

A shared information framework across design and manufacturing: Opportunities, Objectives and Obstacles

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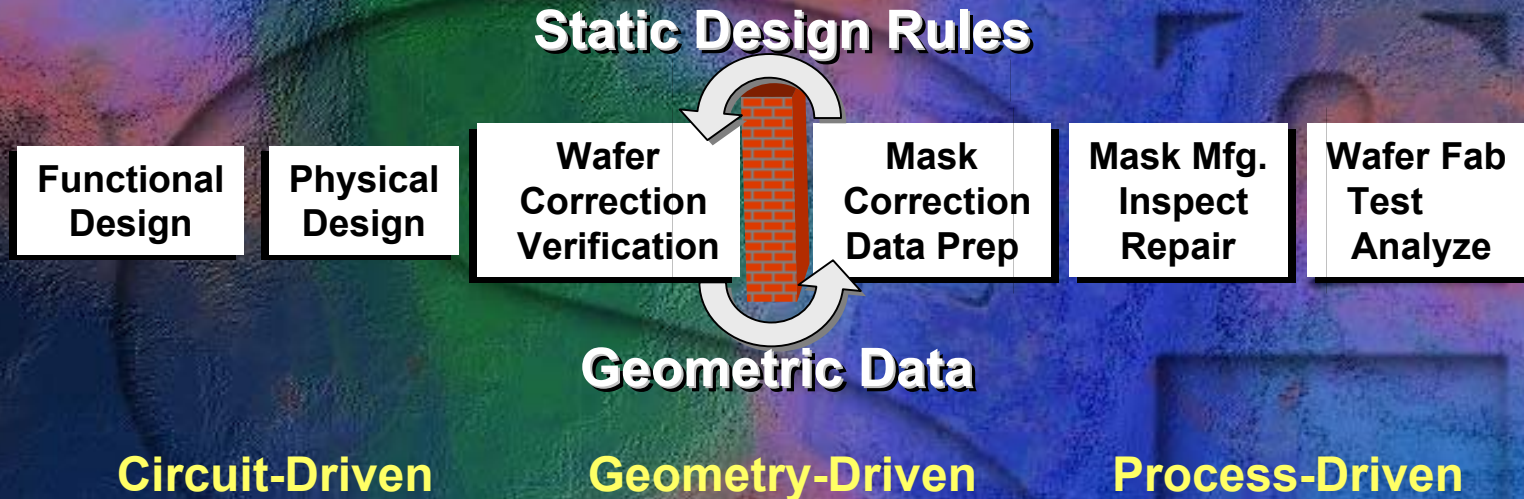
Introduction

- What is DFM
 - ***Design for Money...*** (Mark Mason, TI)
- It includes:
 - *Lithography aware design,*
 - *Yield aware design,*
 - *Power aware design,*
 - *Performance aware design, DFT, . . .*
- It requires: knowledge about the effects of design tradeoffs on mfg. and of mfg. decisions on design
- It is stressing our disaggregated supply-chain

What the Industry is Observing

- Increasing mask costs and design cycles are impacting ASIC's and fabless companies
- Ownership of wafer yield is moving from the the fab manager to product designers
- Design rules are becoming increasingly complex while less representative of the real-world
- Significant investments made in DFM and DFY technology (>\$100M VC alone), but it's a challenge to evaluate or get evaluated

Issues in the Current Methodology



- Mfg. impacts determined late in design
- Mfg. impacts hinder reuse
- Long design-to-volume cycle

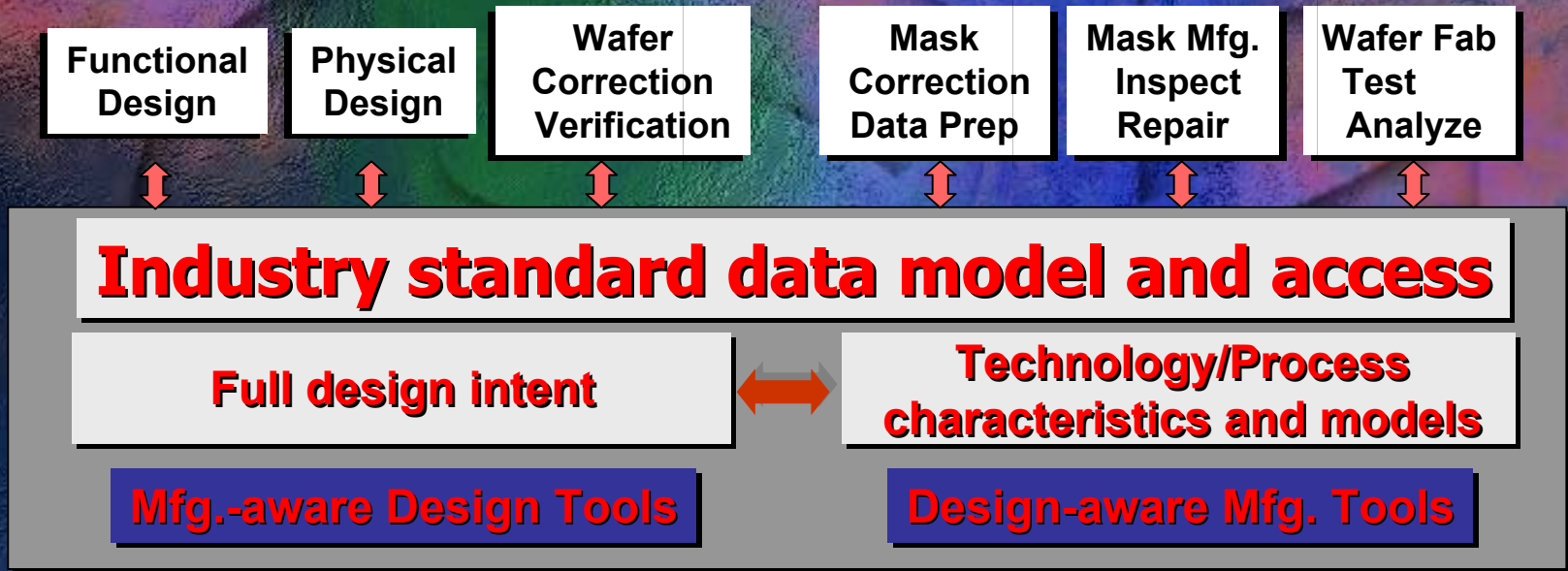
- Design rules are complex
- Rules do not characterize process variation
- Communication of design intent is incomplete
- Access to predictive design and analysis models is lacking across the design flow

- Non-trivial inspect/repair
- Lack information to determine defect disposition
- Sequential flow

Original Compliments of: Aprio Technologies

The Need

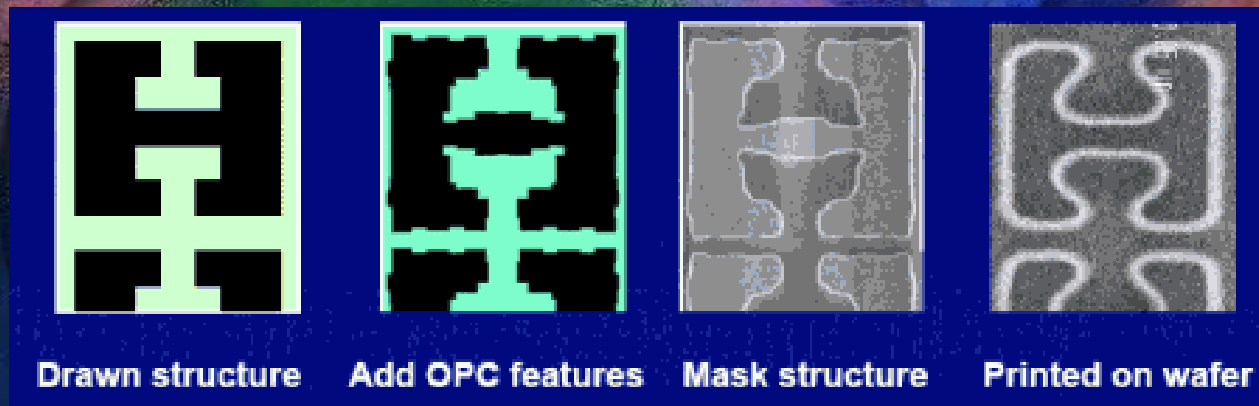
Virtual Integration of the supply chain



- Access to needed information
- Integrated flows - allowing tools of choice
- Concurrent processes to shorten cycles
- Additional knowledge to reduce cycles

Some Arguments for Change

- Lithography - design geometry is but a binary approximation of the manufactured result

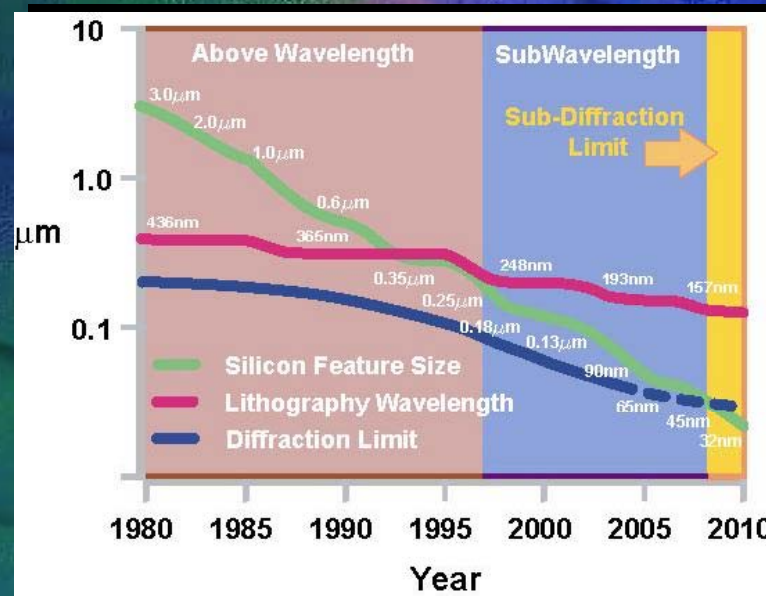


Source: Intel

- Yield Ramp - now a shared problem
- Inter-process and intra-process variation

Lithography Issues

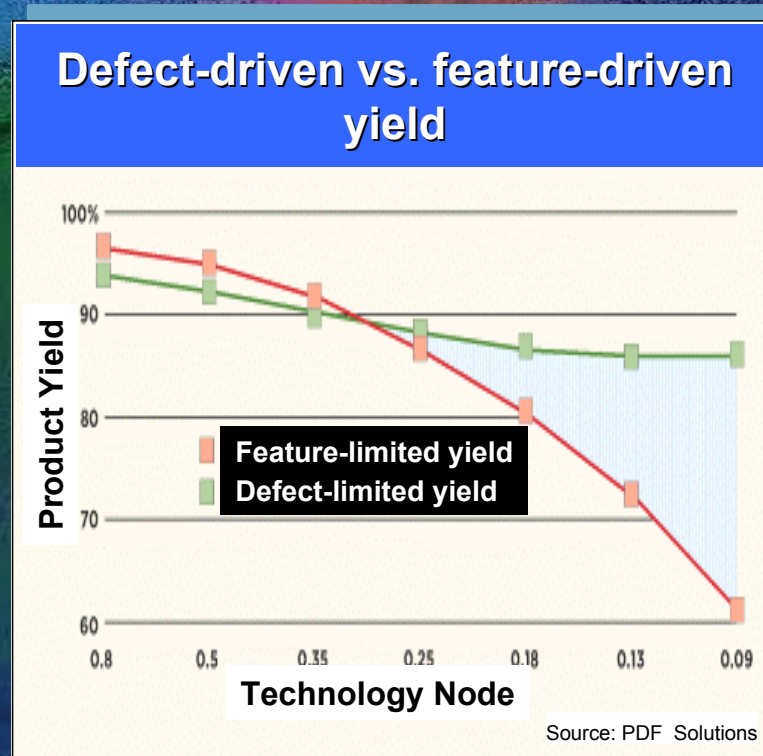
- OPC and other RETs used to compensate for sub-wavelength effects impact processing times, data volume and cycle times
- Lacking manufacturing impact models, RET is obligated to over “polish the bearing”



Litho Opportunities

- Design aware RET can reduce correction time and data volume
 - Ex.: timing slack allowances, pre-corrected blocks identified, feature purposes, . . .
- Design related geometry can improve manufacturing cycle-time and yield
 - Ex.: Full CD specificity, mask fault disposition, feature purposes, . . .
- Mfg. characterization models provide *correct-by* rather than *correct-after* construction design
- A method to access and explore complete design and manufacturing information is needed

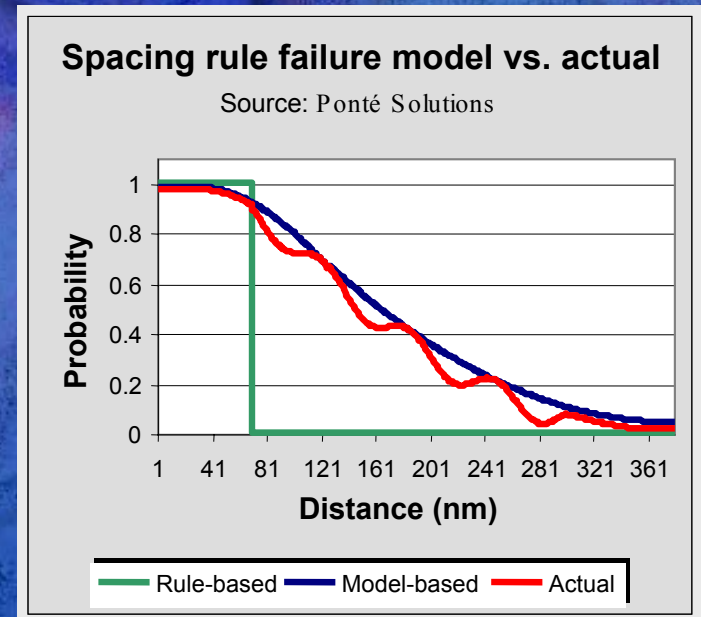
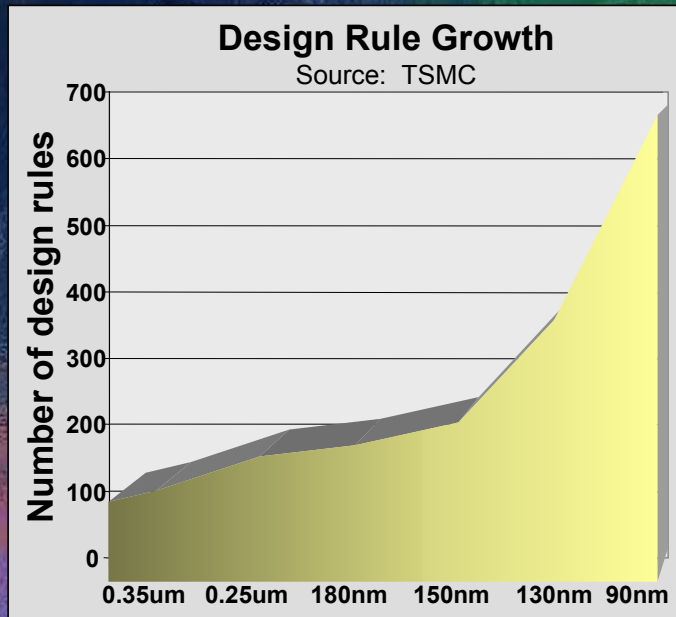
Yield Issue



- Increasingly, yield is becoming limited more by design features and parametrics
 - Product designer must now share responsibility for yield with fab manager

Current Methodology for Yield

- Binary DFM rules are used to characterize the analog mfg. process - and, do not reflect variation or probability
- Numerous and complex rules complicate and constrain the design



Yield Opportunities

- Model-based Mfg. process characterization provides:
 - Continuous statistical-view
 - Process variation
 - Product-driven design with predictable results
- But, the models must:
 - Be fab specific
 - Be available, accessible and usable
 - Protective of their intellectual property

The Opportunity

OpenAccess Technology

Open Standard

API

Common software interface

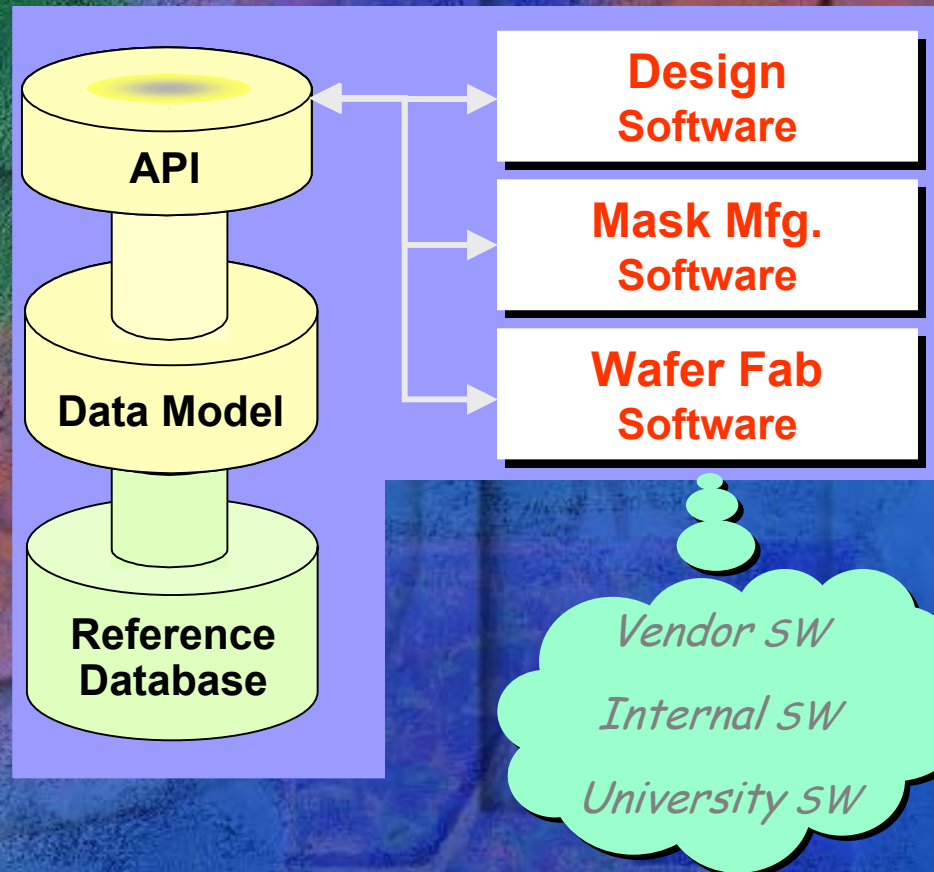
Data Model

Common definition of information

Reference Database

*Production quality database:
compliant and royalty-free*

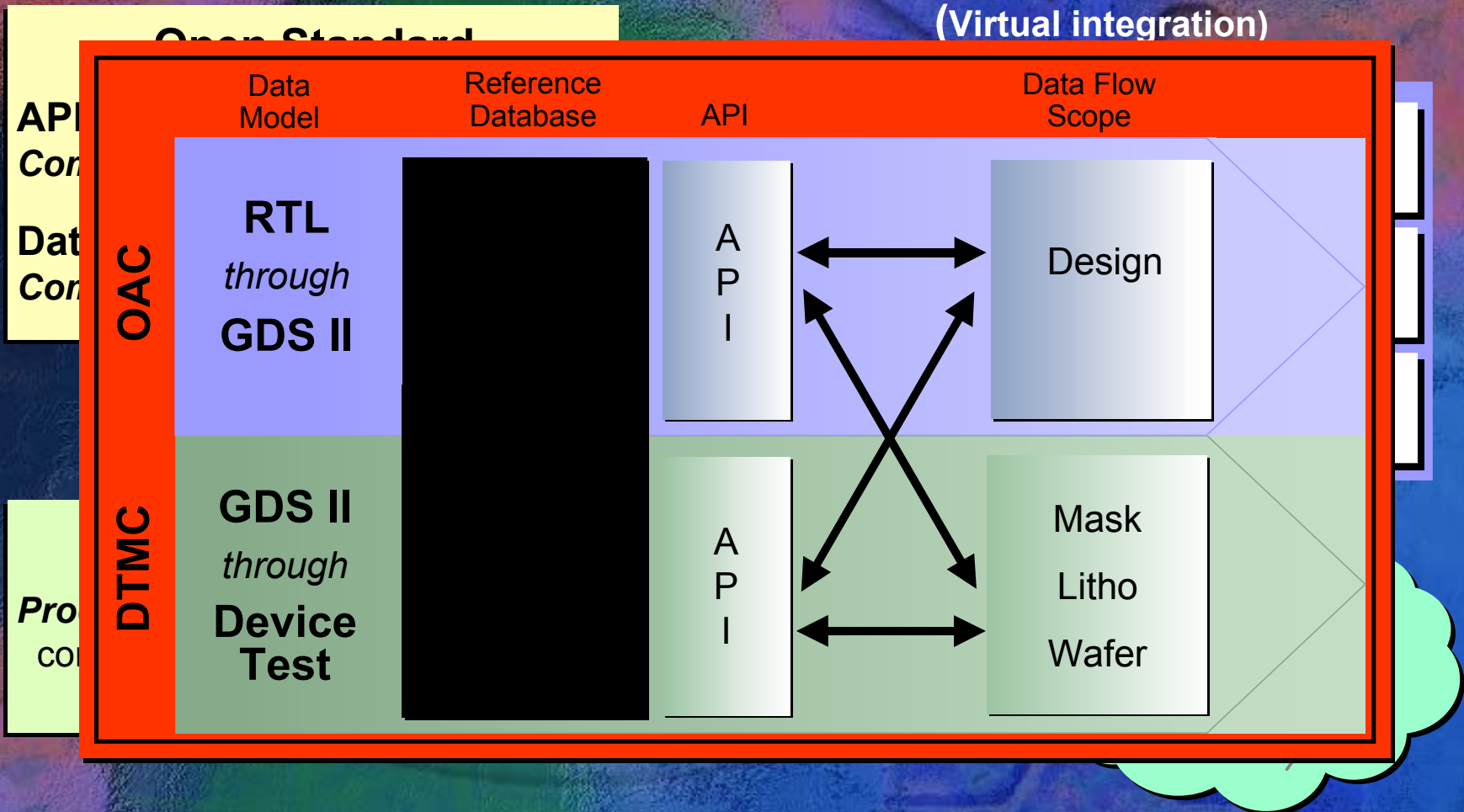
Adoption across the supply-chain (Virtual integration)



The Opportunity

OpenAccess Technology

Adoption across the supply-chain
(Virtual integration)



The Opportunity

OpenAccess Technology

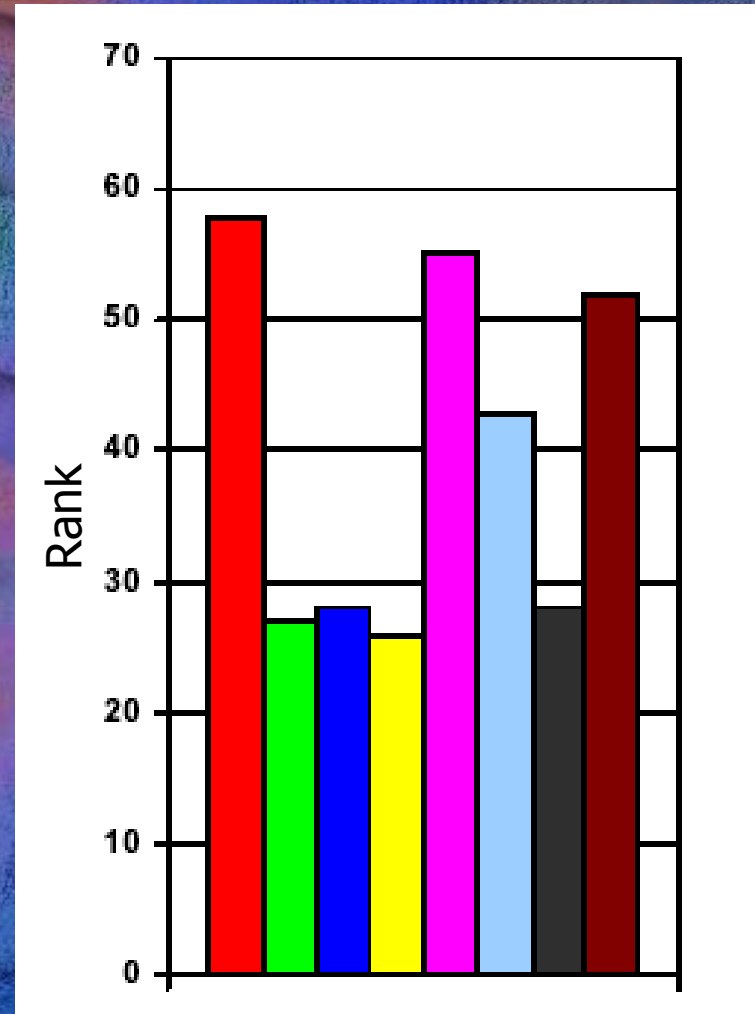
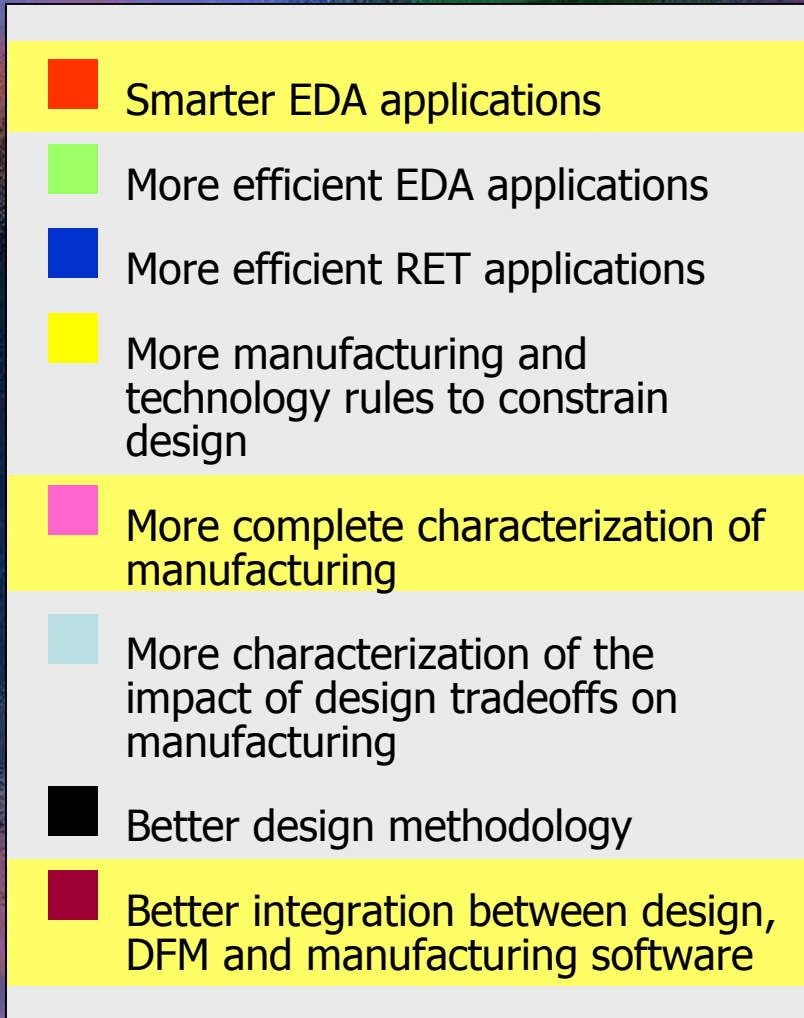
Adoption across the supply-chain

(Virtual integration)

- Direct access and consistent interpretation of required information
- Incremental operations
- Concurrent vs. Sequential flows
- Scalable infrastructure
- Facilitate research through private and secure data extensions
- Improved DFM technology transfer
- Secured data, protected models

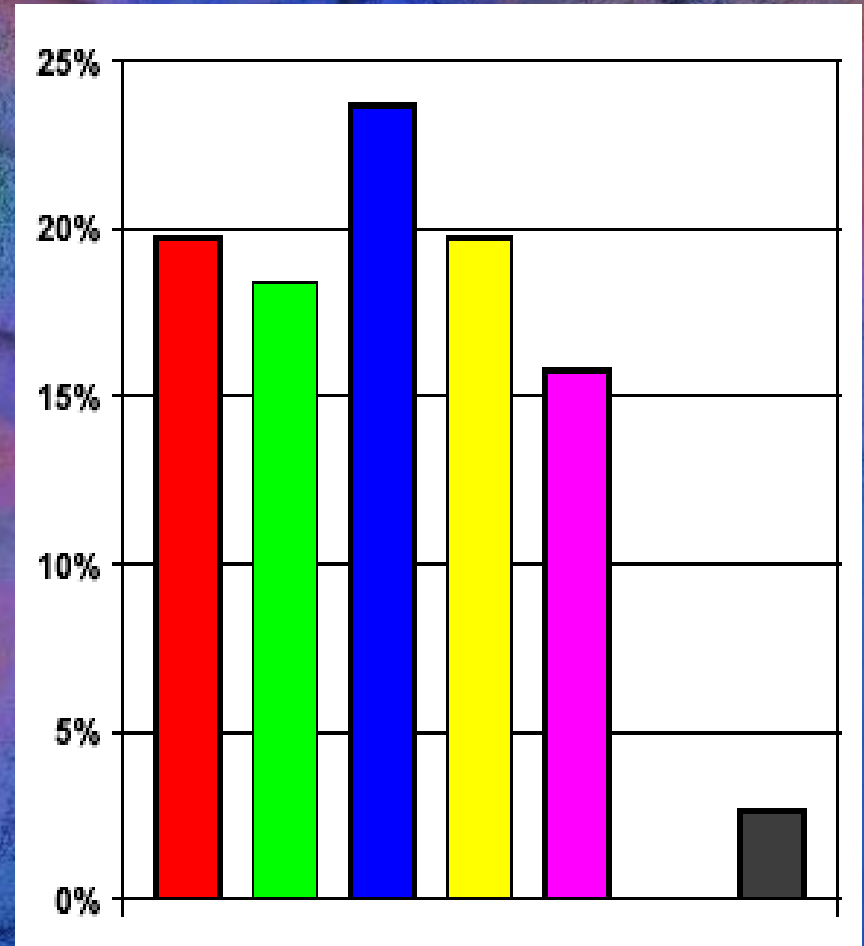
Industry Speaks

Rank how you feel your DFM issues are best solved



Industry Speaks

How do you feel non-competitive industry collaboration can best serve?



Obstacles

- Is the industry ready?
 - Supplier reluctance to expose yield
 - Customers view of supplier responsibility
- Open technology proven to reduce startups' development cost and TTM but:
 - Established players have greatest influence on change
- Industry players recognize need to change, but market positioning affects their actions

Design for Money

