R&D cost improvement opportunity using quantitative benchmarking for a global semiconductor IDM

**Background**

**Client situation**
- A top-10 global semiconductor IDM
- R&D spend was higher than peers
- Management was unclear how to best address spending gap

**Engagement objectives**
- Identify root causes of higher R&D spend
- Prioritize “easy wins” to pursue first
- Quantify benefits of improvement initiatives

**Approach**

**Establish capability baseline**
- Measure R&D performance of teams on 3 recently completed IC development projects
- Select peers targeting same type of End Equipment Category, having similar complexity and analog content

**Root-cause analysis**
- Compared client’s projects to peer average and top quartile
- Normalized results based on design complexity
- Uncovered root causes of higher R&D spending

**Impact**

- Identified largest (26%) opportunity to reduce spending in validation
- Main issue: peers used end-to-end validation methodology while client used unit-level validation.
- Also identified opportunities in silicon respins and geographical consolidation of development

**R&D Cost impact**

- Original R&D cost: 100
- Optimized R&D cost: 74
- 26% reduction

McKinsey & Company
Performance benchmarking revealed that overall “efficiency” of Client’s projects was lower than peers.

- Project effort spent on Client projects is 1500 to 2300 person-weeks higher than the peer group, for projects of equivalent complexity.
- Project teams can generally process lower levels of complexity units with a given effort.

1 Peer group defined based on IC’s main functions, complexity levels, process technology, team sizes, percentage of analog/mixed signal content. The light blue band highlights a 50% confidence interval over the average value for the peer group.

SOURCE: First run of Numetrics analysis on Client projects
Further analysis revealed that most of the effort gap is in silicon validation.

Distribution of effort spent
Parentage of total effort

<table>
<thead>
<tr>
<th></th>
<th>From Start to Spec</th>
<th>From TOto Samples.</th>
<th>From Spec to Tapeout</th>
<th>From Eng to Prod</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Client project average</strong></td>
<td>2.4</td>
<td>32.9</td>
<td>18.7</td>
<td>46.0</td>
</tr>
<tr>
<td><strong>Peers</strong></td>
<td>4.4</td>
<td>47.8</td>
<td>18.7</td>
<td>29.1</td>
</tr>
</tbody>
</table>

Effort from Engineering Samples to End of Project
Percentage of effort spent

- **Silicon validation**: 44%
  - Client: 16%
  - Peers: 27%

- **Productization**: 24%
  - Client: 18%
  - Peers: 24%

- **Design verification**: 11%
  - Client: 14%
  - Peers: 11%

- **Digital Design**: 27%
  - Client: 9%
  - Peers: 6%

- **Physical Design**: 9%
  - Client: 2%
  - Peers: 7%

- **Management**: 7%
  - Client: 1%
  - Peers: 4%

- **Product Definition**: 4%
  - Client: 1%
  - Peers: 4%

- **Other**: 4%
  - Client: 1%
  - Peers: 4%

- +181%

1. Taken as an average representative case of the Client project set
2. Includes all the certification, qualification, characterization, production test etc. activities

**SOURCE:** First run of Numetrics analysis on Client projects

- **Client used nearly 3X peers’ silicon validation** effort due to unit-level rather than system-level validation methodology
Root-cause analysis showed the cause to be using more all-layer and less metal spins than peers.

- All-layer spins, as compared to metal ones, imply increase in cycle times and effort.

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Geographical distribution also impacted productivity, with projects spread across 3 more sites.

- Average number of development sites is 5 for Client projects, as compared to 2 for the peer group.
- Within the IC HW industry, the average impact of each additional development site is a 10% productivity loss.

**Comparison of geographical distribution of project development**

- Frequency (no. of projects in each bin): 5 (71%), 1 (14%), 1 (33%), 1 (33%), 1 (14%), 1 (33%).
- Number of geographic sites that comprise the team:
  - Project 1: 1 (14%), 1 (33%), 1 (33%), 1 (14%), 1 (33%)
  - Project 2: 1 (33%), 1 (14%), 1 (33%)
  - Project 3: 1 (33%), 1 (14%), 1 (33%)

1 Benchmark obtained out of >2000 IC projects Numetrics database

SOURCE: First run of Numetrics analysis on Client projects