“Soft” factors and software productivity - which ones matter?

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Outline

- Objectives
- Common subjective factors?
- Factors influencing productivity?
- How to use this knowledge?
- Conclusions
Factors influencing effort

- Size
- Productivity:
  - Quantitative: programming language, team size, business sector, user base, ...
  - Qualitative: team skills, user involvement, quality, ...
- Quantitative factors explain half the variation in effort
Data set (465 projects)

- Up to 17500 FP; median 320 FP
- 62% new, 33% enhancement
- 41% MIS, 33% transaction processing
- 68% are banking, government, insurance, manufacturing, utilities, business services
- 53% 3GL, 39% 4GL (30+ languages)
- 60% MF, 20% MR, 20% PC
Analysing subjective factors

- **Read factors, classify, count**
- **Statistics:**
  - Code each project for each soft factor:
    - Positive comment, negative, neither, both
  - Exclude inappropriate projects
  - Remove “outliers”, combine small groups
  - Normalise effort
  - Analysis of variance
## Normalising effort (% by phase)

<table>
<thead>
<tr>
<th></th>
<th>Plan</th>
<th>Spec</th>
<th>Build</th>
<th>Test</th>
<th>Impl</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dev team</strong></td>
<td>7</td>
<td>13</td>
<td>31</td>
<td>12</td>
<td>5</td>
<td>67</td>
</tr>
<tr>
<td><strong>Support</strong></td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>1</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td><strong>Users</strong></td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7</td>
<td>21</td>
<td>41</td>
<td>21</td>
<td>11</td>
<td>100</td>
</tr>
</tbody>
</table>
Outline

- Objectives
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Team skills/experience 54%

- Front end (analyst) 25%
- Back end (programmer/tester) 43%
- Experience in problem domain 12%
- Experience with application 14%
- Experience with env/tools 19%
Requirements

50%

- Completeness, clarity 17%
- Stability 15%
- Difficulty 11%
- Interfaces to other systems 8%
- Overhead, omissions 10%
Clients

- Involvement 34%
- Commitment 8%
- Experience 6%
- Communication, proximity 15%
**Methods**

- **Methodology** 11%
- **Particular techniques** 12%
- **Reuse** 8%
- **Rework** 5%
Environment 25 %

- Development/testing 9 %
- Tools 17 %
Team operation 24%

- Stability 6%
- Harmony, “team spirit” 6%
- Commitment 6%
- Organization / structure / size 14%
Importance

- Priority 5%
- Management commitment 9%
- Deadline 11%
Managers

- Experience 3%
- Management quality 6%

9%
Other 16%

- Third party
- Good base to start from
- Noisy workplace
- Building relocation
- Part of umbrella project
- ...

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Positive and negative comments

- Team experience
- Requirements
- Clients
- Methods
- Environment/tools
- Team operation
- Importance
- Management
- Other
What has changed in 6 years?

- Demographics have changed:
  - Broader industry base
  - New languages, applications
  - PC projects replace midrange projects

- Change in soft factors?
  Nothing!
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Factors influencing productivity

1 team size

2 context
   • organisation type, business area

3 development “platform”
   • language, DBMS, type of computer

4 team skills

? techniques; other soft factors ... (?)
Estimated PDR = 6.3 hrs/FP, plus the effects from the factors below

<table>
<thead>
<tr>
<th>Max team size</th>
<th>Organisation type</th>
<th>Language</th>
<th>Team skills</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>-3.1</td>
<td>-2.6</td>
<td>-1.1</td>
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<td>-2.1</td>
<td>0.0</td>
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<tr>
<td></td>
<td>0.9</td>
<td>-1.6</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>6.9</td>
<td>-1.3</td>
<td>0.8</td>
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<tr>
<td>Other [74]</td>
<td>-0.6</td>
<td>SQL [18]</td>
<td>-0.9</td>
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<tr>
<td></td>
<td>-0.4</td>
<td>Natural [40]</td>
<td>-0.1</td>
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<tr>
<td>1.0</td>
<td>Community services [9]</td>
<td>Misc 4GL [33]</td>
<td>0.0</td>
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<tr>
<td></td>
<td>1.8</td>
<td>Cobol II [37]</td>
<td>0.3</td>
</tr>
<tr>
<td>Banking [53]</td>
<td>5.8</td>
<td>Telon [10]</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Easytrieve [9]</td>
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<td></td>
<td>Unknown [8]</td>
<td>0.9</td>
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<td></td>
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<td>PL/I [28]</td>
<td>1.1</td>
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<tr>
<td></td>
<td>Cobol [53]</td>
<td>1.5</td>
<td></td>
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<tr>
<td></td>
<td>C [14]</td>
<td>1.7</td>
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<tr>
<td></td>
<td>Smalltalk [13]</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C++ [12]</td>
<td>8.1</td>
<td></td>
</tr>
</tbody>
</table>
## Estimating effort

<table>
<thead>
<tr>
<th>Model</th>
<th>$R^2$</th>
<th>MMRE</th>
<th>$P(.50)$</th>
<th>Mean $\mid error\mid$ in PDR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>0.48</td>
<td>1.22</td>
<td>0.44</td>
<td>4.86</td>
</tr>
<tr>
<td>Size, team size, org type, language, team skill</td>
<td>0.69</td>
<td>0.79</td>
<td>0.58</td>
<td>3.82</td>
</tr>
</tbody>
</table>
Other factors (?)

- quality of requirements: -1.8 to 0.1
- use of prototyping: -0.1 to 0.5
- relationship with client: -1.5 to 2.1
- environment/tools: -0.3 to 1.4
Outline

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Observations

- **Limits:** 2,000FP 13,000 hours
- Estimates poor
  - Initial ball-park; use other methods also
  - Factors identified are all known early
    - Accuracy comparable to other methods
  - Most factors affect PDR by ± 20%
Conclusions

• Industry evolves, but soft factors stay same

• Key soft factors:
  • developers, requirements, clients

• Impact on productivity:
  • small (with weak information)
  • adding more factors ("cost drivers") no help for estimation