MANAGING THE RISKS OF A LARGE-SCALE INFRASTRUCTURE PROJECT: the case of Spoorzone Delft

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Abstract

Risk management in large-scale infrastructure projects is attracting the attention of academics and practitioners alike. After a brief summary of the theoretical background, this paper describes how the risk analysis and risk management shaped up in a current large-scale infrastructure project in the Netherlands. The project in question is Spoorzone Delft, which involves the construction of a railway tunnel, the demolition of a railway viaduct, and the realisation of some 1,500 housing units, 20,000m² of office space, covered parking lots, bicycle sheds, new civic offices and a ticket hall in a railway station. ProRail and Ontwikkelingsbedrijf Spoorzone Delft B.V. drew up a risk management plan to identify potential risks and to present strategies for controlling or reducing them.

It emerged that risks were determined and quantified largely on the basis of subjective estimates. The risk inventories exhibit strong dynamics from quarter to quarter.

The findings indicate that it would be sensible to concentrate more closely on the insurability of risks and to differentiate between risks at system level and component level. The academic theory advises a stronger orientation towards flexibility and the identification of options.
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1. Introduction and theoretical background

In recent decades, both academic journals and professional publications have homed in on the risks associated with large-scale infrastructure projects (see e.g. Miller & Floricel, 2005; Miller & Lessard, 2008; Priemus et al 2008), primarily with a view to the avoidance of overrun budgets. This very theme has been discussed several times by Flyvbjerg (e.g. Flyvbjerg et al., 2003; Flyvbjerg & Cowi, 2004; Flyvbjerg, 2009), who makes a case for ‘reference-class-forecasting’, a strategy in which the primary steering instrument is not the project budget but references to similar previously implemented projects against which the project in question can be compared.

A second strategy involves the systematic application of ‘checks and balances’. Often, projects are hampered by principal-agent problems, whereby the empowered authority (central or local government) is largely dependent on the knowledge of the parties who are directly involved. Checks and balances can be strengthened by professional, independent supervision, the four-eyes principle and the insertion of go/no go moments, when benefits can be reaped from market forces (TCI, 2004). In such cases an integrity policy is certainly advisable (Wachs, 1989; 1990).

This brings us to a third strategy: the utilisation of market forces and the reinforcement of competition. A level playing field is stimulated in the construction industry by, amongst others, European tender procedures, which place constraints on the formation of monopolistic power blocks. Until recently, the construction sector in the Netherlands was riddled with cartels and, even now, deals between construction firms, real-estate players and suppliers, and subcontractors may still be hampering fair competition.

Finally, some authors make a case for keeping the options open: promote flexibility to avoid entrapment (Brockner & Rubin, 1985) and ‘groupthink’ (Janis, 1982; Miller & Lessard, 2008). The determination of alternatives and keeping the options open for as long as possible can prove important in this regard. Value can be created by deploying the options in the course of time. Accordingly, the ‘real-options framework’ has been developed academically along the same logical lines as the model that Black & Scholes (1974) developed for the financial markets. The translation from financial options to ‘real options’ is analysed by Dixit & Pindyck (1995) and Trigeorgis (1996).

The latter strategy is at odds with the strategy propagated by the Elverding Commission (2008), namely: early determination of a preferred variant after a broad orientation phase involving many different players.

The main questions addressed in this paper are: How does the risk management of a large-scale infrastructure project take shape in practice in the Netherlands and how can it be improved? It should be noted beforehand that there is no reliable database for recently executed projects, so the actual application of ‘reference class forecasting’ is not yet possible.

The methodology is simple. It involves one case study: risk management in the Spoorzone Delft Project. This project was chosen because it represents a good combination of infrastructure and real-estate development. The main focus is risk management in the execution phase. The case is placed in a broad theoretical framework in which many problems that commonly arise in strategies for large-scale infrastructure projects are explained. We look for the theoretical framework that best explains current risk management for Spoorzone Delft.

The aim of this study is twofold: to point the way towards a more effective and efficient risk management for large-scale infrastructure projects and to find theoretical explanations for the problems that arise in practice.
The subject of this paper is the railway tunnel project in Delft: a large-scale combined infrastructure (a rail tunnel to replace a rail viaduct) and real-estate project (new civic offices, homes, offices and parking facilities). The combination of functions and the embedment in a dynamic environment make this a very complex area-development project.

The paper starts with a brief history and description of Spoorzone Delft and the structure of the project organisation. I shall then discuss the concrete aspects of the risk analysis and the risk management. I shall conclude the paper with some evaluative comments and recommendations.

For the record, it should be noted that I have been a member of the Supervisory Board of Ontwikkelingsbedrijf Spoorzone Delft BV since 2009. Though I am certainly not the auctor intellectualis of the risk management method, I agree that this paper could be interpreted as an example of a 'butcher who approves his own beef'. It would indeed be difficult to contest allegations of mixed roles. But the aim of this paper is not to evaluate the methods that were applied but rather the way they are presented. This will take place as clearly and as objectively as possible so that every observer can draw his own conclusions on the basis of the information. If such conclusions lead to practical improvements in the way risks are managed in large-scale infrastructure projects in the Netherlands, then so much the better.

2. Brief History of the Spoorzone Delft Project

In 1988 the Dutch Railways set out its vision for the future in a publication entitled Rail 21 (Nederlandse Spoorwegen/ NS, 1988), in which one of the main spearheads was quadruple tracks on the entire Amsterdam-Dordrecht line. The double-track rail viaduct that cut straight across Delft was identified as a bottleneck and a search began for creative solutions to what was a very noisy stretch of railway. The preliminary sketches showed a quadruple-track railway tunnel, which would not only get rid of this bottleneck in the transport system of the Randstad but would open up opportunities for enriching the city of Delft with a top-notch urban development comprising homes, offices, central amenities and parking facilities (Van Til, 2004). In 1990 the Municipal Executive of Delft incorporated the railway tunnel in its programme (Priemus, 2004).

A public-private partnership was set up with Ballast-Nedam and NS Vastgoed (partners in the Spoorzone Delft Development Combination/Ontwikkelingscombinatie Spoorzone Delft/OCSD) to work out the plans, the costing and the exploitation prospects. The Spanish architects’ firm Busquets drew up an ambitious plan for the layout of the railway terrain. The contest for the contract for the civic offices had attracted a lot of publicity and was awarded to Mecanoo Architects. The station upon which the civic offices would be built was designed by Benthem Crouwel Architects.

In October 2006 Ontwikkelingsbedrijf Spoorzone Delft (OBS/ Spoorzone Delft Development Company) was set up with the Municipality of Delft as the sole shareholder. In July 2008 the Ministry of Transport, Public Works and Water Management revised the budgets and reallocated them between the Municipality of Delft and the Dutch Government: the Government assumed the risk for the construction of the tunnel.

3. The Spoorzone Delft Project

The area covered by the Spoorzone Delft Project is shown in Figure 3.1.
The tunnel would be funded by the Ministry of Infrastructure and the Environment (formerly, Transport, Public Works & Water Management) and realised by ProRail. The municipal authority would contribute to the costs. ProRail was awarded the contract for the shell of the tunnel (not for the railway infrastructure) and Crommelijn contractors’ consortium (CCL) was awarded the contract for the underground station (rail section of the Transport Hub). ProRail also commissioned CCL to make the entire area ready for the construction work and the new layout of the public space (IOR): the OBS acted as the principal for the construction of the Spoorsingel parking garage (PSS).

The OBS would be responsible for the urban redevelopment and the realisation of the urban part of the Transport Hub and the civic offices. At the request of ProRail the OBS also took charge of the realisation of the ticket hall.

**Rail tunnel**

The rail tunnel scope included the underground station, complete with bicycle shed, and the preparations for the construction of housing on the surface. The rail tunnel would be built as a concrete shell with a capacity for four tracks, but only two tracks would be laid for the time being. ProRail would be responsible for realising this part of the project. Since then, the timetable has been adapted: the work will take 13 months longer than originally planned. The milestones in the contract planning (excluding risk profile) have been revised on the basis of the planning scenarios developed in the collective planning studio (OBS/ProRail/CCL/partnership team).

**Town hall and ticket hall**

The town hall (29,000 m²) and the above-ground ticket hall (4,500 m²) would be integrated in one building located on and beside the tunnel to the north of the Station Square. The ticket hall and the public hall would be located on the ground floor of this building – on and beside the tunnel respectively.

The ticket hall would form the main entrance to the underground station and the space where NS would develop commercial space. The municipality would set up the public desks, the information centre and the working area in the public hall. The premises above the two halls would be used by the municipal staff / third parties and include a restaurant and a meeting centre. A bicycle shed for the staff, the boiler rooms etc. and the dispatch centre would be built in the basement of the civic offices.
Plan Busquets/Public Space

The sub-project for the layout of the public space (Inrichting Openbare Ruimte/IOR) revolved around the realisation of Plan Busquets. It was split into two parts:

- The part in the CCL contract. ProRail awarded the contract for this part of the layout of the public space to CCL in July 2008.
- The rest of the project – for which the contract is still to be awarded.

CCL has recruited Grontmij to work out the design for the public space.

Real-estate development

The area development encompasses the construction of around 1,500 homes, 20,000 m² of office space and covered parking facilities. A public park on the tunnel will be a crucial quality element in this new part of the city.

At present, market downturns appear to have stymied the chances of realising the desired proceeds from the land. There is also a growing awareness that the developments in the area need to be tackled in a different way from the one that was contractually agreed.

Various real-estate scenarios were discussed with OCSD and the consequences were mapped out. The urban planning structure, the programme, the phasing and the finances were comprehensively studied in these scenarios. A decision has since been taken to pursue a more flexible, process-based strategy with no predefined results. This is a major departure from the original plans.

Parking

OBS has been tasked with solving the following parking issues in the Spoorzone:

- Compensation for parking places that will cease to exist (residents’ and visitors’ parking);
- Parking places as a result of new-builds (residents’ and visitors’ parking for homes and offices);
- Parking places for the civic offices (users and visitors);
- P+R places.

Initially, the car park for the civic offices and the station was to be built under the civic offices. This plan was abandoned in the tendering phase because it was financially non-viable. New locations are being sought adjacent to the Spoorzone.

Management of conditions

Risks stem not only from the project itself but also from the prevailing conditions. The quarterly OBS report pays attention to the following determinants: archaeology, permits, land acquisition and other land transactions, soil transport and – most importantly – groundwater abstraction. Safety and communication are also important themes. These themes are explored further below.

Business case

The business case is systematically updated twice a year (the end of June and December) whereby all information known at that moment is taken into account. The updated business case at the end of 2010 (version: January 2011), with an end value of zero in January 2031, addressed, amongst others, the effects of the adapted realisation timetable, the new analysis of the economic value of the parking facilities, and initial cohesion with the financial administration. A new analysis was drawn up for the public space comprising elements that depend on the real-estate
development and other, more detached elements. The planning and phasing in the business case were updated on the basis of this analysis.

**Planning**

The second half of 2010 was spent mainly on drawing up an uncertainty analysis for the tunnel planning and the effects on the parts of the projects within the scope of OBS. The most important element was the construction of the new civic offices and the integrated new ticket hall. A 4D (3D+Time) simulation was made of the construction of the civic offices and connected to the draft timetable. ProRail, CCL and the partnership team made a start on a phasing book (2D+Time) for the station area.

**Risk-management plan**

On 14 December 2010 the basis for the risk policy of Ontwikkelingsbedrijf Spoorzone Delft was recorded in a Risk Management Plan authored by Robert Huisman (Huisman, 2010). Joris Hoogerwerf drew up a similar plan for ProRail (ProRail, 2011). It was clear that, for many years, there had been no risk management plan for the development planning. The risk management for Spoorzone Delft is described in an analysis by the Nederlands Adviesbureau voor Risicomanagement (2010), commissioned by Delft Municipal Council.

The risk management plan “should explicitly set out all risks and opportunities that could influence the outcome of the project so that they can be adequately addressed or utilised via prompt and efficient action.” (Huisman, 2010: 3).

“The primary aim of risk management is to support the project management. The continuous and pro-active identification and quantification of uncertainties that influence the outcome of the project and the implementation of management measures and subsequent reports are of prime importance. The aim of risk management is, at all events, to stabilise the project risk or reduce it to an acceptable level and to get an optimal result. A direct link must be laid with the Business Case and the management of unforeseen items.” (Huisman, 2010: 5).

An additional, incidental aim of risk management in the OBS part of the Spoorzone Delft project is to support the tendering procedure across the entire spectrum, all the way from issuing invitations to offers, negotiations, selection and planning permission.

The risk management process for Spoorzone Delft consists of ten steps:

1. “Organise the project management.
2. Compile an inventory of/identify uncertainties and opportunities.
3. Determine and confirm cause and phase of action.
4. Allocate and categorise uncertainties and opportunities.
5. Name risk/opportunity owners (internal allocation).
6. Quantification (estimate risk/opportunity).
7. Management (fix management tactics).
8. Monitor, evaluate and update risk/opportunity and management tactics.
9. Analysis (in relation to available resources) and
10. Report.”

(Huisman, 2010: 6; ProRail, 2011: 7).

Steps 2 through 8 are ongoing; the last two take place at the end of each report period. Every step in the process is supported by a risk dossier. Every risk/opportunity that is identified is recorded in one of the risk dossiers.

Risks/opportunities can be identified by any employee of the OBS Project Organisation. The risk manager is responsible for recording any new risks/opportunities in a risk dossier. The risk
manager ensures that the inventory procedures are properly structured. Interviews are held once every six weeks and plenary sessions are organised at least once a year for this purpose. Theme sessions and top-down analysis can also be organised.

Every risk is allocated to a risk owner in the OBS project organisation. The risk owner is operationally responsible for managing a risk/opportunity. He decides how the risk is to be managed and coordinates the actions. The chance of action, the planning implications and the (direct) financial consequences are estimated for every risk/opportunity. The guiding principle for Spoorzone Delft is that all deviations from the scope (and quality) be redressed; the project aims are not adjusted.

Risk management comprises the following elements:
- determination of the management strategy;
- balancing management tactics with decision-making;
- allocation to an action owner;
- quantification of adjustments and registration of development;
- closing a risk (Huisman, 2010: 7; ProRail, 2011: 9).

In the case of bigger risks a management strategy is first determined by the Management Team. The chosen strategy is then converted into concrete actions. In the case of smaller risks the risk owner can start right away on an inventory of management tactics. The management strategy is recorded in the respective risk dossier (Huisman, 2010: 8).

The risk-management proposal for overlapping and overarching risks must be approved by all relevant, participating parties and have a strong support base (Huisman, 2010: 8). Each action is assigned to an action owner, who is operationally responsible for implementing it and monitoring the results. Every project worker can be an action owner.

Every risk should be reviewed at least once a quarter to ascertain whether the quantification needs to be adjusted. The development of the management tactics and the risk/opportunity as a whole must be recorded in full in the respective risk dossier (Huisman, 2010: 8).

If the risk/opportunity has expired (because the project has moved on or because the risk has been contained or eliminated, it is accorded the status of ‘closed/expired’. If a risk/opportunity has materialised (and corrective measures are taken), it is accorded the status of ‘materialised’. The plan economist is then contacted to decide whether the ‘unforeseen’ item in the Business Case should be adjusted (Huisman, 2010: 8).

The financial risk profile shows the current effects of the uncertainty on the extra costs in the budgets for the different sub-projects, viz public space layout (Inrichting Openbare Ruimte/IOR), car parks and bicycle sheds, real-estate development, and civic offices. Towards the end of each quarter a financial profile is drawn up for all the risks. This profile is based solely on the information in the risk dossiers. Any changes that have occurred since the previous quarter are explained (Huisman, 2010: 9; ProRail, 2011: 10).

Uncertainty analyses are performed to define the feasibility of the milestones. Because of the interconnections between the activities of the different parties, the planner performs the uncertainty analysis for the milestones in the current ‘overall’ planning.
The financial consequences of overrunning (cost-related) milestones are calculated and recorded as one or more separate risks in the risk dossier. The planning economist and the controller agree on the consequences of the risks and the planning economist records them in the Business Case. To ensure that nothing is missed and to enhance reliability quarterly ‘challenge’ meetings are held with the budget holders from the Project Management Department (Huisman, 2010: 9).

The risk manager is responsible for the risk management process and a well-structured inventory. Risk analysis and risk management are a permanent item on the agenda for the discussions between the risk manager and the Director and the Supervisory Board.

Amongst other things this may include change-processing in the risk dossier, trend analyses, the facilitation of risk sessions and management support. The risk manager also checks that the risk dossier is filled in consistently.

The risk owner is operationally responsible for managing his risk. He decides on the risk management strategy (possibly in consultation with the risk manager and/or the core MT) and coordinates the actions (Huisman, 2010: 10).

Once a quarter the OBS director reports on the ten greatest risks, divided over the three categories: OBS business case, civic offices, and other risks to the municipality. The risk inventory, which is constantly updated, is much longer and consists of multiple risks which, in monetary terms, are smaller than the top 10 in each category. The OBS risk inventory is sent once a quarter to the Supervisory Board and Delft Municipal Council. The Municipal Council is informed later of any confidential or market-sensitive risks. The risk report by ProRail is for internal use only. Neither the Supervisory Board of OBS nor Delft Municipal Council are informed of the risks of the ProRail scope.

5. Concluding remarks

This final section establishes a link with the questions posed at the start of this paper:
- How does the risk management of a large-scale infrastructure project take shape in practice in the Netherlands and how can it be improved?

The risk management strategies described in this paper are fairly commonplace in large-scale projects in the Netherlands. Risks (probability x consequence) are identified at fixed intervals. Probability and consequence must be estimated subjectively to some extent. We can see some strong dynamics at work when we compare the quarterly risk inventories. New risks materialise with some regularity. Meantime, other risks disappear, either because they have been addressed or because they have not emerged within the set period.

It is key to understand the interconnection between the risks and to determine the cost implications of changes in the timetable and throughput times. A change in risk A may cause a change in risk B. Delays can lead to new risks or to changes in already identified risks.

It is important that the OBS organisation continues to report the risks once a quarter to the OBS Supervisory Board and Delft Municipal Council. In this context, it is all the more remarkable that
ProRail, which also identifies and quantifies the risks once a quarter, does not share its findings with either party. ProRail should report periodically to the Municipal Council in the same way as OBS.

It might prove worthwhile to perform risk management at two levels: system level and component level with the main emphasis on the relationship between the two. Reviews of the area development and adjustments to the agreements with OCSD are typical risks at system level. The chances of unexpected windfalls are underexposed. Potential windfalls merit as much attention as potential setbacks.

In practice a key role is played by the interaction between the risk manager and the other players. The risk manager is dependent on document analysis, and particularly on what is referred to in the OBS organisation as ‘challenge’ meetings. The initiative can come from the risk manager or another project worker or the director. As soon as a risk is identified, action is undertaken to control it so that no new risks can arise.

Separate attention should be paid to the question of which risks are insured or uninsurable. The national government does not normally insure externally against risks. To cover municipal risks more insight is required into the ins and outs of insured risks.

Miller & Floricel (2005: 120): “The real-options approach recognizes that decisions that determine project cash flows are made sequentially over many episodes. The key insight of this approach is that uncertainty or volatility can actually increase the value of a project, as long as flexibility is preserved and resources are not irreversibly committed.” This general perspective is not yet operational in Dutch project management. The spirit of the real-options approach is, however, being followed in the current redefinition of area and real-estate development in Spoorzone Delft. Recently, a process-based approach and greater flexibility have been accorded a more important place in the real-estate brief, which had to be fundamentally reformulated in the aftermath of the credit crunch and the debt crisis.

The strategy for the Spoorzone project in Delft was not introduced until the execution phase had begun. It is advisable to apply a robust method of risk analysis and risk management at an early stage, preferably when the project is being developed and concretised.

As mentioned earlier, ‘reference class forecasting’ recommended by Flyvbjerg is unfortunately unworkable at present because there are not enough data on completed projects.

The above comments on the risk management of Spoorzone Delft can be put to use in the broader risk management context of large-scale infrastructure projects in general.

It is important that risk management be concretised not only in the execution phase of the project, but also in the planning phase, when it is vitally important to identify and work out alternatives.

When market-sensitive information needs to be protected, limits can be set regarding the public disclosure of the risk inventories. Otherwise, the risk policy should be disclosed in full to the empowered authorities (Municipal Executive and Council, States Deputed/States Provincial; Cabinet/House of Representatives).

A study of recent project histories would prove an interesting exercise in a more general sense. How were risks perceived beforehand and how did they pan out later? Where did surprises still spring up – despite a prospective risk analysis? How can these surprises be explained and how can they be prevented in the future?

The study of project histories requires reliable documentation of the decision-making and can deliver useful information for future infrastructure projects. In the long term ‘reference class
forecasting’ (Lovallo & Kahneman, 2003; Flyvbjerg, 2009: 133) is a useful method not only in relation to costs and overrun budgets but also planning times, throughput times, risk factors and risk analysis.

The literature that highlights the value of checks and balances, competition, and the four-eyes principle has practical relevance for managing the risks in large-scale infrastructure projects in the Netherlands. Go/no-go moments are seldom defined in advance; this needs to change. It is far more difficult to keep alternatives open for the railway than for the real-estate development. The flexibility in the railway tunnel stems, amongst other things, from the possibility of realising a quadruple track – if desired – at a later stage: enough scope has been allowed for this. The real-estate development, on the other hand, was fixed in a fairly early stage. Unfavourable developments on the market (homes, offices) and the inevitable cuts in public spending (civic offices) forced the OBS to make the plans more flexible and process-based. It would have been better to adopt this approach from the start. So far, the experience gained from Delft Spoorzone has certainly borne out the academic arguments and theoretical frameworks that emphasise the need for flexibility and a process-based approach.

References


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