
Fixed price without fixed specification
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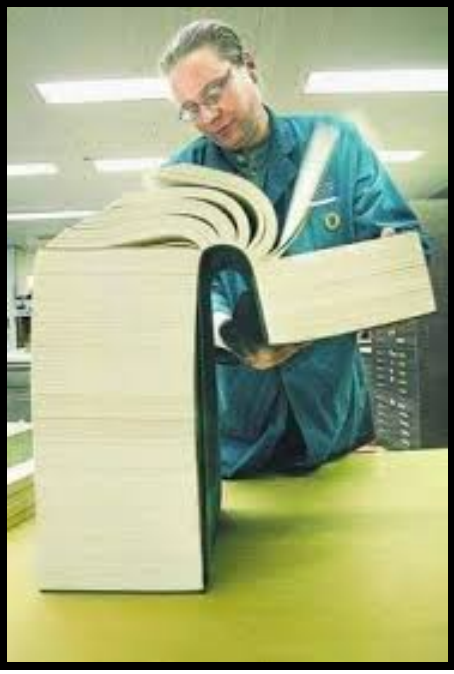
Presentation based on:

- Jørgensen, Magne. "A Survey on the Characteristics of Projects with Success in Delivering Client Benefits." submitted paper.
- Jørgensen, Magne. "Failure factors of small software projects at a global outsourcing marketplace." Journal of Systems and Software 92 (2014): 157-169.
- Jørgensen, Magne. "A strong focus on low price when selecting software providers increases the likelihood of failure in software outsourcing projects." Proceedings of the 17th International Conference on Evaluation and Assessment in Software Engineering. ACM, 2013.
- Jørgensen, Magne. "The influence of selection bias on effort overruns in software development projects." Information and Software Technology 55.9 (2013): 1640-1650.
- Jørgensen, M., & Grimstad, S. (2005, February). Over-Optimism in Software Development Projects:" The Winner's Curse". In Electronics, Communications and Computers, 2005. CONIELECOMP 2005. Proceedings. 15th International Conference on (pp. 280-285). IEEE.

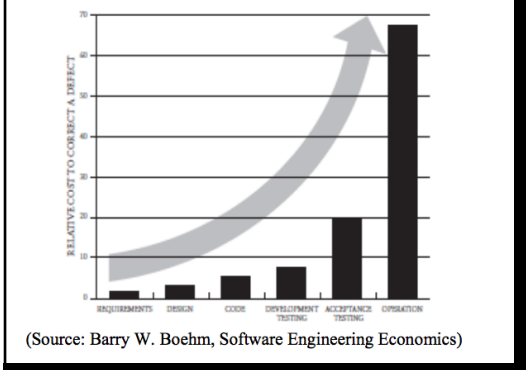


The obvious:

No requirements specifications are complete (and most are changing).

This may lead to re-work, re-negotiations, missing deadlines, misunderstandings, etc.

Incomplete requirements and changing requirement are bad for your project



(Source: Barry W. Boehm, Software Engineering Economics)

Barry Boehm, Software Engineering Economics, 1981

Opinions about why projects are impaired and ultimately cancelled ranked incomplete requirements and lack of user involvement at the top of the list.

Project Impaired Factors	% of Responses
1. Incomplete Requirements	13.1%
2. Lack of User Involvement	12.4%
3. Lack of Resources	10.6%
4. Unrealistic Expectations	9.9%
5. Lack of Executive Support	9.3%
6. Changing Requirements & Specifications	8.7%
7. Lack of Planning	8.1%
8. Didn't Need It Any Longer	7.5%
9. Lack of IT Management	6.2%
10. Technology Illiteracy	4.3%
Other	9.9%

Standish Group, Chaos Report, 2015

My own survey on cost estimation seemed to support this ….

Project managers in a large, multi-national software company responded that ”Incomplete and changing requirements” was the most frequently reason for cost overruns.

BUT ….

The facts told another story

The analysis of the project data in the same multi-national company gave that the projects assessed to have the most incomplete and changing requirements had better, not worse, budget control than the other projects!

AND

Our survey of Norwegian software projects gave that the projects who had the largest changes of the requirements during the project execution **as a result of external changes or learning during the project execution** were on average more successful than the other projects.

The success rate on "client benefit" factor was for those projects 67% compared to 21% on the other projects. They were also better on quality, budget control, time control and efficiency.

AND

Our on-going, in-depth analysis of 40+ governmental projects suggests that incomplete and changing requirements are at least as frequent in successful as in less successful software projects.

COULD IT BE THAT INCOMPLETE AND CHANGING REQUIREMENTS ARE NOT SO BAD AFTER ALL?

PERHAPS THEY ARE MAINLY HANDY SCAPEGOATS ("NOT MY FAULT") TO EXPLAIN FAILURES.

A clarification

- I do not claim that incomplete and changing requirements **never** will lead to problems and project failures.
- It may for example be connected with severe problem when:
  - It is a symptom of incompetent/non-involved clients, or
  - The development process/contract assume fixed requirements
- The question is rather WHEN incomplete and changing requirements is a threat and when an opportunity for a software project's success

HYPOTHESIS: THE PROBLEMS ARE MAINLY THERE WHEN APPLYING METHODS AND CONTRACTS WHERE CHANGING REQUIREMENTS ARE THREATS RATHER THAN OPPORTUNITIES

IS FIXED PRICE CONTRACTS ONE OF THE BIG BAD WOLVES FOR SOFTWARE PROJECTS?

AN EXCURSION INTO SOFTWARE CONTRACTS:

WHICH WILL HOPEFULLY LEAD TO INSIGHT ABOUT THE CONNECTION BETWEEN FIXED PRICE PROJECTS, LACK OF COMPLETE/CHANGING REQUIREMENT SPECIFICATIONS AND PROJECT FAILURE

WORK CONTRACTS: NOTHING NEW UNDER THE SUN

EXAMPLES FROM MESOPOTAMIA
(2000-5000 YEARS OLD CONTRACTS)

Time and material contract

MAR-SIPPAR has hired for one year Marduk-nasir, son of Alabbana, from Munapirtu, his mother. He will pay as wages for one year two and a half shekels of silver. She has received one half shekel of silver, one se [1/180th of a shekel], out of a year's wages.

Risk sharing contract

Two manas of money belonging to Nabu-akhi-iddin, son of Shula, son of Egibi, and one half mana seven shekels of money belonging to Bel-shunu, son of Bel-akhi-iddin, Son of Sin-emuq, they have put into a copartnership with one another. Whatever remains to Bel-shunu in town or country over and above, becomes their common property. Whatever Bel-shunu spends for expenses in excess of four shekels of money shall be considered extravagant.

Fixed price (with penalty clause)
(Shows that time overrun is not a new problem!)

He shall pay a part of the money at the beginning, a part of the money at the completion. He shall pay it on the day of Bel, the day of wailing and weeping. In case the house is unfinished by Iskhuya after the first day of Tebet, Shamash-iddin shall receive four shekels of money in cash into his possession at tne hands of Iskhuya.

Use of contracts (1442 US government IT projects)

source: itdashboard.gov/data_feeds

- Fixed price 64%
- Per hour
  - Cost Plus 13%
  - Time and material 13%
- Other (risk sharing, profit sharing, ...) 10%

- Similar results from many countries shows a frequent use of fixed price contracts. Surveys typically report that 40-70% of all IT projects have fixed price contracts.

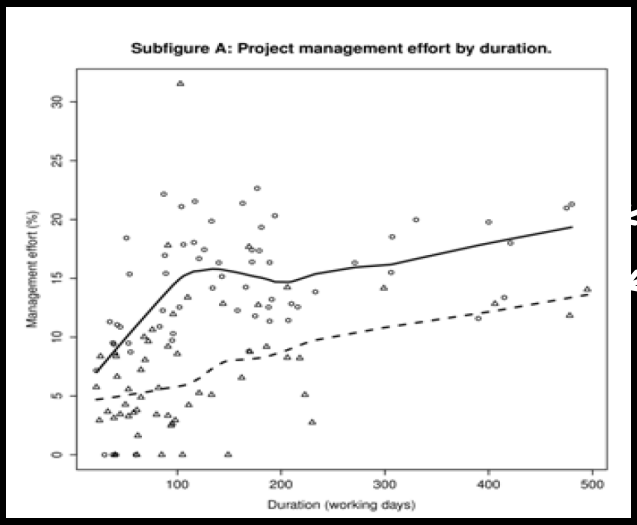
Why do clients prefer fixed price contracts?

- They do not trust the provider, and think that the provider will behave more opportunistically (”moral hazard”) if using time and material-based contracts.
  - Time-and-material: The provider get more paid the less productive it is.
- They believe that the risk of failure is on the provider when using fixed price contracts:
  - Fixed price: Cost over-run leads to higher cost of the provider, not the client.
- They think they get better deals (pay less) when using fixed price.
- **Claim**: They are mostly wrong about all three beliefs.

EMPIRICAL EVIDENCE ON THE EFFECT OF FIXED PRICE CONTRACTS

More administration

Ahonen, Jarmo J., et al. "Reported project management effort, project size, and contract type." Journal of Systems and Software 109 (2015): 205-213.



More project failures

Type of contract	Number of projects	Proportion failed projects (cancelled or with very low client satisfaction)
Fixed price	408.491	12%
Per hour (time and material)	2.338	2%
Trialsourcing + per hour	1.133	0.1%

Fewer successes

Study of Norwegian software projects)
Percentage of projects perceived to be "successful"

Success criteria	Per hour contracts	"Agile" contracts	Risk sharing contracts	Fixed price contracts
Client benefit	59%	29%	22%	0%
Quality	24%	43%	22%	22%
Budget control	31%	71%	22%	33%
Time control	29%	43%	44%	11%
Efficiency	19%	29%	33%	0%
Proportion	37%	14%	41%	18%

Changes are threats rather than opportunities
Follow-up study with Norwegian software projects)

- Contract types:
  - Fixed price (includes risk sharing contracts)
  - Per hour (includes agile contracts)
- Correlation between amount of changes and client benefit:
  - Fixed price projects: -15% (less successful with more changes)
  - Per hour paid projects: 6% (more successful with more changes)

Higher cost overrun & cost risk not removed

	Total overrun	
	Unconditional	Conditional
	Random effect	Random effect
	(1)	(2)
Reputation		
Young firm	−0.48	−3.8
	(5.0)	(5.0)
Repeated contract	1.8	1.5
	(4.9)	(4.8)
ISO-certified firm	15	16
	(7.9)	(7.7)
Contract		
Fixed-cost contract		14*
		(5.4)
Time and material contract		5.5
		(7.5)
Firm and client characteristics		
Number of employees (/100)	−0.77*	−0.38
	(0.24)	(0.24)
Client is big	0.88	0.43
	(4.8)	(4.8)
Client is Indian	4.1	2.8
	(5.6)	(5.6)
Project characteristics		
Estimated project size (man-months)	0.11*	0.11*
	(0.040)	(0.040)
Area is familiar	−5.6	−5.9
	(5.1)	(5.1)
Platform is familiar	−20*	−18*
	(10)	(10)
Y2K, data manipulation, etc.	−13*	−13*
	(7.2)	(7.1)

PANEL E: CONTRACTS (proportion)	
Fixed-cost contracts	0.58
Mixed contracts	0.26
Time and material contracts	0.15
PANEL F: SHARE OF OVERRUN PAID BY THE FIRM (percent)	
All contracts	57
Fixed-cost contracts	66
Time and material contracts	28
Fixed-cost contract, firm responsible	86
Fixed-cost contracts, client responsible	61

Abhijit V. Banerjee and Esther Duflo
Reputation Effects and the Limits of Contracting: A Study of the Indian Software Industry
The Quarterly Journal of Economics
(2000) 115 (3): 989-1017

Found only one study with positive effect: Fixed price project may be staffed with more competent developers (Indian offshore company).

Results differ from other studies, but suggest that there are many mechanisms in play.

The Role of Contracts on Quality and Returns to Quality in Offshore Software Development Outsourcing

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ABSTRACT

In this study, we examine how the different incentive structures inherent in two primary contract types—time and materials (T&M) and fixed price (FP)—influence the quality provided by the vendor in the software development outsourcing industry. We argue that the incentive structure of FP contracts motivates a vendor to be more efficient in the software development process, which results in higher quality as compared to projects executed under a T&M contract. We thus argue that vendors consistently staff FP projects with better trained personnel because they face the most risk on these contracts, resulting in better outcomes on these projects. We extend our analysis to propose that providing higher quality is associated with higher profit margins for the vendor only for FP contracts. We develop and test these hypotheses on data collected from 100 software projects completed by a leading Indian offshore vendor. The results provide strong support for our fundamental thesis that the drivers of and returns to quality vary by contract type. We discuss the implications of our research for both researchers and practitioners.

What are the mechanisms connecting fixed price contracts, incomplete specification and failed software projects?

Selecting a provider with **low price** (typical for fixed price projects) increase the likelihood of over-optimistic estimates, opportunistic behavior and software project failure (enabled by incomplete requirements)

Selection of provider with bid less than 25% of the average bid, led in a fixed price context to a 9% increase in project failure **for the same level of provider competence.**

M. Jørgensen, A Strong Focus on Low Price When Selecting Software Providers Increases the Likelihood of Failure in Software Outsourcing Projects, EASE, Porto de Galinhas, 2013

Analysis of nearly 800.000 small projects at VWorker.com

Failure = Cancelled or completed with client satisfaction of "poor" or worse.

Competence = Average client satisfaction + failure frequency.

A model of the winner's curse

Variance shrinkage

Degree of random variation

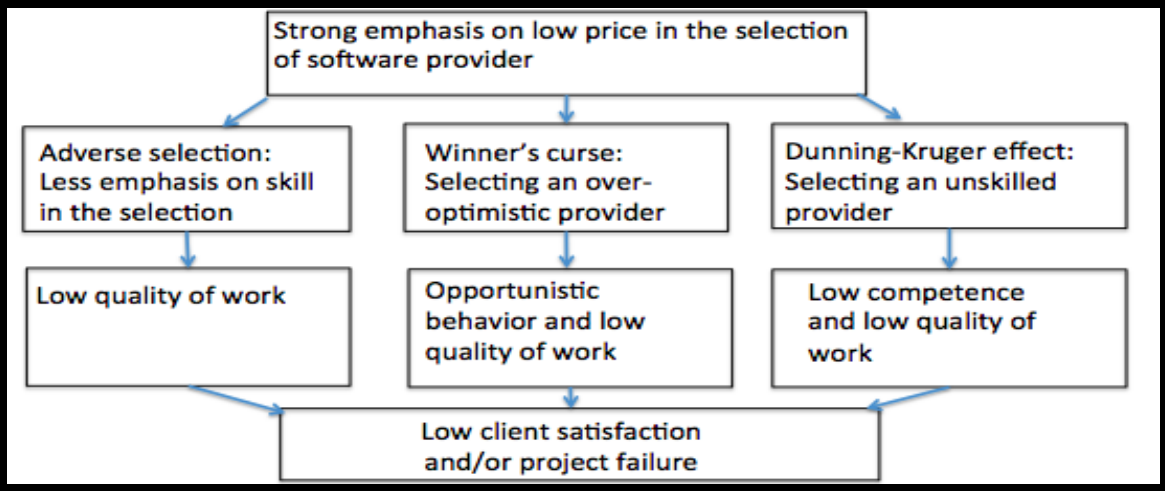
$$estimation\ overrun = \frac{act-est}{\mu} = \frac{\mu\left(1-\rho_{est,act}\frac{\sigma_{act}}{\sigma_{est}}\right)(1-w)}{\mu} = \left(1-\rho_{est,act}\frac{\sigma_{act}}{\sigma_{est}}\right)(1-w)$$

Extremeness of value

M. Jørgensen. The Influence of Selection Bias on Effort Overruns in Software Development Projects, Information and Software Technology 55(9):1640-1650, 2013.

The client is very much to blame by selection of provider and contract type

(Incomplete and changing requirements is a contributing factor)



Summary of results from several studies on the effect of price-focused selection of providers

Ongoing, in-depth analysis of 40+ Norwegian governmental projects

- Fixed price contracts were quite common when the requirement uncertainty was high, i.e., when they are not well suited.
  - Perhaps because this often corresponds with low trust situations
- Consequences of fixed price contracts:
  - Much more contract discussion due to lack of clarity in requirements
  - **Less solution-oriented and more contract/requirement specification-oriented providers**
  - The providers more likely to behave ”opportunistically”
  - Project problems, such as time and cost overruns, were more likely to escalate, abort the project and end up in court

Main messages summarized

- There is no such thing as a complete requirement specification Many requirements, in particular non-functional requirements, cannot be described in a precise and complete way.
- Many requirements will (and should) change due to learning and changing environments.
- Requirement changes may (and should) be seen as opportunities and enable more successful delivery of client benefits. This is the essence of good benefit management!
- It is, given the above factors, not possible (nor a good idea) to put the full risk on the provider through a fixed price contract.
- More providers will behave opportunistically in a fixed price contract, with the requirement specification as their ”weapon”. This is especially the case when they have been selected based on a low price.
- There is a very unfortunate incentive when the project is fixed price and the maintenance and further development is paid per hour (The worse the quality, the higher the profit in later phase!)

EXTRA MATERIAL

Analysis of choice of contract type

Gopal, A., Sivaramakrishnan, K., Krishnan, M. S., & Mukhopadhyay, T. (2003). Contracts in offshore software development: An empirical analysis. Management Science, 49(12), 1671-1683.
<The higher the unc, the more likely is time&mat>

Table 3 Probit Analysis Results

Variable	Coefficient	Std Error	Pr(|Z| > z)	Supported?
Requirements uncertainty	−0.90	0.33	**0.006**	**Yes**
Effort	−0.42	0.21	**0.05**	**Yes**
Human resources (training)	−0.90	0.28	**0.001**	**Yes**
MIS experience	0.80	0.29	**0.006**	**Yes**
Client experience	0.22	0.21	0.27	**ns**
Client reputation	0.05	0.16	0.73	**ns**
Future business	0.30	0.19	0.10	**ns**
Client size	0.59	0.26	**0.02**	**Yes**
Project importance	−0.58	0.27	**0.03**	**Yes**
Competition (vendor)	−1.37	0.34	**0.0001**	**Yes**
Competition (client)	0.83	0.32	**0.01**	**No**
Number of prior projects	−0.08	0.02	**0.001**	**Yes**
Project type	−0.80	0.36	0.02	**NA**

Notes. $-2 \text{Log } L = 62.90$. Model fit = 57.46 with 12 df, significant at $p < 0.01$. Association of predicted probabilities and observed responses = 90.2%. ns: Not significant. NA: Not applicable.
Contract: 0 — time-and-materials, 1 — fixed-price, $N = 93$.

Poor communication of requirements leads to project failures (paper to be presented at ICSIE)

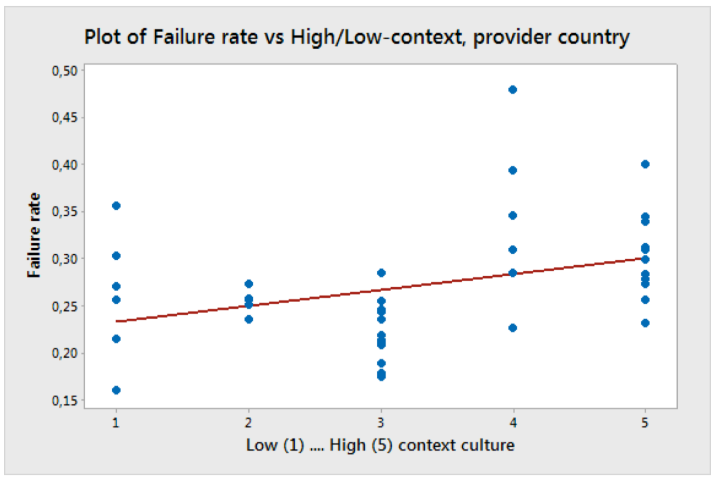


Figure 5: Analysis of speaking style of provider countries