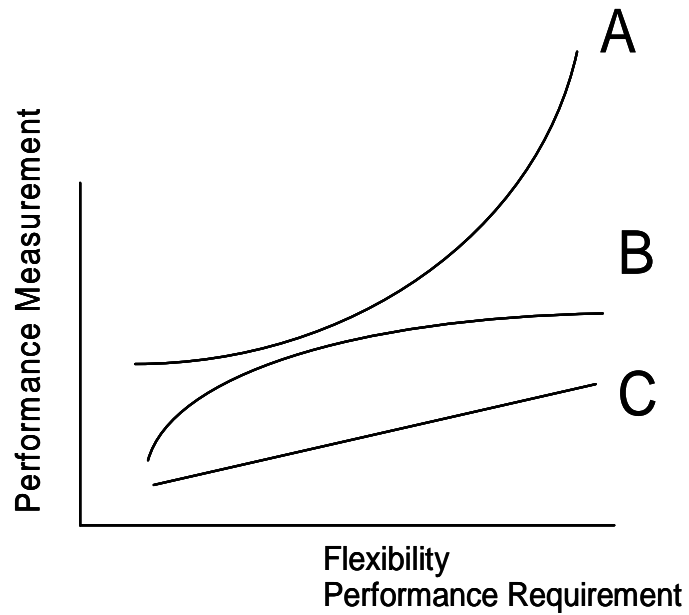
Reduce Sensitivity vs Improve Fab

Relative Cost

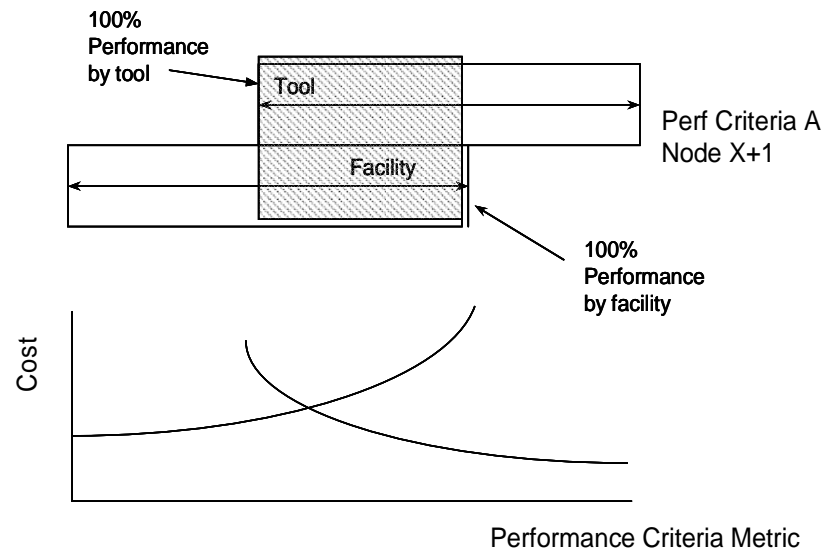
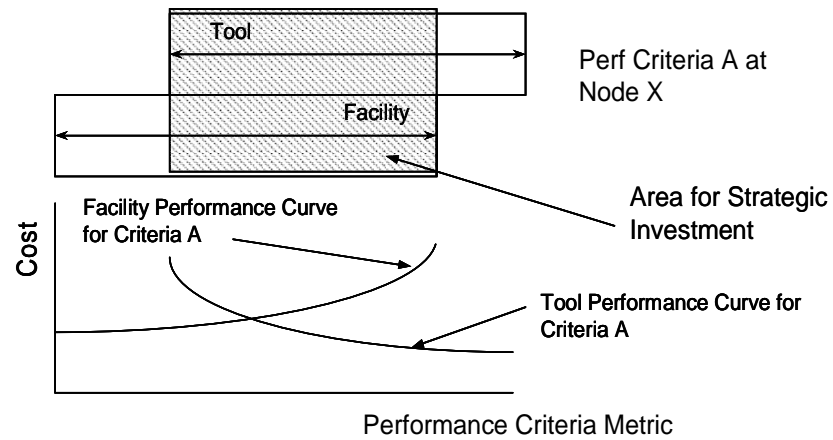
- Designing a “better” vibration environment in a fab involves cost
 - But it allows a cheaper tool
- Designing a less sensitive tool increases cost
 - But it reduces facility cost



How do Costs Vary with Performance?

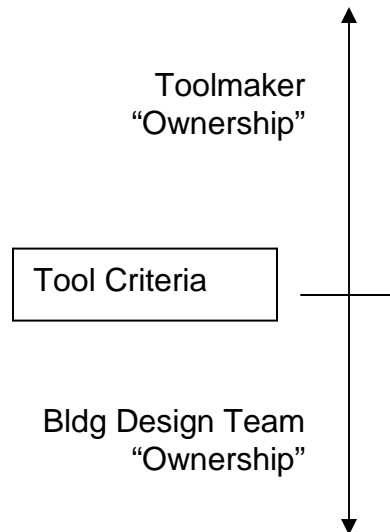


Performance Overlap from One Node to the Next



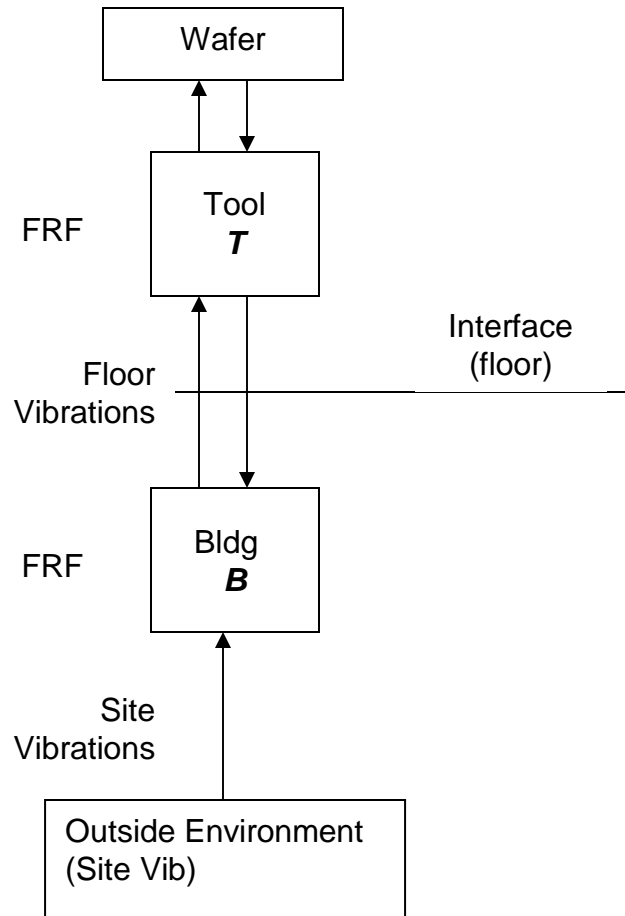
**Must Establish a
Communication Protocol**

Communicate via Criteria



- We have to have consensus regarding tool criteria and communication
- Detailed level for individual tools
- Generic level for long range planning (e.g., ITRS Roadmap)

A Model for Communication



- Ultimately, wafer must be protected from contamination from *Outside Environment*
- Building reduces some
- Tool itself reduces some

How do we relate environment to wafer?

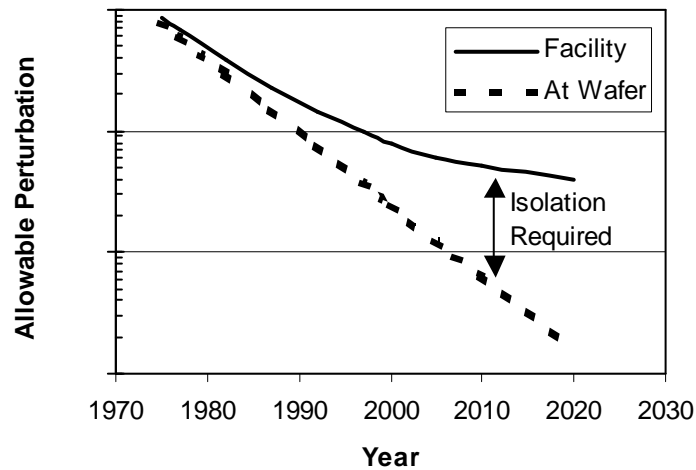
- Theoretical – Inaccurate
- Experimental – Accurate, but expensive
- Experience – Requires iteration
- *Must have:* units and vocabulary for communication; must recognize reality

Experimental “transfer function”



- Expensive
- Time consuming
- Requires special facilities

Happening by default



- Moore's Law means that sensitivity is increasing at wafer level
- Sites have practical limits
- Owners are limiting facility costs
- Toolmakers are improving isolation performance of tools

Impact on Roadmap Effort

- Newest edition of Roadmap “freezes” vibration requirements of photolithography
- This forces toolmakers to “pick up the slack”, the difference between what the site provides and the tool requires at the wafer
- *Total* costs could be optimized if
 - We could define cost tradeoff curves
 - Facility designers and tool designers could communicate