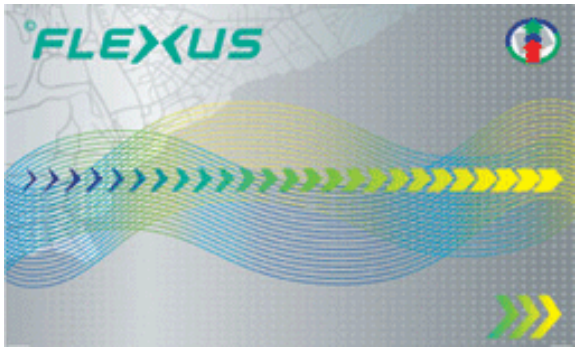


Identification and management of IT-projects with high risk of cost overrun

Magne Jørgensen

[simula . research laboratory]

1) Designed by the famous Filippo Brunelleschi. Funded by the Medici. Considered a milestone in the development of Renaissance architecture.

2) Begun around 1419. Lack of funding slowed down the construction and forced changes to the original design.

3) By the early 1440s, only the sacristy had been completed.

4) Brunelleschi died in 1446

5) The building was “completed” in 1459 in time for a visit to Florence by Pius II (a Medici himself), but the chapels along the right-hand aisles were completed later (1480s and 90s).

6) By the time of completion many aspects of its layout, not to mention detailing, no longer corresponded to the original plan.

7) There were major problems with the design, e.g., the columns along the nave should have been elevated on plinths, and, errors, e.g., the pilasters along the wall of the side aisles rest on a floor that is three steps higher than the nave.

8) Most problems, however, were in the details.

(source: Wikipedia)

Abbreviated IRS TSM Timeline

~1968-1978	"System of the '70s" project to modernize agency
~1978	Project terminated by then President Carter
~1979	Service Center Replacement System (SCRS) project
1982	Tax Systems Redesign program established
1982-1985	3 approaches to modernization tried and failed at conceptual stage
1985	Crisis year in tax processing; SCRS project scope problems
1986 (Oct)	TSM approach starts
1988 (Mar)	TSM plan approved with goal of modernization by 1998
1991-1995	National Academy of Sciences committee brought examines why project is not making progress
1997	TSM is terminated after 10 years and $3.5B Charles Rossotti, former CEO of AMS becomes Commissioner of the agency
1998	IRS Blueprint Project begins
2001	New BSM plan in place targeted to take 10-15 years and $5-7B

Source: Mark R. Nelson, Taylor A. Smith, Summer UG Research Fellow

Current status …

- The Internal Revenue Service has been trying for years to upgrade its antiquated mainframe computers, which process Americans' tax returns by churning through millions of lines of assembly code written by hand in the early 1960s.
- But after more than 20 years and over $5 billion, there's still no end in sight.
- Government audits show that the many years of planned upgrades have been dogged by the same missteps that plague so many massive government computer upgrades: inadequate management, ill-defined goals, repeated cost overruns, and failure to meet deadlines and expectations.

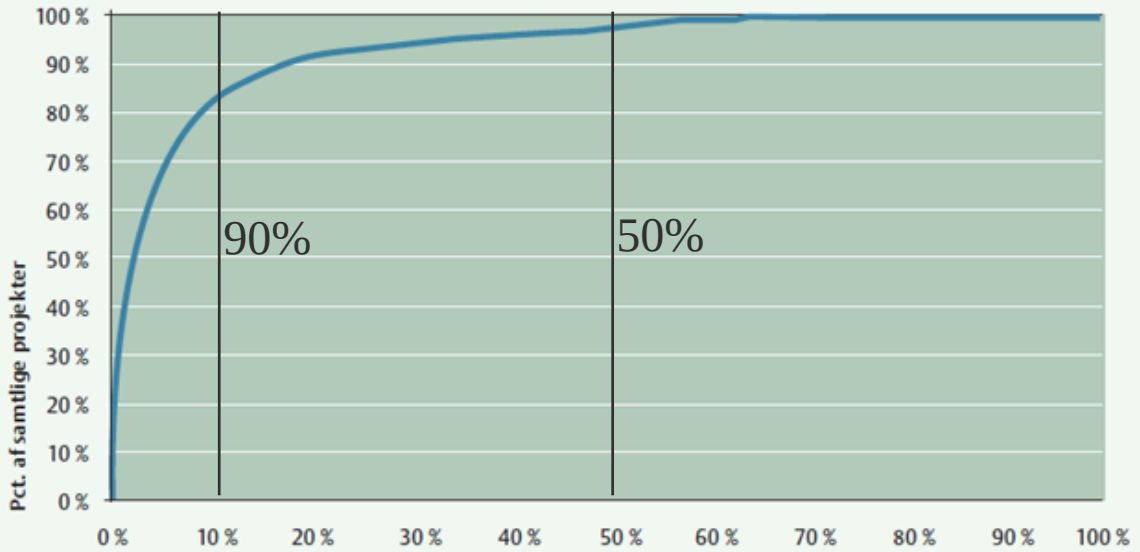
Source: http://news.cnet.com/IRS-trudges-on-with-aging-computers/2100-1028_3-6175657.html

Less than 20% of the projects use 90% of the resources
Lars Frelle-Pedersen (Department of Finance, Denmark)

FINANSMINISTERIET

Lille gruppe projekter driver store dele af samlede omkostninger i staten

Figur 2.3 Sammenhæng mellem de kumulerede omkostninger og antallet af it-projekter, n=197



FINANSMINISTERIET

Problemer med at gennemføre it-projekterne

- Spørgsmål fra Finansudvalget:
  - *"Der ønskes en oversigt fra 2001 til nu over større statslige it-projekter, for hvilke der er sket betydelige overskridelser af de budgetterede omkostninger ved projektet og/eller væsentlige forsinkelser i projektet."*

Typical focus

Oprindeligt budget, gns.	Gns. budget-Overskridelse*	Oprindelig tidsplan	Gns. tidsover-skridelse*	Større ændringer af projektet	Udskiftning af leverandører
282 mio. kr.	39%	41 mdr.	74 %	10 af 15	4 af 15

N = 15

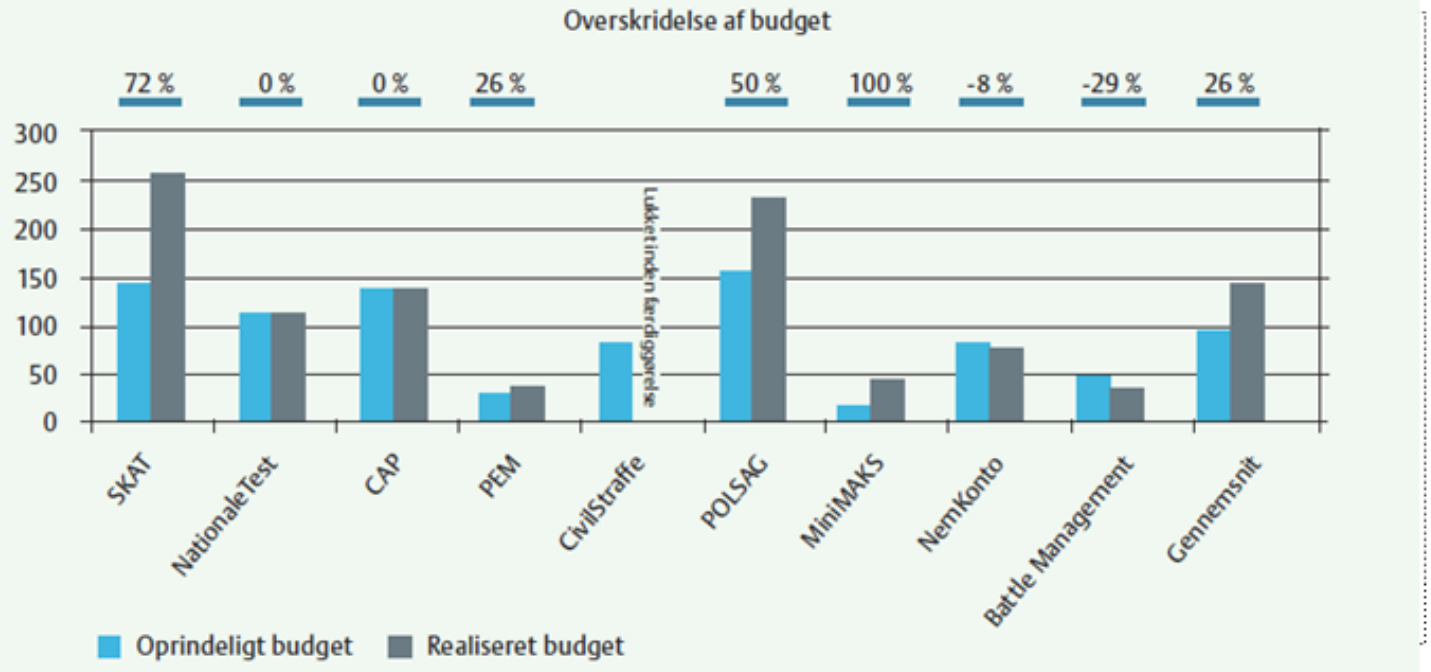
Kilde: Finansministerens svar på Finansudvalgets spørgsmål nr. 96 af 26. marts 2009.

* Som talt fra 1. forelæggelse for Finansudvalget.

FINANSMINISTERIET

Budgetoverskridelser i undersøgte projekter

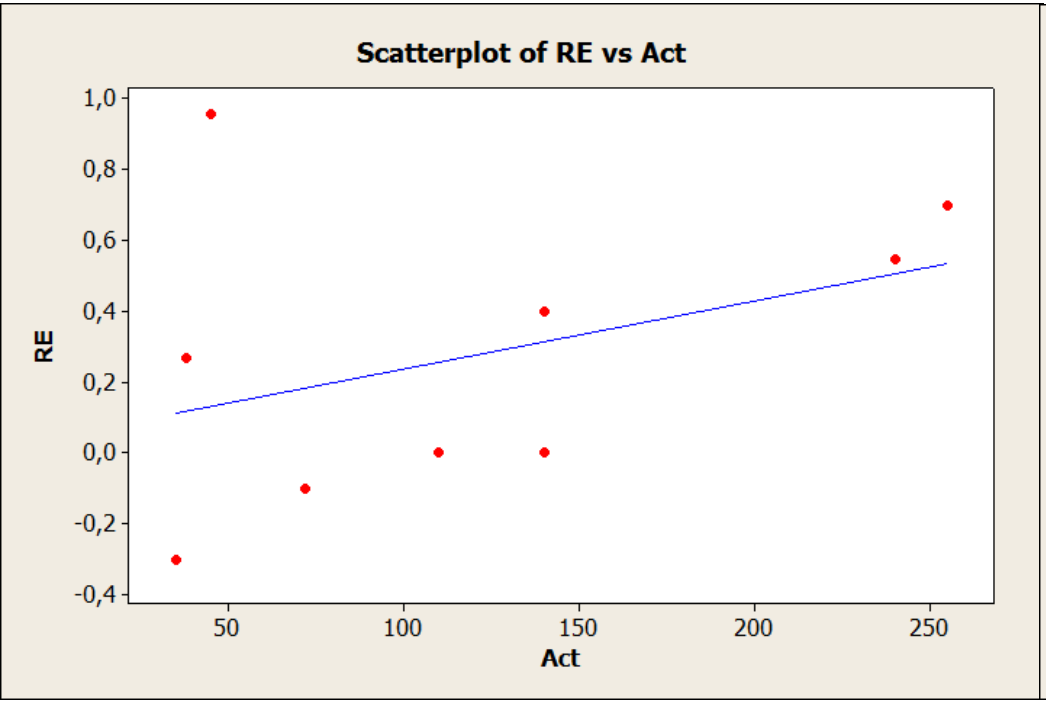
Figur 2.1 Budgetoverskridelser i de undersøgte projekter

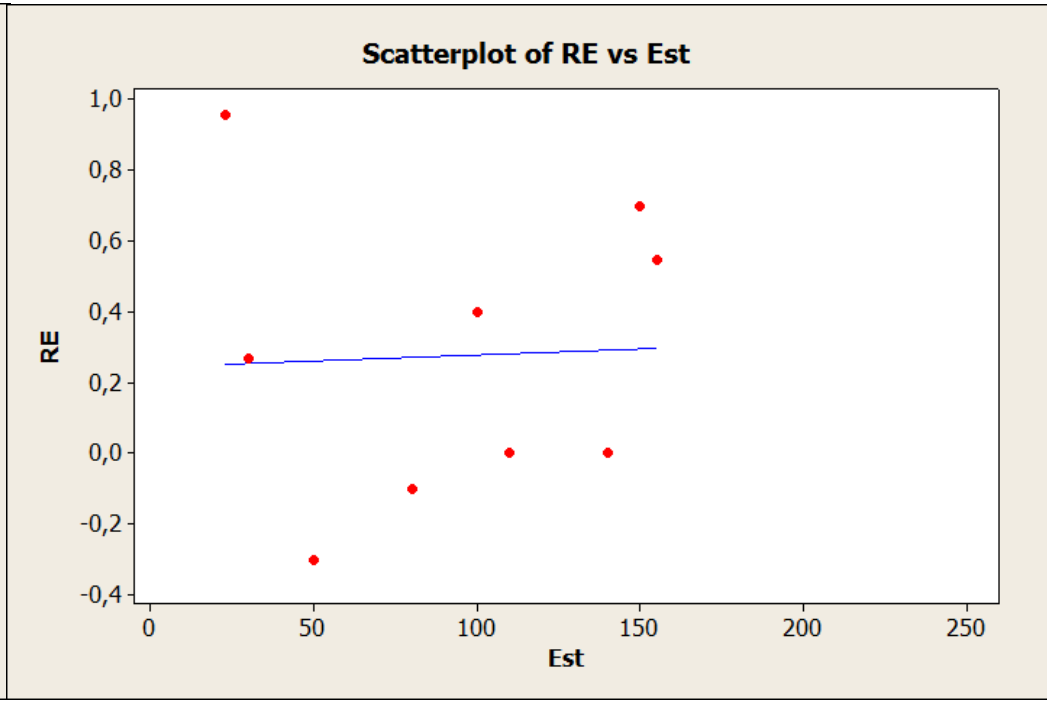


Kilde: *Ernst & Young: Undersøgelse af it-projekter i staten, 2010*

Are Larger Projects More Likely to be Under-estimated? (Data set: Danish problem projects)

RE = (Act – Est)/Est

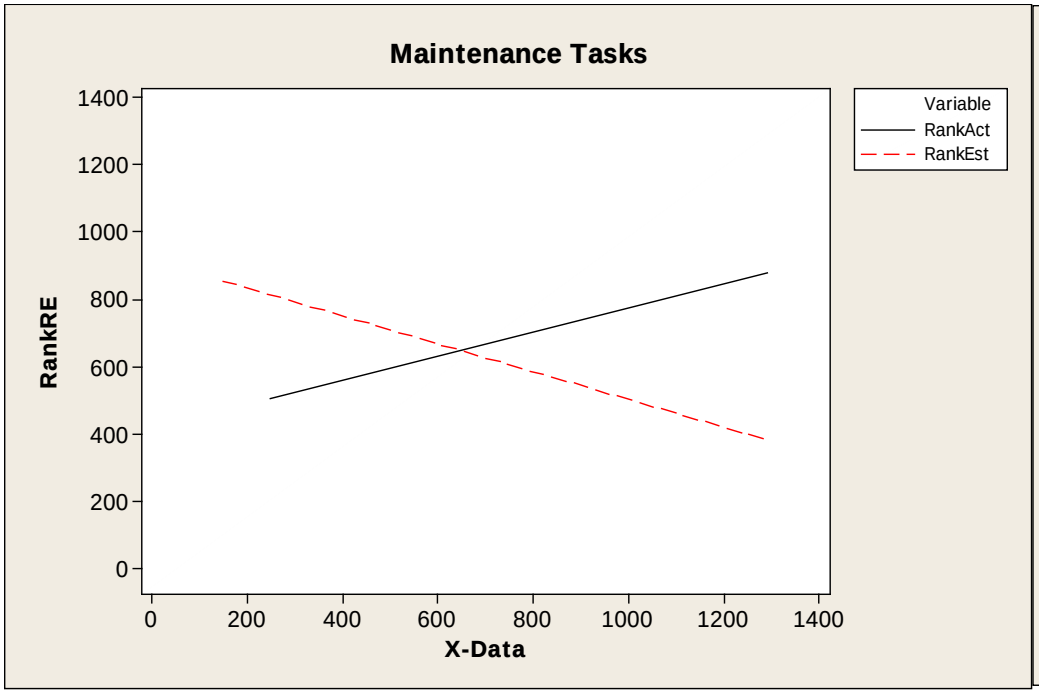


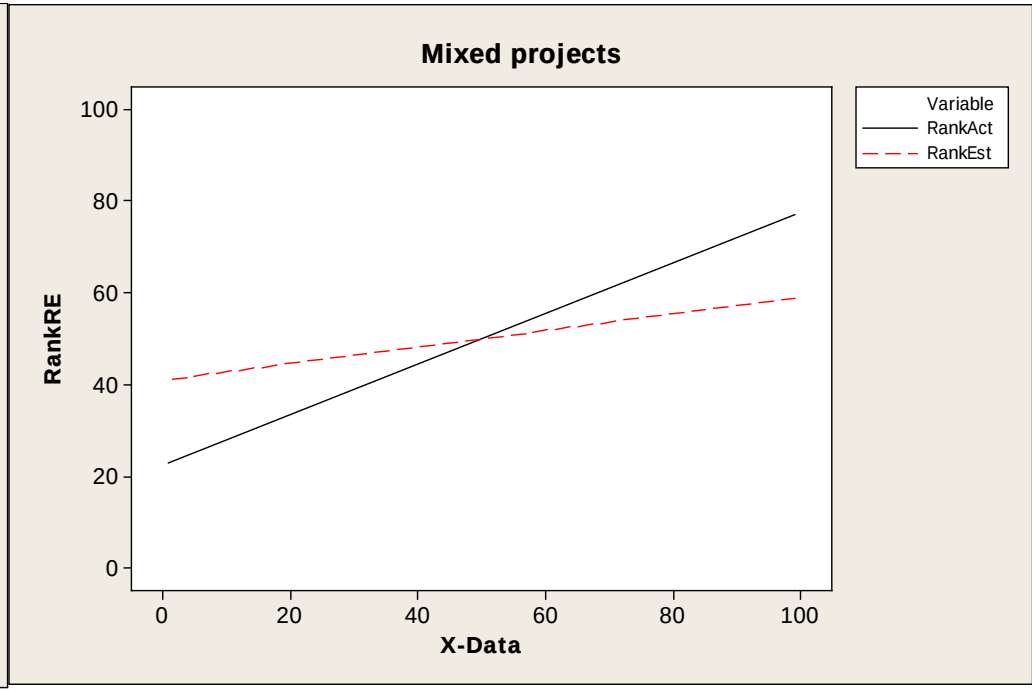


High correlation between actual effort and overrun.

Low correlation between estimated effort and overrun!

It matters how you analyze the data!





Underlying problem with this type of error vs size measurement: i) The error terms (unsystematic error) of actual and estimated effort are included in the error measure, ii) Regression to the mean effects.

Indicators of projects likely to overrun its estimates

- Factors we may have to accept (or stop doing complex projects):
  - We do things that are substantially different from what we have done before
  - There are many interfaces to other systems and/or many stakeholders
  - A substantial re-engineering of existing work processes is involved
  - The problems to be solved are complex
  - Bad luck (could be many small ”bad lucks” or one large)
- But, there are factors where we can and should improve:
  - Ambition level
  - Situational and human biases
  - Competence of client and provider
  - Attention, supervision and management support.
  - Communication with providers, sub-contractors, clients and other stakeholders, including cultural issues.
  - Bidding processes (avoiding winner’s curse, adverse selection, …)
  - Development methods.

Findings by ESSU:

- Many projects are over-ambitious.
- Long-term or delayed projects are often overtaken by new technology, changes in legislation and public policy.
- The private sector often overstates its ability to deliver.
- Clients are often under-resourced and/or do not have the required skills.
- The procurement process is a high-risk strategy, heavily influenced by market forces in respect to who bids, the level of competition and private sector strategies to increase market share.
- Some projects are driven by the application of the latest information and communications technology to meet ‘customer demand’ for seamless one stop contact centres combined with pressure to achieve substantial savings. However, a more incremental approach may be more desirable, effective and economical.
- Off-the-shelf is no guarantee for success. Many projects were based on off-the-shelf products, but nevertheless failed.

http://www.european-services-strategy.org.uk/news/2007/ict-contract-chaos/105-ict-contracts.pdf

Divide et impera?

- What is a common element in the Waterfall model, the sashimi model, agile development, rapid application development (RAD), unified process (UP), lean development, modified waterfall model, spiral model development, iterative and incremental development, evolutionary development (EVO), feature driven development (FDD), design to cost, 4 cycle of control (4CC) framework, design to tools, re-used based development, rapid prototyping, timebox development, joint application development (JAD), adaptive software development, dynamic systems development method (DSDM), extreme programming (XP), pragmatic programming, scrum, test driven development (TDD), model-driven development, agile unified process, behavior driven development, code and fix, design driven development, V-model-based development, solution delivery, cleanroom development ?
  - **Answer**: The reliance on work breakdown (decomposition of the problem into activities, user stories, use cases, increments, releases, ….).
- What's wrong about that?
  - **Answer**: Nothing. Decomposition of a problem into smaller problems is a very good idea for planning and execution. Incremental execution models are documented to improve success rate.
- BUT, it does not solve the problem of what you don't know that you don't know, AND it seems to have an increased optimism and an increased illusion of control as potential side effects.

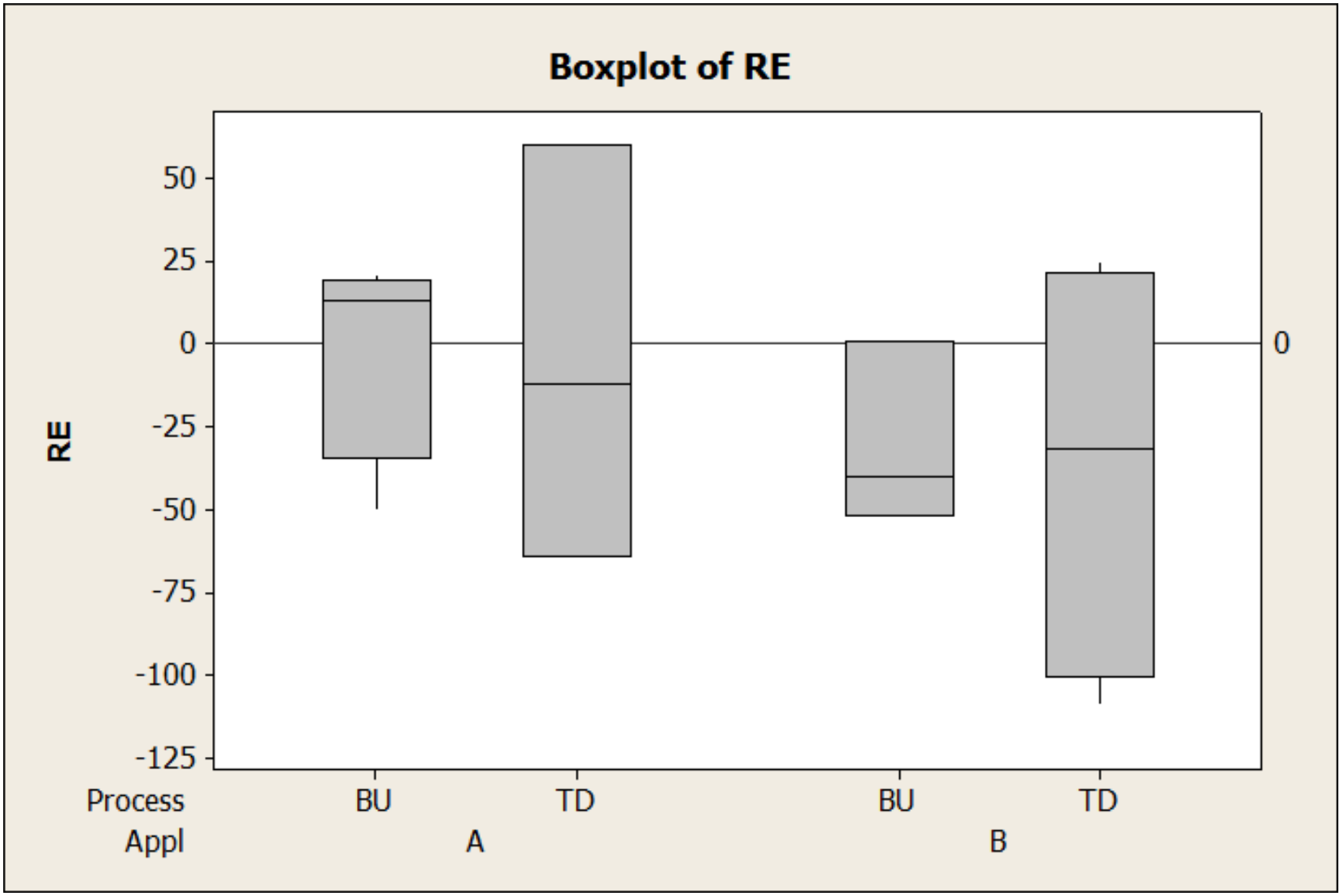
Advantages of top-down estimation
(reference class, analogy-based, holistic estimation)

- The total effort of similar projects includes the effort of expected as well as unexpected (what we don't know that we don't know) activities.
- "Looking back" on previous performance seems to induce more realism compared to "looking forward".
- It does not require as much know-how as the bottom-up (decomposition-based) method.
- BUT, it depends on our ability to find and use meaningful analogies.
  - How easy is that?
  - Results from a study

Top-down or bottom up? A study

- Participants: Seven experienced estimation teams from the same organization (large Norwegian consultancy company).
- Estimation tasks: Two applications (A and B) to be estimated and completed (by another team in the organization)
  - The actual effort of Project A was 1340 work-hours and that of Project B 766 work-hours.
- Process:
  - Spend 30 minutes individually to read the specification
  - Four of the teams used a bottom-up process to estimate Project A, three used a top-down process (searching for analogies in the company's project database, their own memory, calling other people in the organization).
  - Estimation of Project B (switch of estimation method instructions)
- The team discussions were video-recorded

The Estimates
(RE=(act-est)/act))



Study observations and implications

- When analogies (similar projects) were found, the top-down was very accurate.
- When not found, bottom-up was better. On average, the bottom-up was better.
- The teams were not very good at identifying analogies and rejected using previously completed projects that were not very similar. Why is that? Large potential for improvement?
- Combined estimates would, especially for Application A, have led to substantial improvement of the accuracy.
- Implications:
  - Improve training and support in finding close analogies (and accept analogies that are not so close as valuable?).
  - Combine top-down and bottom-up estimation processes.

Some recommendations

- Develop a checklist of indicators of risky project in your organization based on, for example, the items presented in this presentation and your experience. Give those projects extra attention.
  - The government in Denmark now tests the use of an “expert support group” for projects identified as risky and large. We have earlier recommended the educations of “cost engineers” for that purpose. The essential idea is to find people that accumulate experience in identifying relevant experience (references, analogies).
- Ensure that your ambitions and estimates are realistic through “looking back” on previous, similarly complex projects. (Reference class estimation)
- Expect that some of your complex projects will fail (10%?). If possible, think of your projects in a “portifolio management” framework, e.g., with a risk premium paid by all projects.
- Don’t outsource too much competence. Keep at least 20% of the IT-budget on own resources – if not possible, at least by using “consultants” representing your company.

Uncertainty analysis

- The uncertainy of an IT-project is needed to properly plan and budget risky IT-projects.
- How to do this?
- Design of a study:
  - 19 estimation teams of software professionals in one company.
  - Estimation of most likely effort
  - Estimation of the uncertainty.
  - Two groups:
    - Group A: As usual. Ordinary risk analysis.
    - Group B: Base the uncertainty assessment on the distribution of the estimation error of similar projects.

Distribution of Estimation Error of Similar Projects

Teams (Group B only)										
Estimation Error Category	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**Mean value**
>100% overrun	45	18	10	10	10	5	10	0	18	14
50-100% overrun	20	40	35	20	10	5	20	5	25	20
25-49% overrun	15	22	25	30	30	35	40	20	30	27
10-24% overrun	10	15	25	20	30	45	20	40	15	24
+/- 10% of error	7	4	0	5	10	10	10	20	12	10
10-25% too high estimates	3	1	0	10	5	0	0	10	0	3
24-50% too high estimates	0	0	0	0	5	0	0	5	0	1
>50% too high estimates	0	0	0	0	0	0	0	0	0	0

Observations and implications

- Group B teams applied the history to set the (95% confidence) minimum effort (mean value 90% of most likely effort), but **only few of the teams** used it to set the maximum effort (mean value 150% of most likely effort).
- Group B teams had, however, more realistic uncertainty assessments than Group A.
  - This is based on the estimation error of four other companies implementing the specified software.
- Possible implications:
  - It is not enough to have relevant history available. One has to be willing to use it, as well.
  - The buffer representing “unknown activities” should be based on the distribution of estimation error [or perhaps effort spent on non-planned activities] of similar projects.
  - Use the error distribution of previous projects of similar estimation complexity. Such data are available, even for mega-projects!