Business of Formal

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Business of Formal: A Tale of Two Perspectives

User perspective (project manager, engineering VP)
- Need for bringing formal technology in verification flow
- Availability of resources to apply formal
- Return on investment

EDA vendor perspective
- What’s the right business model: products vs. services
- How to maximize the growth
- How to achieve, maintain, and increase profitability
Prerequisites for Positive Formal Verification ROI

• **Sufficient Potential Return**
  - Are the properties that can be proven / verified by the formal tool important enough to merit using formal?
  - Will the expected results provide an overall productivity gain and/or quality improvement?
  - Can complex bugs be exposed?

• **Predictable Resource Requirements**
  - Can expected results be achieved within a predictable timeframe, with specified resources?

Recipe for *Negative* Formal Verification ROI:

**Haphazard use of formal verification – where results are left to the “discretion” (i.e. limitations) of the tool**
Challenges in Building FV Market

<table>
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<th>Challenge</th>
<th>Description</th>
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<td>Early Formal Tools</td>
<td>Required Formal PhD Users</td>
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- Early Formal Tools: Required Formal PhD Users
- Effort: Low effort, low value solution
- Value: Raise Expectations
- Ideal Solution: Show Adoptability
EDA Startup Alternatives

Low-Cost, Low Value Solution

<$100K Value to Customer

High-Cost, High Value Solution

>$1M Value to Customer
The Bulls-eye Strategy

Customers receive highest possible value

Direct exposure to real-world customer problems clarifies product direction

Service methods, once documented, become methodology steps

Predictable methodology steps, validated by use, are made into tool features
The Bulls-eye Strategy: Product Evolution
Current Status of Acceptance of FV Technology: An Illustration

**Timeline**
- 2 years ago: FE(2)
- Today: FE(3)+DE(10)+DVE(10)
- 2 years later: FE(5)+DE(20)+DVE(20)

**Proliferation**
- Manager
- FE(2)
- FE(3)+DE(10)+DVE(10)
- FE(5)+DE(20)+DVE(20)

**P.O. Amount**
- $'
- $$$$
- $$$$$$$$

**Visibility**
- Manager
- VP
- Multiple VPs
How can Academia Help the Business of Formal

- Reduce barrier to acceptance by producing “formal” savvy engineers:
  - Incorporate components of formal application in the course/project work
  - Designing with right level of modularity, proper interfaces
  - Ability to think of systems in terms of properties

- Continue progress on the biggest Achilles heel for formal – lack of predictability of results
  - Need technology AND methodology to bring predictability in the process

- Enhance the “R” of ROI from formal
  - Domain specific (semi)-automated formal techniques
  - (Semi)-automated techniques for property decomposition
  - Robust and scalable ways to leverage simulation infrastructure in formal analysis
How can Industry Help the Academia

• Make commercial formal products available to universities for course and project work
  – Issues to overcome: trade secrets, cost of support

• Make real industrial data (testcase, testbench, VCD) available for academia to benchmark against (possibly through a consortium)
  – An impossible dream?

• Provide opportunities for students to get some hands on industrial formal experience (internship etc)