

Cost Overrun in the Public Sector, A Case Study

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Summary

The case studied is that of the Betuwe Route, a new 160 km double track railway, exclusively for freight, that will link the Port of Rotterdam with her European hinterland. This megaproject has been strongly disputed ever since its conception. Government, opponents and proponents have spent tremendous efforts in studies and reports. In most cases these are easily accessible to the general public. At first sight the cost seems to have tripled in ten years. Was it so difficult then to provide a reliable estimate, or should an explanation be sought elsewhere? With this question in mind many reports were studied, and the final conclusion is that not so much the estimators as well as politicians are responsible.

Introduction

Mid 1997 first ground was broken for the construction of the so called *Betuwe Route*, a new 160 km double track electrified railroad, exclusively for freight. As from 2006 it will be an addition to existing rail-, road- and water-ways linking the Port of Rotterdam with her European Union hinterland. Most likely the total cost of this civil construction project will exceed € 5 milliard. This fact classifies it as a megaproject, less spectacular, but nevertheless in the same order of magnitude as the Channel tunnel between France and England, the Øresund bridge between Denmark and Sweden, or the Three Gorges Dam in China. Such projects tend to have strikingly poor performance records in terms of economy, environment and public support. (Flyvbjerg, 2003).

Original funding plans were based on Public Private Partnership. No private partners were willing to share the risk, however, and practically the full financial burden is on the shoulders of the Dutch tax payer. Ever since her conception the Betuwe Route has been a strongly controversial subject, and more than once the project was almost abandoned.

Once the railroad is ready, private companies will run their trains, paying a levy per ton-kilometer transported. For years on end the revenues from this levy may well be less than even operational and maintenance cost. Opponents have strong doubts that the Betuwe Route will ever be able to compete with inland shipping and road trucking, or with combinations of the three earthbound transport modalities. This is all the more so since both in inland shipping (Jowi, one 135 m barge carrying the load of five freight trains) and in road trucking (maximum length of road trucks recently up 35% to 25.25m) new developments have strongly increased their competitive strength.

In 1990, in the very first proposal to parliament, the cost to improve the rail link between the Port of Rotterdam and Germany was estimated to be € 1.59 milliard. When in 1995 the final decision was made the estimate had gone up to € 3.67 milliard. Anno 2003 the estimate stands at € 4.71 milliard, to which at least € 300 million should be added, at present accounted for as a 'risk reservation'.

This paper was triggered by the question to what extent the cost engineering profession is to blame. Since construction of a railroad mostly follows existing technology, estimating should be relatively easy.

The Betuwe Route project is placed in context, and data are presented and discussed.

The Netherlands

Densely populated: 16.2 million inhabitants / 33.9 thousand sq. km land. GDP 2002: € 445 milliard.

Infrastructure: 2 808 km rail, 5 046 km waterways, 418 (crude oil) + 965 (petroleum products) + 10 230 (natural gas) km pipelines, 104 850 km paved roads, of which 2 235 km expressways.

(Source: CIA Worldfactbook)

The Port of Rotterdam

For many years now the port of Rotterdam has been (and is) the number one in throughput on the list of world's major ports. Deep (23 m) waterways and the absence of locks make it accessible to even the largest seagoing vessels. It is connected to a hinterland of hundreds of millions consumers by inland shipping, pipelines, rail, road, as well as shortsea and feeder services, guaranteeing short and cost effective cargo handling and transport.

Table I: Throughput world's major ports

	Gross weight × 1 million metric tons				
	2002	2001	2000	1999	1998
Rotterdam	322.1	314.7	322.4	303.6	313.7
Singapore 1)	258.1	242.0	251.4	251.6	241.1
Sjanghai	230.0	220.0	204.0	187.0	163.9
Hong Kong 2)	192.5	178.2	174.6	168.8	167.2
Nagoya 1)	134.1	132.4	133.5	115.7	116.5
Antwerp	131.6	130.0	130.5	115.7	119.8
Kaohsiung	129.4	127.9	115.3	110.7	98.2
Pusan	114.8	101.1	93.8	86.2	77.1
Hamburg	97.6	93.7	94.8	92.7	95.4
Yokohama 1)	95.7	92.4	85.1	81.0	75.8

1) Including river trade 2) Conversion from freight tons into metric tons

Source: www.portofrotterdam.com

In the Netherlands Rotterdam has always had a reputation of pro activity, determination and efficacy. Timely planning of a new hinterland rail connection for cargo fits well in this picture.

Some Statistics for the Betuwe Route

40 km Port Railway, Shunting Yard Kijfhoek, 120 km Betuweroute

3 bored tunnels (Botlek, Sophia, Pannerdensch Kanaal) – 3 different techniques

2 traditional tunnels (trench digging)

Passage Barendrecht: 9 tracks (4 regular trains + 2 HSL-Zuid + 3 Betuwe Route) through mid village

150 viaducts, ecodecks, aquaducts, bridges

20.000 man-year construction time

Capacity 10 trains per hour per direction

Project Environment

In the early nineties the conjuncture was excellent, the prognoses for cargo transport were very optimistic, the roads got ever more congested, and inland shipping was in a rather deplorable state. Deregulation and liberalization of the market was the word, and expectations of public private partnership were high. All of this in combination provided favorable conditions for a new rail link, expensive though it would be.

In a democracy public authorities have to disclose what they are doing, and why. People want - and have all the rights to do so - to participate in decision making, inside or outside parliament. No matter what is their motivation, opponents have the power and the means to obstruct and frustrate governmental plans. Often being highly intelligent people, they will use all means to their full extent.

In a private company it usually is easier for management to push a project, since the influence of shareholders is limited and internal opposition is subdued, mostly for fear of making a CLM ('career limiting move'). Withholding information is not regarded as the deadly sin it is in public administration.

Both the economic viability and the benefits to the environment of the Betuwe Route are in heavy dispute, as well by politicians, as by stake holding organizations, as by experts in the fields of transport economics and environment, as by the media, and as by public protest. The internet accessibility of government information as well as that coming from anti-lobbyists and pressure groups facilitates stirring up commotion among the general public. For instance, proponents and opponents of the Betuwe Route

agree that it will attract new trade to Rotterdam. Both use it as an argument, the ones for the economic effects, the others for the environmental effects.

What didn't help either was that in 2002 a parliamentary enquiry 'Bouwfraude' brought to light that public construction projects had been the subject of contract rigging and fraudulent price inflation by contractors that were and are also involved in the construction of the Betuwe Route. Also at the same time the HSL-Zuid, the high speed passenger rail connection Amsterdam-Brussels-European Network of high speed lines is under construction, appealing to the same contractors for construction capacity. And on top of that some severe accidents in tunnels in the Swiss and Austrian Alps made everyone aware of tunnel safety, to be secured at high additional cost only.

Enormous effort was put in public relations. Being only 50 m in width, by 160 km in length, 320 km of stake holding neighbors had to be reckoned with. A website www.betuwroute.nl was created, providing progress reports in the Dutch, the English as well in German. Apart from these many reports were written, by the Ministries involved, by universities and consultants, by parliamentary committees, by pressure groups pro and contra, and by the State Council of Accounts. Not for the first time now the heavy instrument of a full scale Parliamentary Inquiry is requested by the opposition. It has been estimated that the total cost of some 140 reports until 1999 was already over € 90 million (Roscam Abbing, 1999).

Table II: Budget Development Betuwe Route

[€ million]

Progress Report No. Closing end of:	3 1H97	4 2H97	5 1H98	6 2H98	7 8-99	8 1H00	9 2H00	10 1H01	11 2H01	12 1H02	13 2H02
Budget Before	3744	4034	4138	4238	4243	4282	4386	4386	4502	4546	4715
Labor & Material Esc.	132	104	100	5	49	77		121		73	
Scope changes	104					27			43		
Setbacks/Windfalls					-10			-5			
Other Corrections	54								1	96	-3
Budget After	4034	4138	4238	4243	4282	4386	4386	4502	4546	4715	4712

Highlights in the history of the Betuweroute

- 1985 Master plan for the future of the Port of Rotterdam suggests restructuring the existing (and possibly to be closed down) Betuwelijn to a freight only line. (Van Dongen).
- 1990 Strategic importance of modernization of the Betuwelijn is recognized by the government. Estimated cost € 1.59 milliard, expected demand 50 million metric tons/year in 2010.
- 1991 The cabinet of ministers makes the Betuwe Route a plan of national importance.
- 1993 The feasibility of a fully subterranean railroad is researched and found not to be feasible. (Van Engelshoven)
- 1994 Parliamentary approval, followed by a change of government to the earlier opposition. This results in political reconsideration of the project; a parliamentary committee recommends continuation of the project, however. (Hermans).
- 1995 Green light by the Cabinet of Ministers and by the Second Chamber of Parliament. Estimated cost: € 3.67 milliard, some 20% of which to be invested by private partners. (Tweede Kamer der Staten Generaal, 14 juli 1995)
- 1996 The track plan (Tracébesluit) is fixed. The railroad will closely follow the existing expressway.
- 1998 8 Professors trigger a new public discussion by sending an open letter to the Minister of Transport, Public Works and Water Management, expressing their concerns on the viability of the Betuwe Route. They call for a full stop of all activities. The Minister sees no cause for reconsideration, and summarizes once again the arguments pro, together with updated management info. (Tweede Kamer der Staten Generaal, 1998). Several motions to abandon or to temporize the project are rejected by the Second Chamber of Parliament.
- 2000 The first report of the State Council of Accounts: Management Information Betuweroute. (Algemene Rekenkamer, 2000). Main conclusion: the management information used in decision making was incomplete and partly defective. The usage of management information often was

not transparent. The quality of the information used was insufficiently guaranteed. Surprisingly even as late as in this year 2000 the same report stated that “a sound and comprehensive cost/benefit analysis of the Betuwe Route is missing”(!). Also: “Decision making has been dominated by the postulate that the Betuwe Route is of strategic importance to the economy and to the environment”(!). Several motions to abandon or to temporize the project are rejected by the Second Chamber of Parliament.

- 2001 The second report of the State Council of Accounts: Construction Betuwe Route: Project Management and Finance. (Algemene Rekenkamer 2001). Main conclusion: Although ever since 1995 much effort has been spent to keep organizational as well as financial control over the project, the effect, especially in the field of cost control, has been disappointing. Especially prior to 1998 the ministry was insufficiently successful in keeping the cost estimates of the executive organization within the limits of the task setting budget.
- On estimating: “Cost control has been – and still is - seriously hampered by the lack of uniform definitions and conventions regarding estimating concepts and cost categories. The procedures followed did insufficiently account for risk, implying that uncertainties easily can lead to setbacks.”
- On cost control: “Cost cutting measures yielded (as yet) insufficient results; instruments for cost control are (as yet) insufficiently effective; management information is still inadequate and incomplete. Per ultimo 2000 again a large spread (€ 273 million) exists between estimate (€ 4386 million) and budget (€ 4059 million).”

- 2003 The third report of the State Council of Accounts: Risk reservation for the Betuwe Route and the HSL-Zuid. (Algemene Rekenkamer, 2003). Main conclusion: The necessity of having this risk reservation could have been prevented by adequate project and risk control.

7 Professors once again send an open letter to the Minister of Transport, Public Works and Water Management, claiming that completion of the Betuwe Route as planned will lead to permanent and forever steadily rising exploitation losses, and requesting a parliamentary inquiry as well as an immediate full stop of all activities. (Heertje, 2003).

Cost cutting proposals asking for non-electrification and a more simple train control system are rejected. The Betuwe Route will be electrified with 25 kV~ and ETCS-2 (European Train Conduct System, level 2) will be installed. This will add € 17 million to the risk.

At the time of this writing the most recent item is the installation of tunnel technical installations (TTI) in the 5 tunnels, to guarantee their safety, availability and preservation. Competing alternatives are a sprinkler installation and a provision for heavy ventilation. Both systems are extremely advanced if compared to measures in other countries. Heavy ventilation is at least equally effective as sprinklers, and certainly more cost effective.

Unfortunately construction permits, as granted by lower authorities, provide for the sprinkler option only. Starting a procedure to overrule these lower authorities, an instrument that earlier had been used successfully in the ‘track decision’ (tracé besluit), was no option now, since that would cause an unavoidable and unacceptable delay of 8 months. So € 104 million (€ 195 million cost minus € 91 million budgeted) from the Risk Reservation in the National Budget was shifted to the Project Budget of the Betuwe Route, and sprinklers will be installed in the tunnels.

Project Phases

In a project like the Betuwe Route three phases – ideally sequential - have to be discerned, that in practice show often undesirable but unavoidable overlaps (Buck, 2000):

- initiation
 - all activities from concept to decision, a.o. handling 5500 reactions and objections
- conditioning, necessary for enabling undisturbed realization
 - land acquisition, 3000 files, € 600 million, amicable acquisition or expropriation
 - diverting cables and pipelines
 - soil treatment
 - archeology, 30 interesting sites, 19 actual digs
 - obtaining permits, 60 regulations, 2000 à 3000 permits
 - removal and/or demolition of obstacles
 - damage and compensation claims handling
 - outer wall insulation
 - adapting zoning plans in 28 municipalities
 - establishing covenants with 35 authorities

- call for tenders, contract (Design & Construct, traditional RAW, Alliance, Design, Build & Maintain) preparation and award, 25 contracts from € 100 up to 300 million + scores of smaller contracts for local activities
- setting up an (ISO certified) project organization, within the alliance of the Ministry of Transport, Public Works & Water Management and Railway Management, to manage, supervise and control the project
- continuous risk assessment, plan risk, scope risk (both functional and technical scope), market risk, interface risk, environmental risks, changes in laws and regulations, public protest, political and media climate, and all other risks that generally pertain to (mega)projects, up to preliminary abandonment
- preparing a detailed design and/or construction specification for each km of the tract
- realization
 - cost estimation
 - contract management
 - project supervision, regular audits by 8 different stakeholders
 - project control
 - cost control

Estimating

Estimating 1600+ separate objects was outsourced to three consultants, under the responsibility of the project management. The lack of detailed specifications in some cases, e.g. for tunnels to be bored with new technology, resulted in too optimistic estimates, that later had to be adjusted. Only in 1999 the globally specified Program of Requirements for the Betuwe Route was elaborated, and it was split in two: a Functional and a Technical P of R. Until that time a grey area existed between functional requirements and design specifications, a handicap for good estimating.

The second report of the Netherlands Court of Audit (Algemene Rekenkamer, 2001) sheds some light on the specific estimating methodology applied for the Betuwe Route. It is described as 'functional design / median cost'. For each function with several options, such as a waterway crossing by ferry, by bridge or by tunnel, the lowest cost / fully functional option is selected. When for instance it turns out that it should be a bridge, the median – not the minimum – cost of the various types of bridges is reported in the estimate. Based on experience a 10% *construction contingency* is added covering for change orders, divergent quantities and provisional sum differences. In accordance with the project phase an experience based uncertainty range is given: conceptual 20%, basic engineering 15%, detail engineering 10% and control budget 5%.

The 10% construction contingency should not be confused with a 20% *project contingency* covering for market developments, technical risk, planning risk, regulatory changes (environmental, health & safety, labor conditions), natural disasters, interface risk, public protest, etc.. The project management advocated incorporation in the budget of such a project contingency, but 'politics' did never accept that.

Cost Control

Abbreviated from the second report of the Netherlands Court of Audit (Algemene Rekenkamer, 2001):

'In the period 1992 to 2001 the budget for the Betuwe Route Project more than doubled, from € 2.3 milliard to € 4.7 milliard. This cost increase is mainly due to escalation (€ 0.8 milliard), scope expansion by the Second Chamber and by the Cabinet of Ministers, and re-sharpening of laws and regulations (€ 1.1 milliard) and shortcomings in design and/or provisional estimates (+ € 0.2 milliard).'

'It turned out that the Project Management did not consider the budget allowed by parliament as task setting, which resulted in an increasing divergence between (estimated) cost and budget. It seems that cost control was done in the accountant's way (registration and ex post accountability) rather than in the cost engineer's way (challenging estimates and monitoring and countering cost/budget divergence).'

Risk Management

Apart from specific allocations for the Betuwe Route and for the simultaneous project HSL-Zuid, the high speed passenger rail connecting Amsterdam and Rotterdam to Brussels, the National Budget 2003 showed a new reservation for a financial risk in 'railway programs, to the amount of € 985 million.

When asked, the responsible Minister of Transport, Public Works and Water Management admitted that this reservation had been earmarked for the HSL-Zuid and the Betuwe Route.

The idea of taking the risks together, and not detailing a split up or details was motivated by the idea that you should not show your cards to contract partners, and that by using this reserve the Minister would not have to ask the parliament for a budget increase each time there was a scope change.

Parliament did not accept this without comment, and the 'Netherlands Court of Audit was asked to report on this 'Risk Reservation for the Betuwe Route and the HSL-Zuid' (Algemene Rekenkamer, 2003). Some interesting conclusions were:

- The necessity of having this risk reservation could have been prevented by adequate project and risk control.
- The Court of Audit can not validate the reserved amount of € 985 million. Neither an integral risk analysis, nor separate risk analyses but opportunities for reallocation and availability of funds determined the exact amount(!). The estimated probability of cost overrun is in the 90% range(!).
- The definition of scope change was scrutinized. Agreement was reached that two types of scope should be discerned, the functional scope and the technical scope. Replacing a bridge by a tunnel would be a functional scope change, whereas replacing one type of bridge by another type would be a technical scope change. The State Council of Accounts and the Minister also agreed that a scope change is to be defined as an explicit choice for a new functionality. The Council disagrees with the Ministry on the point of cost allocation of a scope change, however, and states that the cost of a scope change cannot be charged to a risk reservation. The implication is that the Minister would have to get parliamentary permission and funding for each scope change.

Discussion

It is not to be denied that there is a large difference between the first proposal € 1.59 milliard (1990) and the € 3.67 milliard budgeted in 1995. This difference is fully explained, however, by the completely different scope. Whereas in 1990 the reconstruction of an existing railroad was envisaged, this plan was abandoned mainly for environmental reasons. Trains on the existing Betuwelijn pass right through the centre of some 15 towns and villages. The Betuwe Route, to which the Havenspoorlijn (Port line) and the shunting yard Kijfhoek were later added, avoids densely populated areas as much as possible, and where impossible, costly measures were taken to guarantee safety and to prevent hinder, e.g. by an extensive noise reduction plan. In one case a planned bridge was replaced by a costly tunnel, purely to placate an uncooperative municipality.

Nor is it to be denied that a further cost increase from € 3.67 milliard budgeted in 1995 to € 4.71 milliard budgeted per ultimo 2002 is negligible. It should be noted, however, that the State Council of Accounts reported that in the period studied less than 10% of the budget increase could be allocated to 'shortcomings in design and/or estimates'. € 0.10 milliard thereof could be attributed to underestimated electro technical systems, tunnels, engineering structures, and superstructure. New regulation and unrealistic assumptions resulted in underestimates as well.

As an example, the practical impossibility of rolling of the cost of soil treatment to the original polluter added € 0.11 milliard to the provisional estimate of € 0.04 milliard.

It is interesting to note that cost overruns in (public) megaprojects are more rule than exception.

Morrow (1988) studied 52 megaprojects, defined as being in excess of U.S. \$₁₉₈₄ 1 billion. His findings are summarized in the next Tables III and IV.

Table III: Effect of Ownership on Cost and Schedule of Megaprojects

	<i>Ownership</i>		
	<i>Public</i>	<i>Mixed</i>	<i>Private</i>
Cost Growth (Actual cost divided by estimate made at start of detailed design)	1.9 (13)*	2.1 (8)	1.7 (25)
Schedule slip (Actual time from start of detailed design to construction completion)	1.05 (13)	1.22 (8)	1.22 (26)

* Numbers in parentheses represent the number of projects

(We seem to be lucky that public private partnership did not work out in the Betuwe Route case!)

Table IV: Correlation of Megaproject Size and Cost

	<i>Correlation to size*</i>
Cost growth	+ 0.27
Schedule slip	- 0.17
Operational problems	+ 0.19

* measured by natural log of cost

Conclusion

No doubt the megaproject Betuwe Route shows a large cost overrun as well as a two year schedule slip. Comparing the – expected - total cost to the original budget (strictly spoken not yet feasible since the project has not yet finished), one might ask ‘Why does it seem so difficult to make a realistic estimate of the total cost?’.

Based on a study of essential documents, selected from the vast amount of publicly available information, the conclusion may be drawn that in no way one would have to cast doubt on the capability, the dedication or the integrity of the cost estimators involved. Underestimating is responsible for a really small part of the final outcome / original estimate ratio only. And even then, underestimating can be explained by shortcomings in design, by change in regulations, or by assumptions that seemed completely justified at the time they were taken. The State Council of Accounts criticizes the estimating methodology for intransparency and working with fuzzy definitions. No evidence is given, however, that any resulting estimates were ‘off the mark’ for this reason. Cost estimating has elements of science, but also of art. Cost Estimating sometimes needs the help of the Law of Compensating Errors.

It appears that the responsibility for the cost overrun (and accompanying schedule slip) is the full responsibility of politicians, trying to please voters by expanding the scope on the one hand, and by penny pinching on the other. Disagreement between estimate and budget is not necessarily proof of poor estimating, after all.

It is clear that worries over the exploitability of the Betuwe Route are serious. The almost certain losses that will be suffered in the first years (if not forever), however, may well be compensated by hard to measure immaterial advantages and by economic advantages resulting from, but not allocated to, this project. We only may hope that one day a politician will state: “if we would have known in advance the total cost of the Betuwe Route we probably wouldn’t have built it. We are glad now that we did!”. After all inland shipping and road trucking are most serious competitors, but they have vulnerabilities of their own.

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