IMPROVE ESTIMATION MATURITY

using Functional Size Measurement and Industry Data
INTRODUCING ME

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- **International Software Benchmarking Standards Group (ISBSG)** – President
- **Netherlands Software Metrics Association (NESMA)** – board member and chairman of the working groups 'Benchmarking' and ‘FPA in contracting’
- **Common Software Measurement International Consortium (COSMIC)** – Dutch representative in the International Advisory Council (IAC)
- **Dutch Association for Cost Engineers (DACE)** – working group parametric analysis
- **ICEAA trainer of CEBoK chapter 12**: Software Cost Estimation
- Speaker at many conferences on software measurement, estimation and benchmarking

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OVERVIEW

• Industry estimation maturity
• Effect of low maturity
• Maturity levels
• Function Point Analysis (FPA)
• Estimate with FPA
• Historical data
• Use in the industry
SOFTWARE PROJECT RESULTS

<table>
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<th>MODERN RESOLUTION FOR ALL PROJECTS</th>
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<th>2013</th>
<th>2014</th>
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<td>SUCCESSFUL</td>
<td>29%</td>
<td>27%</td>
<td>31%</td>
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<td>50%</td>
<td>50%</td>
<td>55%</td>
<td>52%</td>
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<td>FAILED</td>
<td>22%</td>
<td>17%</td>
<td>19%</td>
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The Modern Resolution (OnTime, OnBudget, with a satisfactory result) of all software projects from FY2011-2015 within the new CHAC3 database. Please note that for the rest of this report CHAC3 Resolution will refer to the Modern Resolution definition, not the Traditional Resolution definition.
As can be seen, schedule delays and cancelled projects are distressingly common among all forms of software in 2016. This explains why software is viewed by most CEO's as the least competent and least professional form of engineering of the current business world.

### Table 1: Outcomes of U.S. Software Projects Circa 2016

<table>
<thead>
<tr>
<th>Application Types</th>
<th>On-time</th>
<th>Late</th>
<th>Canceled</th>
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<tr>
<td>1 Scientific</td>
<td>68.00%</td>
<td>20.00%</td>
<td>12.00%</td>
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<tr>
<td>2 Smart phones</td>
<td>67.00%</td>
<td>19.00%</td>
<td>14.00%</td>
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<tr>
<td>3 Open source</td>
<td>63.00%</td>
<td>36.00%</td>
<td>7.00%</td>
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<tr>
<td>4 U.S. outsource</td>
<td>60.00%</td>
<td>30.00%</td>
<td>10.00%</td>
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<tr>
<td>5 Cloud</td>
<td>59.00%</td>
<td>29.00%</td>
<td>12.00%</td>
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<tr>
<td>6 Web applications</td>
<td>55.00%</td>
<td>30.00%</td>
<td>15.00%</td>
</tr>
<tr>
<td>7 Games and entertainment</td>
<td>54.00%</td>
<td>36.00%</td>
<td>10.00%</td>
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<tr>
<td>8 Offshore outsource</td>
<td>48.00%</td>
<td>37.00%</td>
<td>15.00%</td>
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<tr>
<td>9 Embedded software</td>
<td>47.00%</td>
<td>33.00%</td>
<td>20.00%</td>
</tr>
<tr>
<td>10 Systems and middleware</td>
<td>45.00%</td>
<td>45.00%</td>
<td>10.00%</td>
</tr>
<tr>
<td>11 Information technology (IT)</td>
<td>45.00%</td>
<td>40.00%</td>
<td>15.00%</td>
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<tr>
<td>12 Commercial</td>
<td>44.00%</td>
<td>41.00%</td>
<td>15.00%</td>
</tr>
<tr>
<td>13 Military and defense</td>
<td>40.00%</td>
<td>45.00%</td>
<td>15.00%</td>
</tr>
<tr>
<td>14 Legacy renovation</td>
<td>30.00%</td>
<td>55.00%</td>
<td>15.00%</td>
</tr>
<tr>
<td>15 Civilian government</td>
<td>27.00%</td>
<td>63.00%</td>
<td>10.00%</td>
</tr>
<tr>
<td>Total Applications</td>
<td>50.13%</td>
<td>37.27%</td>
<td>13.00%</td>
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</table>

Source: Capers Jones
IMPACT

- Deliver too late: losing business.
- Fail/stop: loss of time, money, business and still no solution for the problem that needed to be solved.
- Waste of resources that could have been deployed successfully otherwise.

Failing IT projects cost the Dutch government 7 billion USD per year

Projects > 10 million USD only 7% succeeds.

In total, only 30% of IT projects are successful.

These are tax dollars and one of the reasons the whole country was in recession for years.
LOW INDUSTRY MATURITY IN PERFORMANCE MEASUREMENT

• Software industry: low maturity in performance measurement
  • Performance Measurement processes are not targeted to software development and/or maintenance. Mostly financial metrics are used to measure performance.
  • Organizations don’t know the size of their applications and of their software portfolio.
  • Organizations don’t know how if the cost spent on AD and AM is in line with industry averages.
  • Organizations don’t know their productivity.
  • Organizations don’t know their time-to-market.
  • Organizations don’t know their cost efficiency.
  • Organizations don’t know the quality of their software products.

• Result: Organizations don’t know their capability compared to industry peers when it comes to productivity, time-to-market, cost efficiency and quality. They are not able to understand where they need to improve and not able to control process improvement.

• But Application Development is becoming more and more important for organizations as delivering new software functionality fast becomes more and more a driver for business. Increasing performance is sometimes crucial for survival!
SOFTWARE ESTIMATION MATURITY

- **Software industry: low maturity**
  - Low estimation maturity
  - No or little formal estimation processes → ‘expert estimates’
  - No or little use of historical data → ‘experience’
  - Customers chose suppliers based on price, not reality
    - Immature project estimation techniques results in low estimates
    - Unrealistic optimism results often in complete failure!

- **Lots of schedule and cost overruns**
  - Standish Chaos reports: Many projects fail or are at least unsuccessful
  - No learning of mistaken, failing over and over again

- **Low customer satisfaction rates**
  - In Europe: only slightly higher than the financial sector
RESULTS OF LOW ESTIMATION MATURITY

• Many projects are not estimated in a professional way
  • Only expert estimates, no use of estimation models / historical data

• Underestimation results in bad planning
  • Development team too small
  • Duration too short
  • Unrealistic milestones
  • Project management with no grip on the project
  • Extra management attention, more meetings
  • Stress in the team → bad quality → more effort
  • Bad software, low maintainability, hard and costly to adapt to the changing world.
ESTIMATION MATURITY MODEL*

- **Level 0**: Informal or no estimating.
- **Level 1**: Direct Task Estimation, Spreadsheets, Ad Hoc Process.
- **Level 2**: Formal Sizing (e.g., function points), Simple model (Size * Productivity), Some measurement & analysis, Informal Process.
- **Level 3**: Formal Sizing, Direct Task Estimation, Estimate vs. actual capture, Rigorous measurement & analysis, Parametric planning & Control, repeatable process.
- **Level 4**: Formal sizing, Repeatable process, Robust parametric estimating, Rigorous measurement & analysis, Parametric estimation with tracking & control, Process improvement via lessons learned.
- **Level 5**: Formal sizing, Repeatable process, Robust parametric estimating, Rigorous measurement & analysis, Parametric estimation with tracking & control, Continuous process improvement.

95% of the industry

Majority of software projects are not mitigated for bias, resulting in optimistic estimates.

Estimation Bias Mitigation Begins at Level 2, Solid at Level 3
REALISTIC ESTIMATES

A realistic estimate is one of the most important conditions for a successful project.

The estimate is the basis for:

- Business case;
- Planning;
- Proposal (outsourcing: fixed price / date);
- Financial result of the project... and the organization;
- Claiming and releasing of resources;
- Alignment between IT and business / customer;
- Progress reports / dashboards;
- The feeling of the team and the stakeholder.

Without a realistic estimate, the project is likely to fail!
Non-linear extra costs
- Planning errors
- Team enlargement \( \rightarrow \) more expensive, not faster
- Extra management attention / overhead
- Stress: More defects, lower maintainability !!

Linear extra costs
Extra hours will be used
LEVEL 1 AND 2 ESTIMATES: HUMAN (EXPERT) ESTIMATES

- Bottom-up, assign effort hours to work items, based on expert knowledge and experience
- Humans are optimistic! Always! Even when they know they are!

**Result:** expert estimates are optimistic, on average 30% underestimation.

**Disadvantages:**
- Forgotten activities (e.g. testscript reviews, ...);
- No good foundation of the estimate, very subjective, not based on data;
- ‘Easy’ to push back: ‘That’s too expensive. Can’t you do it faster?’
- The expert is not going to do all the work (who will?);
- How expert is the expert? (projects are unique);
- Experts don’t take into account duration, team size, etc.;
- Experts don’t assess the reality value, no real use of history.
TWO WAYS TO ESTIMATE

Objective

Size

Effort

Cost

Estimating & Benchmarking

Level 1 and 2

Level 3, 4 and 5

IT CONFIDENCE, LOS ANGELES (USA) SEPTEMBER 2016
OVERVIEW

- Parametric Estimates Level 3-5
- Optimism
- Pessimism

Additional Costs

0% to 100%

Low Estimates  Realistic Estimates  High Estimates
FUNCTIONAL SIZE

- What the software should be able to do (functionality) expressed in a number based on an objectively described method
- ISO/IEC 14143
- Something intangible like functionality becomes a physical number that can be used for calculation

ISO/IEC 24570:2005
ISO/IEC 20926:2009
FPA PRINCIPLES
FUNCTION POINT ANALYSIS (FPA)

• Can be used early in the project, when functional requirements are known

• Independent of technical implementation. 500 FP Mobile app = 500 FP Legacy Cobol system
  • Just as a 20 m² glass wall = 20 m² brick wall
  • Effort to realize the software depends on productivity
  • Cost depends on productivity and labor rates.

• Independent of the systems requirements

• **Objective, verifiable, repeatable, defensible measurement !!**

• More function points means more functionality: value!

• Functional size is the basis for **objective software metrics:**
  • **Productivity** (Hours spend per FP)
  • **Cost Efficiency** (Money spend per FP)
  • **Time to Market** (FP per calendar month)
  • **Quality** (Defects per 1000 FP)
BASIC ESTIMATION MODEL

- Functional size (FP)
- Productivity (h/FP)
- hours/cost (provisional)
- Influences
- hours/cost (attuned)
- Risk analysis
  - Risks
  - Measures
  - Consequences
Time vs Cost

- Paul Masson’s Law
- Parkinson’s Law
- Brooks’ Law

Realistic

Effort / Cost

Minimal time
Optimal effort
Productivity

Time

ISBSG
The global and independent source of data and analysis for the IT industry
Larger team size means lower overall productivity.

Adding people to a late project only makes the project later.
OVERVIEW

Effort or Cost

Duration

Impossible zone

Minimal duration / highest effort and cost

Realistic zone

Optimal duration / lowest effort and cost

Impractical zone
HISTORICAL DATA

- Parametric estimation models need historical data to estimate
- Preferred for estimation: data of the company itself
- For new types of projects or no data available: Industry data can be used

Sources of industry data:
- Data delivered with the parametric models, e.g.
  - SEER-SEM: knowledge bases
  - QSM SLIM: trendlines based on slocs or FP
- Data provided by Benchmarking suppliers (METRI, Gartner, DCG, etc.)
- Independent data (International Software Benchmarking Standards Group)
INTERNATIONAL SOFTWARE BENCHMARKING STANDARDS GROUP

• Independent and not-for-profit;

• Full Members are non-profit organizations, like NESMA, IFPUG, Beijing Kexin Science and Technology Ltd, JFPEG, GUFPI-ISMA, FiSMA, QESP, DASMA, China SPI and Swiss-ICT.

• Grows and exploits two open repositories of software data (.xls):
  • New development projects and enhancements (> 7500 projects);
  • Maintenance and support (> 1200 applications).

• Everybody can submit project data
  • Questionnaire on the site / on request (.xls) / online
  • Anonymous
  • Free benchmark report in return
OVERVIEW

>7500 rows in Excel, Easy to analyze.

>250 data fields per project

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<tr>
<th>ISBSG Project ID</th>
<th>Data Quality Rating</th>
<th>UF rating</th>
<th>Year of Project</th>
<th>Industry Sector</th>
<th>Organisation Type</th>
<th>Application Group</th>
<th>Application Type</th>
<th>Development Type</th>
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http://isbsg.org/project-data/
EXAMPLE

- Data Quality: A or B
- Year of Project > 2012
- Project Type: Enhancement
- Primary Programming language: Java
- Count approach: Nesma or IFPUG

- Further refinement, for instance:
  - Size category
  - Methodology
  - Industry
  - Application type
  - Team size
  - Time pressure (duration)
  - ...

<table>
<thead>
<tr>
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<th>PDR (hours/FP)</th>
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<td>Number of projects</td>
<td>166</td>
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<tr>
<td>Minimum</td>
<td>4,2</td>
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<tr>
<td>Percentile 10%</td>
<td>5,3</td>
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<tr>
<td>Percentile 25%</td>
<td>6,8</td>
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<tr>
<td>Median</td>
<td>7,8</td>
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<td>Percentile 75%</td>
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<td>Percentile 90%</td>
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<tr>
<td>Maximum</td>
<td>15,3</td>
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<tr>
<td>Average</td>
<td>7,9</td>
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Example: 500 FP Java project ROM Estimate

**Reality Zone:**
Low (P25): 500 * 6,8 = 3400 hours
Likely(Median): 500 * 7,8 = 3900 hours
High (P75): 500 * 9,4 = 4700 hours
PARAMETRIC ESTIMATION IN PRACTICE

• Parametric Estimation is carried out by a number of ‘more mature’ organizations:
  • Global software service providers, e.g. HP, IBM, Capgemini, Sogeti, HCL, TechM, et cetera. They need to understand their capabilities and to be able to estimate fixed price/fixed duration projects accurately.
  • ‘More mature’ companies and governments that have implemented an ‘Estimate and Performance Measurement’ or ‘Supplier Performance Measurement’ process in order to understand their (and their suppliers’) capabilities in order to improve, e.g. many banks, governments, insurance companies, telecom providers.

• Agile project estimation is still needed! Measure the functional size of the backlog and estimate which functionality will be ready at which point in time.

• Next to estimating, performance measurement and benchmarking of completed projects is another main advantage of measuring functional size.

• Use Price/FP in contracting reduces the risk of failures significantly:
  • The supplier takes the risk for the price and gets an incentive if he improves productivity (higher margin)
  • The customer takes the risk for the scope of the project.
Project Success rate >80%
<3% cancelled projects
Productivity increase
Cost decrease
Quality increase
Happy staff
More business value! Corporate success!!
THANK YOU!

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@haroldveendam

haroldveendam

ISBSG: www.isbsg.org
Nesma: www.nesma.org
METRI: www.metrigroup.com