National Science Foundation
Outsourced Product Design & Process Development Field Study: Preliminary Results

Edward G. Anderson  
*University of Texas  
Austin*

Alison Davis-Blake  
*University of Minnesota  
Minneapolis*

Geoffrey Parker  
*Tulane University  
New Orleans*

Research sponsored by National Science Foundation Grant SES-0323227  
April 2007
Motivation

• Large vertically integrated firms are disintegrating in favor of supply chains of specialists
  – But: widespread cost and quality disappointments (anecdotal)
• Case study at Hewlett-Packard, published in Production and Operations Management in 2002
• Studies on how to manage these networks are still immature, particularly w.r.t. engineering/technical projects
• Many have focused on the decision to outsource or not; less on how to make outsourcing work.
• National Science Foundation-sponsored field study begun in 2004
Role of Design in the Supply Chain

- 70% of total product lifecycle cost is determined during design and development (including process design) (Nevins & Whitney 1989)
- Overwhelming majority of supply chain programs concentrate on post-development activities (Closs & Stank 1999)
June 2006: The A380’s wiring literally comes up “short.”

- Fuselage sections designed in Hamburg were designed with a 2D CAD system
- Sections designed in Toulouse used a 3D system
June 14, 2006: Airbus announces delays due to Airbus 380 wiring harness redesign. 1/3 of EADS stock value is lost.
Playstation 3, November 30, 2006 (Bloomberg) Sony chief developer of PS3 replaced after delays announced because of parts shortages.
Increasing Exposure: Supply Chain Glitches Affect Value

**EXHIBIT 8**

**Long-Term Market Reaction**

**EXHIBIT 7**

**Six Most Cited Reasons for Glitches**

- Parts Shortage: -7.01
- Changes by Customers: -10.32
- Ramp-up/Roll-out Problems: -8.49
- Production Problems: -10.07
- Development Problems: -5.78
- Quality Problems: -6.02

NSF Field Study: Research Questions

1. What special challenges do firms face with outsourced product & process development?
2. What practices are used to cope with these challenges and how do these practices affect eventual outcomes (Benchmarking)?
3. What skills help project managers in managing outsourced development projects?

Note: “Outsourcing” for our purposes includes all supplier-lead development projects, not just those that were once done in-house
Partial Literature Review

- **Organizational Theory**
  - **Communication:** Allen (1977), Daft & Lengel (1986), Kogut & Zander (1992), Kusonoki et al. (1998), Sosa et al. (2002)

- **Supplier Selection**

- **Product Development**
Relationships Examined

**Controls**
Duration of Focal Firm Supplier Relationship,
Project Duration, No. of Employees, Project Engineer experience, Etc.

**Cultural Similarity Between Firms**
Shared First Language
Geographic Distance
Same Industry
Etc.

**Organizational Mechanisms**
Unify Purchasing & Engineering
Dedicated Personnel, Co-location
Information Systems
Media Richness & Frequency of Use
Modular Task Design
Etc.

**Coordination Tools**
Formal Project Mgt. Methodologies
Formal Quality Control Programs
Etc.

**Project Engineer Training**
Technical Skills (e.g. Product Integration)
Soft Skills (e.g. Communication, Negotiation)
Business Skills (e.g. Project Mgt., Case Analysis)
Etc.

**Project Outcomes at Launch/Completion**
Working Relationship
Quality (Good Parts, Reliability)
Functionality
Cost
Timing
Methodology

Field study interviewed managers of identified projects at each participant firm (structured interviews)

• Project managers answer questions like:
  – What issues were encountered (language, geography, industrial differences, differing goals, etc.)?
  – What methods were used to coordinate the project?
    • E.g. co-location, project mgt. tools like PERT, modular design, structured design tools like QFD etc.
  – Frequency and types of communications with the supplier
  – Education, background, and training (such as systems engineering, costing, or negotiations skills)
  – Various controls such as number of employees on project, length of project, etc.

• Pencil & paper instruments with standardized questions administered prior to interview
  – Their supervisors rate the success of each project vs. initial expectations on quality, performance/functionality, cost, timing, and overall working relationship
Data Collection timeline

- Initiate contact with a firm
  - Explain project and requirements
- Identify projects and respondents
- Sign non-disclosure agreements if necessary
- Schedule participants
- Collect data
- Stay in touch with newsletters
48 Projects in 18 Organizations Studied (data collection in progress)

Study Respondents (nerds like us)

<table>
<thead>
<tr>
<th>Bachelor's Degree</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Engineering</td>
<td>20.8%</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>18.8%</td>
</tr>
<tr>
<td>General/Other Engineering</td>
<td>14.6%</td>
</tr>
<tr>
<td>Computer Science</td>
<td>10.4%</td>
</tr>
<tr>
<td>BBA</td>
<td>8.3%</td>
</tr>
<tr>
<td>Other Bachelor's Degree</td>
<td>16.7%</td>
</tr>
<tr>
<td>None</td>
<td>10.4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Master's Degree</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA</td>
<td>12.5%</td>
</tr>
<tr>
<td>Engineering</td>
<td>16.7%</td>
</tr>
<tr>
<td>Other</td>
<td>4.2%</td>
</tr>
<tr>
<td>None</td>
<td>66.7%</td>
</tr>
</tbody>
</table>

N = 48 Project Engineers/Administrators

3 B.S. Engineers have MBAs
Preliminary Results

Outcomes, Coordination Tools, Organization, and Skills
Benchmarking: Outcomes

- Projects show a wide variety of success levels
- Relatively low correlation between outcomes
Benchmarking: Tools

Coordination Tools vs. Frequency of Usage

- Stage-gate project mgt. process*
- Overlapped design & mfg. development
- Pre-qualified supplier (e.g. ISO 9000)
- Project mgt. methodology (e.g. CPM, Microsoft Project)
- Formal engrg. design change process integrating supplier
- Formal mat'l's management & tracking process
- Quality control program (e.g. 6 sigma, TQM)
- QFD, DSM, or other structured design tool

N=48
*Question asked of only of most recent 23 projects surveyed
Regression results deleted

Please contact authors for up-to-date figures
Comments on Statistical Results: Tools

- Project management tools associated with more complex projects???
  - Conjecture: complex project management tools brought in when cost and time are of concern

- Tools’ effectiveness increases with more salient outcomes
  - Relationship is intangible
  - Quality often hard to measure until after project is launched
    - Quality programs and timing

- Tools have differential effects on outcomes
  - Quality programs, pre-qualified vendors, and QFD/DSM associated with different favorable outcomes
Interview Results: Organization

- More people needed for outsourced projects
  - Steep learning curve for organization and individuals
  - Burnout from travel & odd hours is a huge issue
  - Virtual integration vulnerable to personnel turnover
- Co-location seems to be a last ditch measure when project is at risk
  - But once established, it tends to be permanent
  - Staggers communication barriers … “Ugly American with an Asian face…”
- There are no high-tech “silver bullets” for outsourcing
  - Webex seems to be growing in popularity
  - Information systems are still usually just e-mail & Excel
    - Although shared computer-aided design (CAD) probably helps
    - Fax still used for complex data interchange
- Unifying purchasing and engineering thought to be beneficial from HP Case Study
- Software projects thought to be perhaps different because of better developed methodologies and approaches to modularity.
Benchmarking: Organization

Organizational Structures vs. Frequency of Usage

- Dedicated Personnel Within Lead Firm: 80%
- Dedicated Personnel Within Supplier Firm: 80%
- Joint Physical Meetings with Suppliers: 70%
- Shared Information System: 60%
- Modular Design to Reduce Communication: 40%
- Use of Industry Engineering Standards: 30%
- Unifying Purchasing and Engineering: 20%
- Co-location of Personnel at Supplier: 10%
- Co-location of Personnel at Lead Firm: 10%
- Videoconferencing: 0%

N=48
Regression results deleted

Please contact authors for up-to-date figures
Interview Results: Skills

- Broad and deep experience in the industry is seen as vital
  - Difficult to get in present-day, fragmented environment
- Most training is either sponsored by company or is “on-the-job”
  - Numerous complaints about cursory nature of company training
- Soft skills (persuasion, leadership, team-building skills) seem key according to most participants:
  - “It’s about getting people on the other side of the line...to like you and to sympathize with you, to do favors for you. I have a guy who’s really good at this. He’s about eight-tenths con-man. He’s got a lot of likeability and is just great at making you feel you have a friendship with him.”
  - “Some of our managers are on the banned list. They are not allowed to visit suppliers.
- Clarity of communication is crucial
  - “Managing by remote-control,” particularly with offshoring and via e-mail
  - Detecting when you’re misunderstood (“Monkey-proofing” ... really)
- Systems engineering at the university level is problematic
  - “I think schools do a horrible job at systems engineering. Product design is pretty good. Integration skills are almost completely lacking. The ability to integrate systems weeds out people who can be promoted versus those who cannot.”
Benchmarking—Skills/Training

Project Engineers with Formal Training in:

- Leadership
- Managing teams
- Project management (incl. software)
- Interpersonal communication
- Systems Engineering
- Estimating project costs
- Negotiations
- Legal issues
- Mediation or conflict resolution
- Business case analysis
- Design for manufacturing
- Manufacturing or service process analysis
- Information systems analysis/specification

N=48
Comments on Statistical Results: Skills

- Differential effects between university and company training
  - Project management, negotiation better at university
    - Numerous interview complaints about cursory company training in “soft skills”
  - Case analysis better at company
  - However, DFM & Communications are good at both levels

- Software projects seem to differ in some respects
  - University training in information systems analysis associated with better results in cost and worse results in working relationship, quality, and functionality
Regression results deleted

Please contact authors for up-to-date figures
Applications

- Core OM courses at BU, Georgia Tech, UT Austin, Tulane heavily influenced
- Opportunities for specialized courses
  - Designing and Managing Global Design
  - Entrepreneurial supply chain and product/process design
- Corporate training, selection, & career paths
Summary

• Outsourcing design, development, and manufacturing often has hidden challenges & costs
  – Software projects may present different challenges

• Successful outsourcing requires a number of organization structures, tools, and skills beyond what’s needed in house.
  – Different coordination mechanisms and tools help in different ways.
  – The promise of high-tech fixes is mostly as yet unfulfilled
  – There are no silver bullets.

• Training programs may need to change
  – Deep experience all around your industry is wonderful, when you can get it
  – Company and university-level courses may be differentially effective
    • University-level product integration training may need to be rethought

• People, and communicating with and relating to people, are the glue that holds your virtual organization together
  – Retention of effective outsourced project managers may prove to be a competitive advantage
Next Steps

• We’re still recruiting participants
  – To improve robustness of results and detect weaker relationships

• Refine statistical and qualitative findings
  – e.g. Does project management training help more when there is a language barrier?
  – Effect of controls on relationships?
Questions?

More information can be found at:

• pdoutsourcing.org
• EdAnderson.org
• ggparker.net
Keiretsus vs. Alliance Outsourcing

Why Keiretsus are different?

• Shared equity between buyer and supplier
• Suppliers often managed by former executives from buyer firm
• Decades-long relationships