Dealing with completion risks

Producing an accurate time and budget forecast for investment projects (CAPEX) remains problematic. Applying a simulation technique with focus on the organisation and their adopted process of managing data and decision making, delivers a better evaluation of the completion risks of a project. The results of such an evaluation demonstrate the envisaged risks in such a way that the associate funding, necessary for the project completion, can be considered more accurate.

By: **André Kik MSc**, senior consultant at AMPS Delft, with years of experience in Capital Projects in the oil & gas industry, chemical and energy sectors, pharmaceuticals and aerospace.

When preparing investment projects, conventional estimation techniques such as benchmarking and risk analysis are not sufficient to accurately predict completion risk. Fight (1999) defines completion risk as: *the risk that projects do not yield (sufficient) revenues as a consequence of time and budget overruns.* Conventional techniques give inaccurate figures because today's projects have become evermore complex. Moreover, the main contractor is outsourcing work to an increasing degree and that makes predicting time and budget overruns much trickier. This article looks at an alternative way to analyse risk, one that does not focus on the work commissioned, rather on the organisation that prepares and carries out the project.

Conventional techniques

Organisations use various conventional ways to try to estimate the operational risks of (investment) projects:

Benchmarking

An investment plan usually starts with an extensive feasibility study. This compares the realisation of the project with a commercial or political objective. Part of such a feasibility study is analysing the risk of time and budget overruns. To fully assess these risks, companies use data from their own industries, known as benchmarking. However, problems arise when projects are so new, large and complex that historical data and benchmark figures no longer have much predictive value. After all, they are based on another organisation carrying out the work. That organisation is so specific in its information processing and its decision making that any data produces inaccurate predictions.

Drawing on first-hand experience

In addition to benchmarking, risk assessment can be based on the organisation's experience. This is done by defining the main project risks and applying a probability of occurrence to each risk. By anticipating the greatest risks, organisations try to reduce their completion risk. Nevertheless, this method also has a disadvantage: more and more companies nowadays outsource elements of a project to other contractors. This reduces the reliability of the results because estimates are largely based on first-hand experience and not on the subcontractors' experience. Their experience of the identified risks is harder to map, let alone operationalise it for risk analysis.

One principal party

Another way to manage project risks is by depositing all the risks with one contractor. The idea is that one party is best able to manage all potential risks. Having all subcontractors report to just one contractor makes it clear to the client who is ultimately responsible for project completion. This mode of contracting saves the client a great deal in legal fees in the case of a dispute, but it does have limitations: when contracting a single main contractor, any penalty on potential delivery overruns is maximised. This maximisation is based on the amount of the (sub-) contracted sum. A delayed delivery date resulting in loss of income and additional interest expense on invested capital ensures that such penalties are, in many cases, overtaken by those lost earnings.

Indirect method

A spin-off technique exists to perform risk analysis. This technique is more indirect as it regards the commissioned work as a derivative of the commissioned organisation. In other words, the focus is not on what is delivered but on the organisation that performs the work, including any associated risks. This indirect technique determines risks by analysing how an organisation processes information and makes decisions. The results of such an analysis have proved to give very accurate predictions about the way the work is carried out and the ensuing quality. This is especially true for complex projects that are carried out in a joint venture. This indirect method was developed at the end of the 20th century at Stanford University in the United States and has been successfully used over the last 20 years to support decision making in a range of investment projects world-wide by organisations such as NASA, BAE Systems, Shell, Chevron, Vopak, Dow, Intel, HP and Genetech.

Make or buy

The concept originated at the US Department of Defense (DOD) and Stanford University. The DOD was searching for a better way to substantiate make or buy decisions (do-it-yourself or outsource) so it approached researchers at Stanford University. They quickly turned their attention to the DOD itself. Using sociological insights, they established that the way information was processed within the DOD was particularly crucial. What happened, for example, when an employee had too many tasks? That person performed certain prio ritised tasks and postponed other tasks. This slowed down the speed of information processing (the person allowed certain information and blocked other information), slowing down the speed of decision making elsewhere. The employee did not give information to other decision makers in the organisation on time, with the result that those employees made decisions based on insufficient knowledge. This increased the chance of mistakes, leading to work that had to be re-done and ultimately delays and costs. The study demonstrated that the essential element was not the estimated and budgeted implementation time but the time it takes to process information and make decisions to commence the implementation process. The developed concept was operationalised (Kunz et al., 1998) using a simulation model that works around a database with validated group properties. Some characteristics of that database are: do team members have a lot of experience in this work, have team members been assigned to one or more projects, are team members often disturbed (phone calls, specialist knowledge) while working, are team members located at one or multiple locations, are standards used, etc? For more characteristics, see the text box example; Horii et al, 2005.

Bad estimates

A significant finding in Stanford's research was that the DOD incorrectly estimated the timetable of projects repeatedly by incorrectly assessing the risks. Researchers had touched on a sore spot common to all organisations: people are notoriously poor in estimating properly (Kahneman, 2011). For example, many estimates are influenced by the outcome we would like to see. Wishful thinking is responsible for distorting many estimates in terms of the completion time and the cost of the work to be carried out. The Construction Industry Institute1 surveyed 975 investment projects approved by Executive Boards (average size $65 million and an average completion time of twenty years), showing that 70% of projects had an acceleration/deceleration and/or a cost under/overrun of more than 10%. What do we learn from this? If the risks had been more accurately estimated, other choices would have been made in the preparation of, among other things, financing terms. >>

Public Private Partnership

In a recent study (Kik, 2010), the simulation model was tested on several Dutch project organisations. The study examined the tendering stages of four Dutch projects with a Public Private Partnership (PPP) contract form. A PPP contract involves the contractor designing, financing and realising a commission and being paid out of the rental income of the completed object. Examples of such objects are buildings, infrastructural works (roads, bridges, tunnels, rail lines) and ships. The study looked at the tendering stage of a PPP because this stage follows a protocol2. This protocol standardises the tasks to be carried out for such a tender, making it possible to compare results. The organisational characteristics of each project were entered into the simulation model. The results of the simulations were determined by comparing the planned end date of the tendering stage (as estimated by the appropriate project organisation) with the predicted end date of the simulation model. Due to the limited nature of the population - just four projects - the results of this study are indicative but spectacular enough owing to its accuracy (reliability > 90%). The table below, based on the data and the results of one of the projects studied, shows how a cost overrun, as part of the completion risk, can be predicted.

Predicted cost overrun

For the purposes of this article, the PPP project chosen as a sample calculation was a new building for the Tax Office in Doetichem, the Netherlands. The simulation model's input data included about twenty characteristics of the client's team. Seven of these characteristics are listed below. In addition, several characteristics from the example in the text box (Horii et al., 2005) were extracted. Further details of this Ministry of Housing and Construction (MHC) project include a client's team of 22 employees with a planned and actual end date of the tendering stage.

		Difference in time in comparison to planned end date
Planned end date (client MHC)	01MAY07	
Actual end date (client MHC)	01MAY08	12 months
Simulated end date	17APR08	11 months and 17 days
		(11months +17d./30d.) / 12months = 0.964
Difference in % in comparison to planned date		4%

From Kik (2010)

The end date predicted by the simulation model, 17 April 2008, was used to forecast a cost overrun. The date of 17 April 2008 deviates slightly (4%) from the actual date, 1 May 2008. Therefore, it gives a good indication of the accuracy of this simulated result (> 95% accuracy). Other data used in this calculation: an assumed average hourly rate of 125 euros with an assumed attendance of 50% and a delay of 11.6 months (the difference between the planned end date and the simulated end date). The predicted straightforward calculation of a client's cost overrun in this tendering process amounts to:

22 fte x € 125 per hr x 50% attendance x 11.6 mths x 4.2 wks x 5 days x 8 hrs = €2,679,600

The unusual aspect of this method of risk analysis is the emphasis on the characteristics of the commissioned organisation. Some of those (twenty) characteristics are:

1) How many times a week do meetings take place, how long do they last and who attends them? (time spent in joint information exchange and decision making)
2) Has the project team ever worked together in this composition? What is the commission's degree of difficulty?
3) Does the commission have a high priority?
4) Are there many (as yet) unknown issues?
5) Can tasks within the project team be taken over by other team members?
6) To what extent do the applied (complex) solutions affect other tasks?
7) How experienced are project members with their work?

All these characteristics can be traced back to the concept of information processing and decision making.

This study highlights the fact that the predicted duration of a (partial) project (in this case the tendering process), and thus indirectly the completion risk, can be determined by focusing on organisational risks. In practice, benchmark data and risk analyses are too inaccurate to predict large-scale investment projects. Benchmark data, by placing too much emphasis on technical risks; risk analysis, by quantifying inaccurate risks because of the increasing amount of outsourced work. When engaging a single main contractor, any penalty for a potential completion overrun is maximised but then consumed quickly by lost income and additional interest charges.

Operationalisation of human behaviour

Horii et al. (2005) showed that decision making within organisations affects the quality of the work. He compared similar work carried out by two organisations with distinctive cultural backgrounds; a Japanese and an American company. Horii and his team used Stanford's simulation model to conduct their research. That model contains a database with validated characteristics of human group behaviour. Examples of such characteristics are: the organisation structure, the way in which employees interact with each other and make decisions; the degree of difficulty of the work and the experiences of the organisation with such work. The study showed that organisational characteristics affect the completion time of work, but that both organisations needed the same completion time to deliver the work. The American company was more flexible because decision making took place lower down organisation (flat organisation, dividual decision-making methods), but this organisation could not always sufficiently maintain the agreed quality due to incorrect decisions. This quality requirement meant exeffort had to be made to deliver job properly. Compared to the American organisation, the Japanese organisation needed more time to make decisions (hierarchical organisation, group decisions). However, the quality of those decisions was so good that tasks were performed correctly first time.

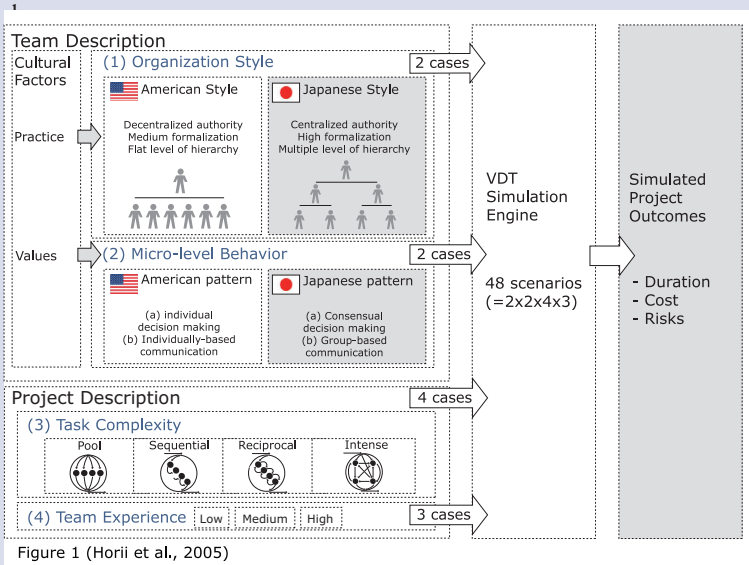

Figure 1 (Horii et al., 2005)

Conclusion

The reliability of current risk analyses with their subsequent inaccuracies regarding the completion risk is limited by the use of outdated analysis techniques. A significantly more accurate prediction of the completion risk is obtained when the work to be delivered is taken as a derivative of the operational organisation. A more precise prediction of the completion risk means resulting decisions, including the financing of a project, are arrived at in a more considered way. Research over the last 25 years, a large number of scientific publications, several dissertations and results on the ground in recent decades all show that the completion risk of a project is determined chiefly by the speed of information processing and the quality of decisions made. This concept is operationalised using a simulation model and has been successfully applied around the world over the last 20 years by a range of organisations to support them in their decision making.

Notes

1. https://www.construction-institute.org/scriptcontent /index.cfm/
2. Congresverslag PPS (2008). Ervaringen met rijkshuisvesting. Den Haag: Staatsuitgeverij.

Literature

- Construction Industry Institute (2012). *Performance Assessment*, Edition 2012. Austin: University of Texas.
- Fight, A. (1999). *Introduction to project finance.* Oxford: Butterworth–Heinemann.
- Horii, T., Y. Jin and R.E. Levitt (2005). Modeling and Analyzing Cultural Influences on Project Team Performance. *Computational & Mathematical Organization Theory*, 10, 305–321.
- Kahneman, D. (2011). *Thinking Fast and Slow*. New York: Farrar, Straus and Giro ux.
- Kik, A. (2010). *Kwantificering van organisatorische risico's binnen een omgeving met bestuurlijke besluitvorming*. Scriptie, Universiteit van Amsterdam
- Kunz, J.C., R.E. Levitt and Y.H. Jin (1998). The Virtual Design Team: A computational simulation model of project organizations. *Communications of the Association for Computing Machinery,* 41(11), 84-92.