Flexibility: The Secret to Transforming Risks into Opportunities

Interview with **Stefan SCHOLTES,** professor of management science, Judge Business School, University of Cambridge (U.K.)

Mathematician Stefan Scholtes helps companies to deal with uncertainty appropriately, meaning without falling into the trap of simplistic planning schemes. He invites us to explore a form of uncertainty inherent to projects—the long-term value of system design —that presents both risks and opportunities. If you are about to launch a large-scale project, whether the construction of a factory, of an oil platform or a hospital, you must design flexibility into the system you are building. System flexibility is key to ensure that the project will deliver value over a long system lifetime.

Are traditional project risk management methods inadequate for managing project uncertainty?

Academically PRM has come a long way, but much of practical project management is still very simplistic when it comes to uncertainty. Project planning will typically involve projections about the future. The project is then planned for these projections. However, if there is one certainy in forecasting then it is that the forecast is always wrong. Therefore projection-based methods of managing the unknown are quite limited in worth. These approaches suffer first and foremost from the "flaw of averages", a term coined by Sam Savage of Stanford University. Sam explains it using the example of a river with an average depth of 50 centimetres. Can you cross the river safely on foot? The answer is no. The average depth of 50 centimetres may be a good initial projection but it does not exclude the possibility that the riverbed be spotted with 3 meter deep holes. The variation is crucially important to understand the situation.

In a recent article[1], Sam and I list seven "deadly sins" that trigger the flaw of averages in business. For example, if a bank is targeting two types of clients, such as students whose average annual income is 10,000 dollars and young professionals earning an average of 70,000 dollars a year, there would be no point whatsoever in offering products and services for an "average" client whose yearly income is 40,000 dollars! Managing the average can be a fatal mistake. Modern project risk management acknowledges the weakness of projection-based plans and advocates the use of ranges and probabilities, leading to contingency planning. However, doing this effectively and systematically across a series of projects is still quite a challenge for many companies. In the above-mentioned article, we suggest a modelling approach that deals coherently with distributions and probabilities and help companies understand how variation propagates from its source to project or system performance. This coherent modelling involves interactive simulation tools where variables can be modified and the effect of uncertainty can be "felt" by managers in real time. A company might also decide to appoint a CPO (Chief Probability Officer) who would be both a manager and a statistician. It would be up to him or her to find a pragmatic balance between complex multi-variable series of statistics and basic average-based projections.

BIOGRAPHY

German-born **Stefan SCHOLTES** is the director of the MPhil in management science program as well as research director at Cambridge's University's Judge Business School. He has held visiting positions at Stanford University, MIT, and the London Business School. Management science applies mathematical rigour and statistical and computer modelling methodology to management problems, and specifically to issues involving uncertainty, choices, and change. Scholtes has written numerous research articles about optimization models and teaches in executive education and MBA programs. He consults for large corporations including IBM, Philips, and BP as well as for start-ups.

Are there other possible approaches for managing project uncertainty?

Generally speaking there are three approaches to risk management: spread your risks through diversification, insure yourself, and make sure you can react flexibly when uncertainties unfold. Diversification is particularly important for financial investments, which can be naturally spread, but less relevant for large-scale projects. Insurance, for example through forward contracts on material prices, can be very important for project risk management. However, I believe the most important uncertainty management concept for large projects is that of flexibility. This is in line with the message of *Managing the Unknown.* The authors advocate that project managers should integrate flexible reaction capacity in the project, so that new schemes can be developed during the course of the project if a wholly unforeseeable event occurs. This is what the authors refer to as "Unk Unks" (Unknown Unknowns). The trial-and-error learning or selection methods that are presented in the book provide generic flexibility, i.e., the flexibility to choose the winner or change the course of action as the project unfolds, without having to know in advance the types of uncertainties that might occur. •••

... Flexibility, however, applies beyond the perspective covered in the book. Managers should not only think about the uncertainty related to a project's execution but also about the uncertainty surrounding the long-term commercial value of the system delivered by the project. Like the approach to unk-unks, this challenge can be met by incorporating flexibility early on in the design of the system.

What do you mean by the uncertainty linked to the long-term future of a project?

A large-scale project has three main areas of uncertainty: The first area is the uncertainty during the construction phase, which PRM aims to capture. Here the focus is often on technical challenges and delivery on budget and time. The second area is operational uncertainty of the installed system after the build phase, with a focus on maintenance and operating costs. The final, and I would argue most important uncertainty, surrounds the long-term demand for the products or services provided, the benefits to the public or the revenues to a company. The focus is on long-term "value for money". Neglecting demand uncertainty can lead to technically brilliant projects which are "value-for-money" flops. A celebrated example is Motorola's Iridium satellite system, which was launched in 1998. The system consists of 66 satellites and is clearly a triumph of modern engineering – but commercially it has been a disaster, with Iridium having to file for Chapter 11 bankruptcy. It has been argued by de Neufville and his colleagues at MIT that this could have been avoided if the project planners had built in flexibility to cope with commercial uncertainty.

The notion of flexible systems design has been the object of much of my recent research[2] Large-scale projects that install systems with a long operating horizon, such as Heathrow's Terminal 5 or the infrastructure work for the 2012 Olympic Games in London, are more subject to uncertainty and risk than other types of undertakings. For instance, changes in national priorities, public pressure, market fluctuation, technological changes, or organizational complexity of the special purpose consortia set up to run the project, and possibly the delivery system afterwards are important sources of uncertainty.

This uncertainty must be anticipated and managed proactively and early on in the design proces. As in the case of the re-planning methods presented in *Managing the Unknown,* operating teams must be enabled to adapt the system to changing circumstances during its operational life. Flexibility will not only provide a guarantee against paralysis, but it may also open doors to opportunities for success that one wouldn't have been able to capture otherwise. The construction of the first bridge over the Tagus River in Lisbon is an illustration of how opportunities may be generated thanks to the principle of designing for flexibility. The Tagus River Bridge was initially conceived for highway traffic, but the government at the time nevertheless insisted that the bridge be strong enough for rail traffic. Twenty years later, Portugal had joined the European Union and benefited from financing to develop a mass transit network in the capital. The initial investment to strengthen the bridge ended up paying off. The flexibility integrated into the project made it possible to adapt it to new circumstances and extend the public transportation network.

Does this mean that it is time to look at risk in a new way, as a herald of opportunity as much as a danger?

Project teams and their leaders do indeed need to change their mindset. First they must become aware that flexibility is at the heart of uncertainty management for large-scale projects and value management of the delivered systems. A mature relationship with uncertainty and flexibility requires us, for example, to complement traditional projection-based appraisal techniques, such as net present value, by valuation schemes that account for the value of flexibility. Secondly, the prevalent mindset from a "delivery to spec" with its focus on cost and time and on "avoiding the downside" must be complemented by a mindset of "value maximisation" for a system over its lifetime, including the exploitation of its upside potential. Once this new mindset has taken hold, a large-scale project team that has to deal with uncertainty should be guided by leaders who approach each stage of the planning, designing, and delivery process in a pro-active way (see table below). This new way of running a project will prevent unpleasant surprises while also potentially creating new business opportunities. ■

1. "Probability Management: Who Will Wear the Chief Probability Officer Hat in Your Organization?" ORMS Today, February 2006, vol. 33, no. 1.
2. "Maximizing Value from Large-Scale Projects: Implementing Flexibility in Public-Private Partnerships", with Richard de Neufville, Engineering Systems Division, MIT, briefing paper, April 18, 2006.

Proposed Process in the **Design and Delivery of Large-Scale Projects**

Process	New Products of this process
Definition of requirements	A range of forecasts or scenarios, and corresponding possible needs
Conception du projet	An initial design that can adapt flexibly to scenarios and needs that develop
Design of project	Appropriate appraisal of the project including the option value of the design flexibility
Implementation	Monitoring of conditions and adapting the initial design as fits the actual scenario