Effort-based Re-estimation During Software Projects

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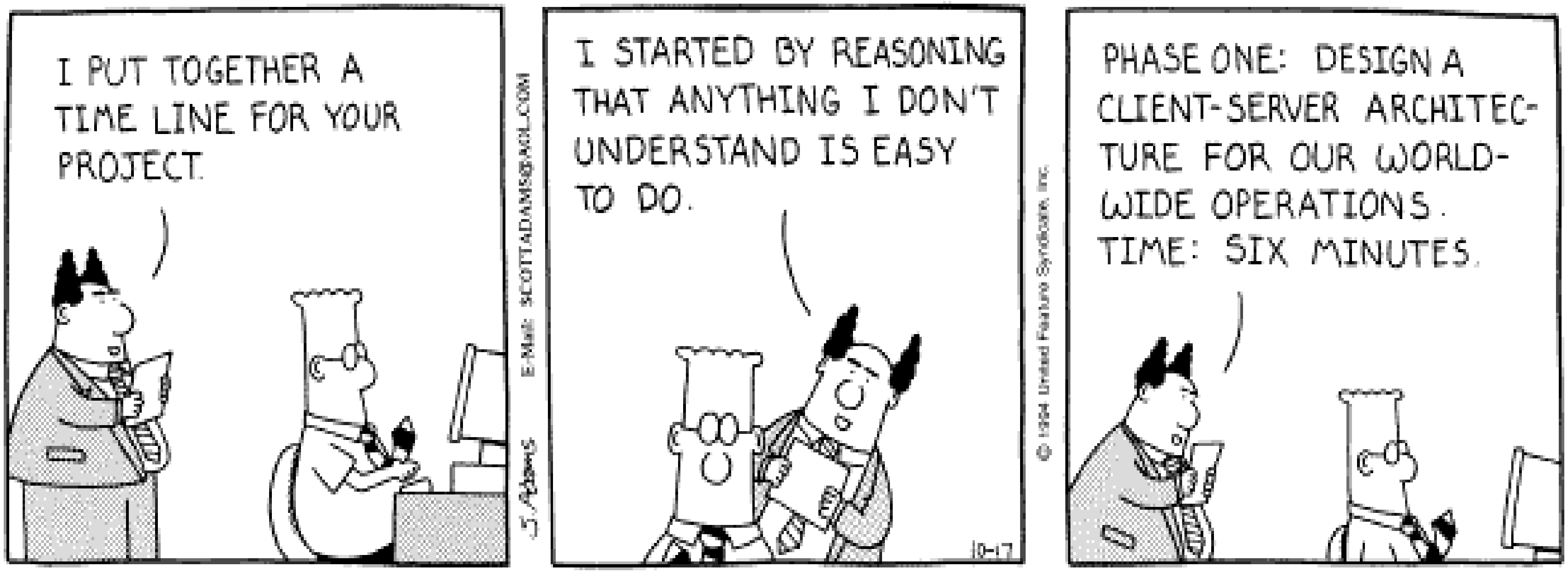
Agenda

- Rationale for re-estimation
- Industry data and analysis approach
- Results of analysis to date
- Outcomes and limitations
- Conclusions and next steps
- Preliminary insights…

Rationale and background

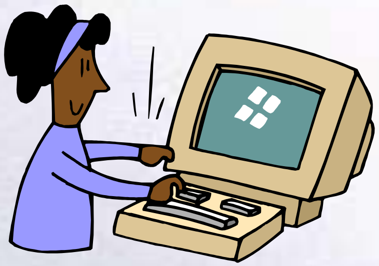
- Accurate estimation is a challenge!
  - Estimation is not (always) rational
  - Managers tend to be optimists
  - There has been a reluctance to move from early estimates
  - Global models, built based on unstable product factors, are widely used

Rationale and background
(ctd)

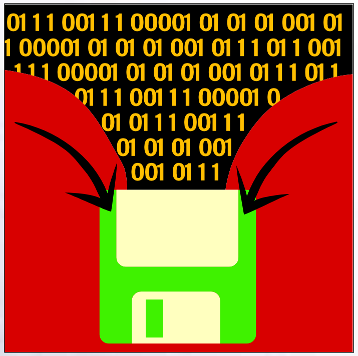


Rationale and background (ctd)

- Alternatively we could (should?):
  - Use local models, based on process/resource factors
  - Harness growing certainty in data
  - Leverage managers' expertise
  - Compare with the plan during (not just after) the project and then re-estimate

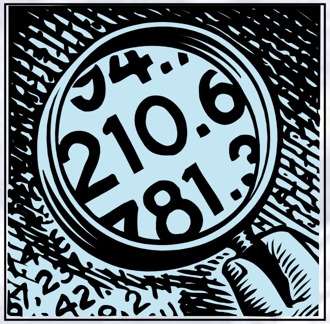


Industry data set



- We had access to one data set:
  - Software developed for a large test equipment manufacturer
  - Single organisation, multi-national
  - Sixteen development projects over an 18 month period
  - Effort range: 500-7800 person-hours
  - Consistency in technology, process, people

Industry data set (ctd)



- For each of the sixteen projects:
  - Effort for each phase had an original estimate (OE) and many had an adjusted, current estimate (CE)
  - Actual effort expended was also recorded at the project phase level
  - There was high confidence in the accuracy of the recorded effort data

Feasibility analysis

- Waterfall-like process, dominated by planning (PP), design (DES), implementation (IMP) and testing (TEST)
- Model fitting of effort per phase based mainly on process measures using least-squares linear regression
- *Note:* the entire data set was used – main aim was to assess feasibility

Model fitting of effort per phase

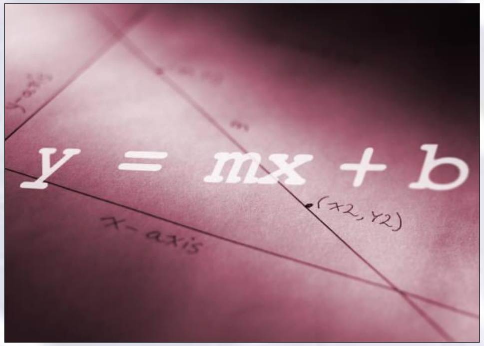
- Focused on design, implementation and testing phases (median 77% of project effort):
  - Design effort from planning effort
  - Implementation effort from design effort
  - Testing effort from design effort
  - Testing effort from implementation effort

Model fitting of effort per phase (ctd)

- Each model was built with and without a dummy variable indicating the intended deployment environment – runtime or non-runtime
- Three baseline models also built – (a) ‘predicting’ zero for every phase; (b) taking the mean phase effort; (c) taking the median phase effort

Model fitting of effort per phase (ctd)

- We also built simple combined models – the mean of the regression value and the manager's estimates (OE and CE)
- Each model was assessed using sum of error and sum of absolute error indicators, and compared to the error of manager estimates



Results against OE (sum of error)

- Minimal improvements in fitting design effort (DES) based on planning effort (PP)
- Substantial improvements in fitting implementation (IMP) from DES, and testing effort (TEST) using DES or IMP (14%, 21% and 21% respectively)
- For specific project phases, fitting both IMP and TEST from DES resulted in improved values in 19 of 32 cases

Results against OE (sum of absolute error)

- Managers' original estimates were more than 17,000 person-hours out
- Regression models reduced error to just over 6,000 person-hours
- Models produced improved values in 29 of 48 cases
- Again, there were minimal gains in fitting DES using PP values

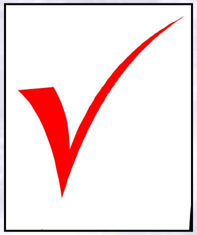
Results against CE (sum of error)

- Managers' current estimates were generally worse than the originals
- In particular, managers significantly underestimated DES and IMP effort
- Our models avoided gross errors (reducing error by 6,500 person-hours), but led to improved phase values in fewer than half the cases

Results against CE (sum of absolute error)

- Managers' estimates outperformed the regression models in fitting DES using PP
- However, an improvement of more than 3,000 person-hours of effort was achieved in fitting IMP and TEST, with 20 of 32 phase values improved

Overall results of feasibility test



- In minimizing sum of error, the multivariate regression models were most effective
- In minimizing sum of absolute error, the combined regression/manager approach worked best
- Modelling implementation and testing effort using design effort appears to be particularly fruitful

- In this case there was little gained in fitting design effort from planning effort

Limitations

- This was a specific data set – general applicability of the results is unknown
- The whole data set was used for fitting *and* assessment of accuracy
- We were unable to utilize manager knowledge about other factors
- Clearly this does not address the ongoing need for early estimates

Conclusions and next steps

- Managers’ estimates can be improved upon using simple models based on prior-phase effort data
- Use of multiple methods appears fruitful
- Next steps:
  - predicting projects in sequence;
  - predicting projects using a moving sample;
  - combining product and process factors

Predicting projects in sequence: preliminary outcomes

- All observations in a 'growing' data set…
  - Against OE, sum of error:
    15% reduction, improved 9 of 22 predictions
  - Against OE, sum of absolute error:
    11% reduction, improved 12 of 22 predictions
  - Against CE, sum of error:
    15% reduction, improved 9 of 22 predictions
  - Against CE, sum of absolute error:
    10% reduction, improved 12 of 22 predictions

Predicting projects in sequence: preliminary outcomes (ctd)

- Moving window using last five projects…
  - Against OE, sum of error:
    24% reduction, improved 8 of 22 predictions
  - Against OE, sum of absolute error:
    14% reduction, improved 14 of 22 predictions
  - Against CE, sum of error:
    24% reduction, improved 8 of 22 predictions
  - Against CE, sum of absolute error:
    13% reduction, improved 14 of 22 predictions