YA-Prognostication on the future of IC Design

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Abstract

We are entering an interesting phase in the electronic systems business as complex integrated circuits become commodities. This has put enormous time-to-market and price pressures on the development and testing of IC components. The solution appears to be to globalize this effort much the same way we have done with the fabrication of these components.

IC Development Landscape

- The IC design industry is currently facing some very tough challenges. These include:
  - Time to $$$ pressures
  - NRE cost pressures
    - Eroding ASP as ICs become commodities.
  - Increasing complexity of design
    - Moore's Law – 2X number of transistors every 24 months
    - Hyper-integration: System-on-a-chip (SOC)
    - Productivity gap increasing
  - Increasing complexity and cost of manufacturing
  - Increasing segmentation of product lines
  - Increased heterogeneity of system/component design – DRAM, Flash, RF, MEMS, Software, etc.

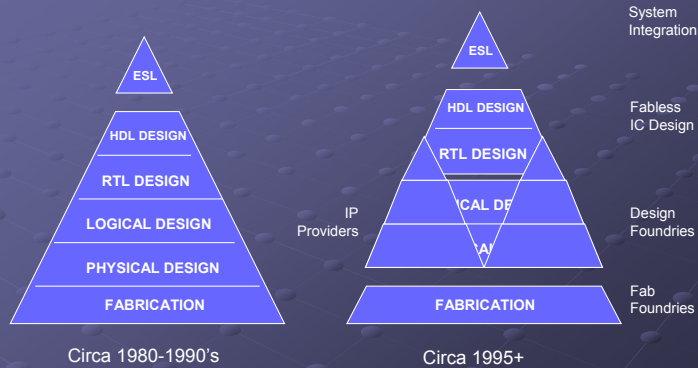## Solution Trends

- There a two distinct solutions to solve some of the IC development issues at this time:
  1) Globally disperse IC design teams to take advantage of inexpensive labor markets.
  2) Drastically improve productivity to keep up with and exceed Moore's law.
- The real solution may be a combination of both. The dilemma that existing IC companies face is how to find the correct balance and when to do it.
  - The "balance" has generally been determined by trial and error. This typically has a huge organizational impact and can be quite costly if not managed correctly.

The current stratification

Circa 1980-1990's

| ESL |
| HDL DESIGN |
| RTL DESIGN |
| LOGICAL DESIGN |
| PHYSICAL DESIGN |
| FABRICATION |

Circa 1995+

System Integration
Fabless IC Design
IP Providers
Design Foundries
Fab Foundries

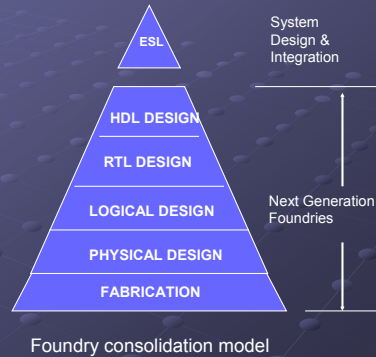| ESL |
| HDL DESIGN |
| RTL DESIGN |
| ...CAL DE... |
| ...A... |
| FABRICATION |

Given this changing landscape...

- Will we really need megalithic IC companies?
  - The answer to this may be playing out in the globalization push that is underway.
  - One thing that is obvious is that big companies have a huge problem globalizing quickly.
- Who does the "IC" design in the future?
  - Will the foundries reconsolidate and become SOC providers?
  - Will it be the system integrators riding the SOC bandwagon, utilizing design foundries & IP providers?
  - Perhaps the megaliths survive globalization?

What about foundries consolidating?

- There are a number of problems of having multiple foundries and IP providers.
  - Inefficient duplication of resources (across various geo-political boundaries).
  - Impedance mismatch between the different design and manufacturing systems.
  - Incompatible (legacy) missions.
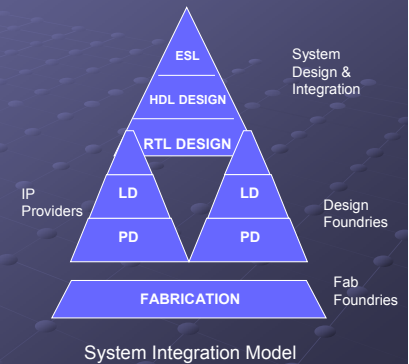- Consolidation will reduce overall costs and is a viable option.

System Design & Integration

Next Generation Foundries

| ESL |
| HDL DESIGN |
| RTL DESIGN |
| LOGICAL DESIGN |
| PHYSICAL DESIGN |
| FABRICATION |

Foundry consolidation model

Consolidation is unlikely!

- The reason will be IP protection.
  - Legal systems are not strong enough to support concerns over global IP protection.
  - Segmentation provides built-in IP protection of key algorithms and products.
  - The key will be to own & protect enough of the HW and SW "stack" to prevent ASP loss due to competition.

System Design & Integration
IP Providers
Design Foundries
Fab Foundries

| ESL |
| HDL DESIGN |
| RTL DESIGN |
| LD | | LD |
| PD | | PD |
| FABRICATION |

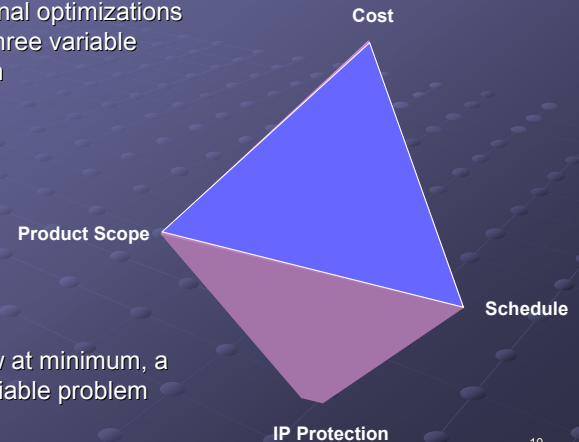System Integration Model

Segmentation issues

- If you accept the fact that the IC design ecosystem will remain segmented for the foreseeable future, then the challenges we face include:
  - Questionable IP protection.
  - Lack of a global collaboration infrastructure.
  - Lack of standardized technology models.
  - Lack of comprehensive product cost models.
  - Numerous economic, environmental and organizational issues.

- Making it challenging to simultaneously optimize:
  - System cost & TT$$$
  - System performance
  - System features

Put another way ...

- Traditional optimizations was a three variable problem

Cost

Product Scope

Schedule

IP Protection

- It is now at minimum, a four variable problem

Therefore ...

- We need to standardize, integrate and virtualize.
  - Standardization is needed to commoditize a product, a tool or a model.
    - Reduces impedance mismatches between various systems and processes.
  - Integration institutionalizes the key learning's into common platforms.
    - Knowledge management systems need to be in place
  - Virtualization provides the infrastructure for standardized platforms to globally support target environments.
- Currently there are few design system standards which support these features.
  - There are too many providers of design systems.
  - This will require the consolidation (commoditization) of the EDA vendors.

More on the economic issues ...

- These include:
  - Accurate cost models and ROI analysis capability to optimize global resources.
    - Standardized accounting mechanisms.
    - Comprehensive cost models for every level of abstraction.
  - Accurate technology models.
    - Needed for optimizing multiple design metrics.
- We also need to consider the organizational inefficiencies:
  - These cost real money and should be accounted for up front.
  - They get worse as we segment more.

More on the ....

- Organizational issues. These will consume us if we are not careful. Things like:
  - Lack of upper management commitment.
  - Unwillingness to risk crucial tasks at distant sites.
  - Goal variance between sites.
  - Mismatch of skill level at different sites.
  - Procedural confusion – lack of common processes.
  - Unfair treatment of sites (perceived or real).
  - Unclear of the advantage - "What's in it for me".
  - Remote sites going offline.
  - Poor communication skills: e-mail, tele-meetings, telephones, English as a second language, etc.
- ... will add enormous baggage to what we need to do.

Lest you forget ....

- The environmental component:
  - This can be summed up in one word: glocalization
    - glocalization (noun). The creation of products or services intended for the global market, but customized to suit the local culture.
  - Glocalization is "the ability of a culture, when it encounters other strong cultures, to absorb influences that naturally fit into and can enrich that culture, to resist those things that are truly alien and to compartmentalize those things that, while different, can nevertheless be enjoyed and celebrated as different."

The bottom line folks, is that ...

- We are globalizing whether we like it or not.
- Solve the IP issues before doing anything.
  - Then, solve the organizational and technical issues.
- Optimize the best way you can. The ability to change will be an advantage.
- We need to push for standardization. Without it, the IC design industry is at a disadvantage.
- Drive for consolidation of design systems.
  - We have too many for our own good at this time.
  - We need to push ESL technology harder.

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Haywood, M. (1998) Managing Virtual Teams: Practical Techniques for High-Technology Project Managers. Boston, MA: Artech House.

Lipnack, J. & J. Stamps (1997). Virtual Teams: Reaching Across Space, Time, and Organizations with Technology. New York, John Wiley and Sons, Inc.