Competitive Advantage through Commonality

March 2012

Dr. Bruce Cameron
bcameron@mit.edu
617-309-9270
Background

- Complex product offerings, leveraging designs across markets and pricing ranges, have become commonplace

- Complexity cost is indirect, difficult to identify, and sizeable
  - P&G valued unnecessary complexity at $3 Billion
  - Motorola valued unnecessary complexity at $2.4 Billion direct, $1.4 Billion inventory

- Platforming has become an important means of cost-sharing across industrial products:
  - Volkswagen’s A platform – VW Jetta, Audi TT, and Seat Toledo
  - Joint Strike Fighter program (variants for the Air Force, Marines, and Navy)
  - Black and Decker’s electric hand tools
Platforming ROI?

2012 MQB Platform

50% reduction in time to market
30% cost savings over previous platforms
Deploy engine technology and information platforms

Platform Strategy
- Scalable vehicle base
- Fixed design reference
- Modular engine design

Common Elements:
- Engine layout
- Drive architecture
- Information systems
- Suspension setup

Differentiation:
- Brands
- Markets
- Styling
- Option codes
- Etc.
Competitive Advantage

2012 MQB Platform

Very different system architectures
VW has many more brands under management
Time-to-market creates strong advantages
Commonality Benefits

Commonality: Sharing components or processes across products

Revenue Benefits
- Deploy new technologies
- Enter Niche Markets
- Reduced Time to Market

Cost Savings
(15-50% savings over individual products)

Enter Markets

Reduced Risk

Risk Benefits
- Lower technology risk
- Higher quality production
- Reduced downtime from sparing

Shared Development Cost
Common Testing Procedures
Production Economies of Scale
Amortized Fixed Costs
Reduced Inventory

Robertson 1998
We have worked on over 30 platforms

Honeywell

NASA
Business Jets
Automotive
Heavy Equipment
Rail Equipment
Communication Satellites
Commercial Aircraft
Semiconductor Manufacturing
# Market Variables

<table>
<thead>
<tr>
<th>Stable - Rail</th>
<th>Stability of Architecture</th>
<th>Changing – High Tech</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan for Commonality</td>
<td>Difficulty Planning</td>
<td></td>
</tr>
<tr>
<td>Low - Mining</td>
<td>Competition</td>
<td>High - Automotive</td>
</tr>
<tr>
<td>Difficulty Justifying</td>
<td></td>
<td>Higher Rewards</td>
</tr>
<tr>
<td>Customized - Rail</td>
<td>Customer Preferences</td>
<td>Stock – White Goods</td>
</tr>
<tr>
<td>Challenging</td>
<td></td>
<td>Easier Forecast</td>
</tr>
<tr>
<td>Low – Heavy Industry</td>
<td>Vertical Coordination</td>
<td>High - Automotive</td>
</tr>
<tr>
<td>Missing Visibility</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Internal Criteria for Commonality

Technically Feasible

Financially Beneficial

Organizationally Possible

Strong Commonality Strategies
## Management *Capabilities* for Commonality

<table>
<thead>
<tr>
<th>Capability</th>
<th>Technical</th>
<th>Financial</th>
<th>Organizational</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Choose a design strategy</td>
<td><em>Forecast commonality savings</em></td>
<td>Exclude segments in the market</td>
</tr>
<tr>
<td></td>
<td>Define the variants</td>
<td><em>Protect commonality premiums</em></td>
<td>Multi-product management</td>
</tr>
<tr>
<td></td>
<td>Enable over-functionality and performance compromises</td>
<td></td>
<td>Realize savings across departments</td>
</tr>
</tbody>
</table>


Which benefit is the largest?

**Dominated by Development Cost**
- Development Cost: Labor mobility?
- Manufacturing Cost: Shared Development, Shared Testing

**Dominated by Manufacturing Cost**
- Development Cost: Purchased
- Manufacturing Cost: Capital, Labor
- Capital: Shape of supplier price-volume curve?
- Labor: How broadly is overhead shared?
- How steep is the learning curve?

**Benefits**
- Bulk Purchasing
- Economies of scale
- Learning Curves

---

*MIT ESD* 
Massachusetts Institute of Technology 
Engineering Systems Division
Commonality Investments

<table>
<thead>
<tr>
<th>Platform</th>
<th>Premium</th>
<th>Max. Subsystem Premium</th>
<th>Variants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Equipment</td>
<td>25-50% ($1-2M)</td>
<td>50%</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(6-12% / variant)</td>
</tr>
<tr>
<td>Rail Equipment</td>
<td>29% ($X.6M)</td>
<td>100% (Software)</td>
<td>1-25 (?)</td>
</tr>
<tr>
<td>Vehicle Manufacturer</td>
<td>12% ($10M)</td>
<td>200% (Electrical)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3% / variant)</td>
</tr>
</tbody>
</table>
**Divergence: Platforms realize less commonality**

- **Strategy**: 80-90% parts commonality
- **Cost**: $233B Dev

- **Realized**: 30-40% parts commonality
- **Cost**: $350B Dev (150%)

- Phenomena is widespread across industries
- Most development programs were offset, lead variant tended to skew the platform’s needs
- Has significant consequences for investment return
Divergence Occurs, Has Costs

Example: Heavy Equipment Platform

- Divergence caused by variant addition
- Growth in purchased parts:
  - Materials cost grows by 2% (but compose ~80% of product cost)
  - Inventory cost grows by $2.7M

Total Impact: 2-5% of margin

Legend
- Direct Impact
- Indirect Impact
- No Impact
Why does Divergence happen?

Acceptable Reasons
- Market changed
- Technology progressed
- Learning during development

Unacceptable Reasons
- Failure to invest & define
- Variant sub-optimization
- Failure to see lifecycle benefit
- Intentional pursuit of uniqueness
Variant Sub-Optimization

Platform Perspective
- Reduced Engineering
- Bulk Purchasing
- Spread fixed costs

Variant Perspective
- Low: Recurring: Too expensive or over-designed
- Medium: Non-Recurring: Too many design iterations
- High: Performance compromise

Management Levers?
- Low: Financial transfers among variants
- Medium: R&D Cost Allocation
- High: Designation of platform authority
### Strategies for Commonality

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical</strong></td>
<td>Commonality Metrics</td>
<td>Risk valuation analysis</td>
</tr>
<tr>
<td></td>
<td>Tagging intended common</td>
<td></td>
</tr>
<tr>
<td><strong>Financial</strong></td>
<td><strong>Variant Impact Matrix</strong></td>
<td>New part introduction cost</td>
</tr>
<tr>
<td></td>
<td>Investment evaluation</td>
<td>Taxing non-common parts</td>
</tr>
<tr>
<td></td>
<td>Development cost allocation</td>
<td>Transfer pricing</td>
</tr>
<tr>
<td></td>
<td>Transparent cost supply chain</td>
<td>Investment pool for common parts</td>
</tr>
<tr>
<td></td>
<td>Production cost allocation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mandatory co-investment</td>
<td></td>
</tr>
<tr>
<td><strong>Organizational</strong></td>
<td>Commonality owners</td>
<td><strong>Variant ordering by volume</strong></td>
</tr>
<tr>
<td></td>
<td>Tiered parts control strategy</td>
<td>Contract strategy</td>
</tr>
<tr>
<td></td>
<td>Participation in design reviews</td>
<td>PnL aggregation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pooled funding</td>
</tr>
</tbody>
</table>

---

*MIT ESD*  
Massachusetts Institute of Technology  
Engineering Systems Division

15
## Variant Impact Matrix

<table>
<thead>
<tr>
<th>Product Lifecycle Phase</th>
<th>Variant 1</th>
<th>Variant 2</th>
<th>Variant 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Impact</td>
<td>Positive</td>
<td>Positive</td>
<td>No change</td>
</tr>
<tr>
<td>Development</td>
<td>More expensive ($0.5m)</td>
<td>More expensive ($0.5m)</td>
<td>More expensive ($1.2m)</td>
</tr>
<tr>
<td>Manufacture</td>
<td>Cheaper ($0.2m)</td>
<td>Cheaper ($0.2m)</td>
<td>More expensive ($2.0m)</td>
</tr>
<tr>
<td>Operations</td>
<td>Cheaper ($4.0m)</td>
<td>Cheaper ($3.2m)</td>
<td>More expensive ($10.0m)</td>
</tr>
<tr>
<td><strong>Total cost impact</strong></td>
<td>+$3.7m</td>
<td>+$2.9m</td>
<td>-$13.2m</td>
</tr>
</tbody>
</table>

This framework was rigorously executed at Lockheed Martin. The list of firms that have failed to bring this perspective is long.
Ordering of Variants - Automotive

Key Outcomes

Platform decisions were weighted towards SUV given greater analysis fidelity / larger teams

Platform Manager re-tasked after SUV Program design

Truck program allowed to ‘variant suboptimize’
Firms Oscillate on Commonality

Ford is a known example of alternation between: “heavyweight” programs and “world-car” attempts.
Platform Strategy Progression

Entrance:
- Parts proliferation
- Configuration complexity

Vehicle Man Family
Helicopter Launch

Platform Strategies
Increasing Commonality

High Cost Subsystems
Vehicle Man Subsystem
Rail Equip Running Gear

Exit:
Product line dominance
Unrealized investment

Requirements Negotiation and Lead Dominance
Rail Equip Launch
Divergence in platform launch
Premature Investment Evaluation

Variant Divergence & Niche Market Entry
Vehicle Man Launch
Heavy Equip Evolution

Parts proliferation
Configuration complexity

Growing Experience & Analogies

Commodity Strategies
Vehicle Man Steel
Automotive Commodities

Reuse Databases

Vehicle Man Low Complexity
Heavy Equip Low Complexity

White Goods

MIT ESD
Massachusetts Institute of Technology Engineering Systems Division
Commonality Management

- Platforming can be a source of competitive advantage
  - Results from firm-wide capabilities

- Management of commonality is a dynamic process throughout the product lifecycle
  - Divergence will occur and will need to be managed

- Successful commonality managers:
  - Create central responsibility for commonality
  - Understand the implications of platform cost structure
  - Make platform, not variant, decisions
  - Manage to commonality benefits, not to commonality percentages

Commonality: Sharing components or processes across products

- Enter Markets
- Cost Savings
- Reduced Risk

Divergence

Planning Product Lifecycle

Commonality (%) vs. time