The SCIP Software Industry Study

Avron Barr and Shirley Tessler
Stanford Computer Industry Project
http://www-scip.stanford.edu/scip/

SEPG ‘97
March 19, 1997
The Stanford University Computer Industry Project

- A. P. Sloan Foundation, Industry Studies
- SCIP’s Corporate Partners Program
  - Andersen Consulting
  - British Petroleum
  - Citibank
  - CMP Media
  - Daiwa Inst. of Research
  - EDS
  - Ernst & Young
  - Fujitsu Limited
  - Merrill Lynch
  - Microsoft
  - Montgomery Securities
  - Moore Corporation
  - Philips
  - Sumitomo Corporation
  - Symantec
  - Toshiba America
SCIP’s Research Initiatives — Investigating Trends and Issues

- IT in use — technology adoption
- Global IT services
- Information Age organizations
- Organization and strategy for rapid innovation in product management
- Networks
- Software
# The Software Industry Programming & Resultant Value Chain

<table>
<thead>
<tr>
<th>Worldwide Expenditures</th>
<th>Impact, Value</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Publishing</strong></td>
<td>$92B</td>
<td>Tools, Education, Entertainment</td>
</tr>
<tr>
<td><strong>Services</strong></td>
<td>$170B</td>
<td>25% of MIS?</td>
</tr>
<tr>
<td><strong>In-house/MIS</strong></td>
<td>$700B+</td>
<td>Productivity, Informed ops., Strategic apps.</td>
</tr>
<tr>
<td><strong>Embedded</strong></td>
<td>?</td>
<td>Functionality, Communication</td>
</tr>
</tbody>
</table>
SCIP Software Industry Study

‘93  Feigenbaum’s Study of the Japanese SW Industry: “Where’s the Walkman”

‘93-5 Interviews with 100 Industry “Insiders”
Structure, trends and critical issues

‘95-6 Pilot Survey on SW Product Management

‘96-7 The Impact of the Global Talent Shortage: On Software Projects, and On the Industry
Issues That Will Shape the Software Industry

- Intellectual property: patents, piracy
- Global competition and trade
- Consolidation, distribution & antitrust
- Software quality and systems failures
- Labor supply, immigration & education
- Technology: new markets & new tools
- Software project management practices
Software Product Management

Results of a Pilot Survey
Software Product Management

Issues Investigated

◆ Software Development Practices
  ● Team composition
  ● Engineering effort, technologies, quality

◆ Product Management Practices
  ● Release/project management
  ● Planning: formality, participants, horizon
  ● Time-to-market tradeoffs

◆ Corporate Style
  ● Decision-making, communication, outsourcing
  ● Balance between engineering and marketing
Software Product Management
Pilot Survey Design

- Focus on a particular recent release
- Survey pairs of team members
  - Marketing product manager
  - Engineering team leader
- One-hour questionnaires
- Follow-up interviews
- Firms in different segments
## Companies Surveyed—1995

<table>
<thead>
<tr>
<th></th>
<th>RDBMS</th>
<th>Call Center</th>
<th>Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Small $&lt;$10M</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Small $10-50M</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Large $&gt;$100M</td>
<td>3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6</td>
<td>5</td>
<td>11</td>
</tr>
</tbody>
</table>
Requirements Formulation Process

- How formal was the process used to determine the requirements for this release?
  - Long-term product line plan
  - Formal marketing requirements document
  - Informal, but before programming started
  - Continuously revised
Product Requirements Formulation

Requirements Formulation - Overall

- Long-Term Prod. Plan
- Formal Release Plan
- Informal release Plan
- Continuous Revision
Product Requirements Formulation: Different Perceptions

Engineering (11)

Marketing (8)

- Long-Term Prod. Plan
- Formal Release Plan
- Informal release Plan
- Continuous Revision
What would you do with 3 more weeks? Top Response

<table>
<thead>
<tr>
<th>Engineering</th>
<th>Marketing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing/QA</td>
<td>Functionality</td>
</tr>
<tr>
<td>36%</td>
<td>27%</td>
</tr>
<tr>
<td>More beta</td>
<td>Testing/QA</td>
</tr>
<tr>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Docs</td>
<td>More beta</td>
</tr>
<tr>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Functionality</td>
<td>Docs</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Fix bugs</td>
<td>Nothing</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Installer</td>
<td>Training</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Training</td>
<td>Performance</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Performance</td>
<td>Marketing</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Last Minute Changes

Last Stage When a Feature Can Be Added

- Before Alpha
- Before Beta
- Other

Last Stage When Feature Can Be Dropped

- Before GM
- Other
Decision-Making Style

- Consensus Mgmt.: 18%
- Senior Mgmt. Dominated: 27%
- Engineering Dominated: 55%

◆ Feedback from 1995 pilot incorporated
  ◆ shorter, more focused instrument
  ◆ more segments of industry included
    » products for business & technical users, consumers
◆ Web-based instrument tested
◆ Discussions with software process groups and other academic researchers
## Companies Surveyed

<table>
<thead>
<tr>
<th></th>
<th>Technical End User Mkt. (IT, Eng or Scientific)</th>
<th>Business End User Mkt.</th>
<th>Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small &lt;$20M</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Medium $20-200M</td>
<td>3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Large &gt;$200M</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
<td><strong>3</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>
Release Schedule Statistics

- 1 team on schedule (so far), 17 revised schedules
- Number of times schedule revised
  - Range: 1 time to “constantly”
  - Average: 3 times
- How late to market
  - Range: 1.5 to 12 months
  - Average: 4 months
Top 5 Reasons for Revision of Release Schedule

◆ Poor requirements specification
◆ Moved key people to other projects
◆ Quality problems
◆ Dependent on other internal projects
◆ Dependent on external partners
Q. Please describe briefly the reasons for the [release] delay:

- Dependent on external partners
- Quality problems
- Dependent on other internal projects
- Moved key people to other projects
- "Underscoping" (requirements)
Formality of Planning & Development Process

◆ Process methodology
  ◆ Small companies used formal methodologies
  ◆ Larger companies used internally developed methodologies
  ◆ 2/3 of respondents used something

◆ Planning
  ◆ Formal planning: 16
  ◆ No formal planning: 2
  ◆ Mostly informal planning beyond current release
Research Issues Arising From the Pilot Survey

- Life cycle planning vs. release planning
- Communication & decision making styles
- Addressing shortfalls in technical talent
  - Team management for focus
  - Managing external relationships
  - Aggressive recruiting and retraining
The Worldwide Supply of Software Labor
There is a Serious Shortage of Software Talent Worldwide

- The ITAA (1977) reports 190,000 open positions
- Reasons for the shortage:
  - Demand for SW may be growing non-linearly.
  - Interest in computing careers has declined.
- The rise in demand was masked for years by the growth of Indian software services and simultaneous massive downsizing in MIS, aerospace/defense and large computer firms.
- The situation will worsen and must be addressed in project planning.
Software is Not Easy

The Software Labor Pool — The Best are Significantly Better

“Not All Programmers Are Created Equal,” G. Edward Bryan, IEEE, 1994
Software Labor Shortages: Who’s Getting the Top Talent?

- Software start-ups & boutique services firms
- Software publishers
- R & D (corporate & university)
- VARs, consulting firms, systems integrators
- Software intensive industries (IBM, AT&T...)
- Aerospace systems firms
- Incidental embedded SW (GM, Boeing...)
- Corporate IS, application development
- DoD
- Federal, state & local government
Will Offshore Sources of Labor Meet Rising Demand?

Will other countries with underutilized engineering talent, as was the case in India, supply a larger percentage of the world’s software products and services needs in the future?
India: A Major Software Services Exporter

- Large supply of engineering talent
  - High quality technical education
  - High prestige for engineers
  - English language competence
  - Underutilized in domestic economy

- Movement towards more enlightened government policies

- Entrepreneurs created international business
  - Early growth as low-cost provider
  - Now, quality software delivered on time
## Country Comparison: Enabling Factors in Development of SW Export Industry

<table>
<thead>
<tr>
<th>Factor</th>
<th>India</th>
<th>Russia</th>
<th>E. Europe</th>
<th>Malaysia</th>
<th>Singapore</th>
<th>China</th>
<th>Japan</th>
<th>Israel</th>
<th>Ireland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good general engineering education system</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>●</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific software and systems training</td>
<td>+</td>
<td>●</td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large pool of capable programmers</td>
<td>+</td>
<td>+</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limited (non-IT) opportunities for engineers</td>
<td>+</td>
<td>+</td>
<td>●</td>
<td>●</td>
<td>● ● ●</td>
<td>● ● ●</td>
<td>● ●</td>
<td>● ●</td>
<td>● ● ●</td>
</tr>
<tr>
<td>English language competence</td>
<td>+</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>+</td>
<td>+ ●</td>
</tr>
<tr>
<td>Government policies or investment</td>
<td>+</td>
<td>●</td>
<td>+</td>
<td>+</td>
<td>●</td>
<td>●</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Communications infrastructure</td>
<td>+</td>
<td>●</td>
<td>+</td>
<td>+</td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Entrepreneurial know-how</td>
<td>+</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Foreign corporate investment</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>● ●</td>
<td>+</td>
</tr>
</tbody>
</table>

**Strong positive:** +  **Strong negative:** ●
What Can Be Done?

- Aggressive recruiting, training and retention of talent if your business depends on software
- Education initiatives to produce more SWE’s
- Private and public investment in retraining
- Explore certification of SW professionals
- Encourage immigration of qualified SWE’s
- Encourage research in software development technology and methodology
- Undertake detailed industry & labor censuses