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Tools to keep projects on the rails - The completion of projects on time and to budget often seems an elusive goal, but success rates can be improved with the application of risk management techniques

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PART 1: Tools to keep projects on the rails - The completion of projects on time and to budget often seems an elusive goal, but success rates can be improved with the application of risk management techniques.

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In 2004 the Standish group, a research company that produces annual reports on IT projects carried out in the US, reported that only 29 per cent of these projects were considered a success, with the vast majority running over time and over budget. Cost overruns averaged 56 per cent of original budgets, and projects took on average 84 per cent longer than originally anticipated. Anecdotal evidence suggests that things are not much better elsewhere. The construction of the new Wembley Stadium in London is two months behind schedule and Pounds 45m over budget. And the West Coast Mainline project, which will introduce high-speed train travel between London and Glasgow, was originally a Pounds 2.1bn project, but has seen costs increase to over Pounds 13bn. Completion has been delayed by three years and compromises in speed and technology have occurred.

Recent years have been marked by a rapid growth in the use of project management as a means by which industrial, commercial and governmental organisations achieve their objectives. Membership in various international project management associations is growing exponentially, postgraduate programmes in project management are appearing everywhere and Microsoft recently claimed to have over 5m users worldwide of its project management software. This growing maturity of project management, however, does not seem to be reflected in a growing success rate. Ensuring project success - delivering a project on time, within budget and to the client's satisfaction - still seems to be notoriously difficult. The cause for all these failures lies in the fact that projects, especially large-scale ones, are inherently risky ventures. How you deal with those risks will be a major factor in whether your project will succeed or fail. Project risks can never be fully eliminated, but efforts can be made to reduce the likelihood of risks materialising or mitigate their impact. The goal of project risk management is to identify the main risks, assess their severity and manage them. The first stage, risk identification, is the responsibility of everyone participating in a project, from senior management to team members, client representatives and stakeholders. By identifying risks, you remove the element of surprise, making dealing with the consequences more effective and efficient. Useful tools for risk identification include brainstorming sessions, industry checklists, post-mortem reports of previous projects and a careful analysis of all the assumptions in the project plan. The result is a risk register, which contains a detailed description of all identified risks.

In the risk assessment phase, the identified risks are classified according to their likelihood of occurrence and impact, should they materialise. Figure 1 provides an example of such an assessment. In most projects, risks are so numerous that they cannot all be addressed with the same rigour. The purpose of an assessment is to prioritise them. The framework in Figure 1, referred to as a likelihood-impact matrix, provides a guideline for focusing your efforts, by distinguishing between extreme (E), high (H), medium (M) and low (L) risks. Risk A, for instance, is considered an extreme risk, B a high risk and C a low risk, although the nature of this categorisation depends from project to project. The result is a prioritised risk register. Such a risk assessment needs to be carried out for the three principal dimensions of project risk: scope (quality), time and resources (budget). In the risk management phase, action is taken to prevent or mitigate risks. These actions can include contingency plans, risk avoidance ideas, risk mitigation measures, risk transference or risk acceptance. Contingency plans do not tackle a risk directly, but provide ready-to-implement plans to mitigate risks in case they occur. This is a useful exercise, since a generally accepted rule-of-thumb says that developing a solution for an issue once it occurs is ten times more expensive than developing a contingency plan beforehand. Risk avoidance implies taking a different route altogether that does not have the same level of risk. Risk mitigation measures can either reduce the likelihood of a risk materialising, or minimise the impact of a risk if it occurs. An example of the former is prototyping, where major issues can be identified while developing a scaled-down version of the project, while an example of the latter is a back-up system that kicks in if the main system malfunctions or is not yet operational. To illustrate, when a new airport was being built in Denver, Colorado, technical problems repeatedly pushed back its opening date, resulting in a 16-month delay and a cost overrun of more than Dollars 2bn, almost bankrupting the city. The delays were mainly caused by a malfunctioning baggage handling system. A back-up system, costing around Dollars 10m, could have prevented these delays. Unfortunately, the city only decided to implement a back-up system six months after the planned opening date. The framework in Figure 1 can also help in understanding how the various risks should be tackled. Risks identified in the top-right quadrant are highly likely events with a major impact, which means they should be incorporated into your plan from the start. The risk of failure for the highly advanced baggage system at Denver Airport was probably in this quadrant, requiring action from the outset. Risks in the bottom-right quadrant require contingency plans. Examples can be found in the Heathrow Terminal 5 project, where plans are in place in the case of terrorist attacks. Risks in the top-left quadrant, of which there will be many, should not be tackled individually, but can be grouped with an overall protection against their joint impact. A typical example is the multitude of minor delays and cost overruns in a project that, when combined, can dramatically affect the project completion but can be tackled by adding time buffers and contingency budgets. Risks in the bottom- left quadrant should not be tackled straightaway, but should be monitored. The final deliverable of this risk analysis process is a prioritised risk register with assigned responsibilities and action plans.

Timeline risks Of the three main project objectives - scope, time and cost - time is receiving more and more attention as time-based competition forces companies to launch products and services earlier and at more regular intervals. This makes managing timeline risks a crucial factor in ensuring project success. Every sensible project manager knows that projects are never executed exactly as planned and that delays are inevitable. So the question is how to manage those delays and how to recuperate from them. Using the framework described above, the first step is to assess the potential impact of delays. To accomplish this, a best-case and worst-case duration estimate for each activity should be determined, along with their expected durations. This enables a calculation of the worst-case outcome to be made, where each activity takes the longest possible time. With this in hand, a rough idea of the potential scale of the problem can be obtained. However, although things will go wrong in a project, it is unlikely that everything will go wrong. Therefore, the second step, a likelihood assessment, is required. For each activity, the likelihood of each of its possible durations should be estimated. This can then be expressed as a distribution, with the duration of an activity specified as anything between its best-case and worst-case estimates, but with more likelihood around the most likely duration. A simulation analysis can then be performed, examining hundreds or thousands of different scenarios, in which the durations of the activities are varied according to their distribution. Software tools such as @Risk for Project developed by Palisade Corporation, which links into Microsoft Project, can be used for this analysis. The result is a range for the overall project duration, with likelihood estimates of being able to complete the project by a certain date. Figure 2 contains an example of the result of such a simulation analysis. The project distribution shows an expected project completion date of July 1 2006, whereas the 90 per cent completion date, which we are 90 per cent sure that we can meet, is September 21 2006. In other words, we need a three-month project buffer between the expected project completion date and the project deadline. Note that it is possible that the project takes even longer, with a worst-case observed outcome of January 18 2007, but this is very unlikely. A simulation also reveals which activities are largely responsible for the potential delays. Traditional project planning results in the identification of a critical path, a sequence of activities from the project start to the project finish that determines the project completion date, with delays in any of those critical activities resulting in a delay of the project. Although the concept of criticality is extremely useful and allows the project manager to focus on a limited set of activities in a project instead of scattering his focus, unexpected events may change the activities to be identified as critical. This means that major delays could arise if the project manager continues to focus on those activities initially identified as critical, but subsequently moved from that list. Using a simulation analysis, one can check which activities in the examined scenarios are responsible for project delays. Some activities will be critical in every examined scenario, and others will never be critical. However, some will be critical only in some scenarios. These activities also require close monitoring, because although they may not be critical at the outset, they can become so because of unexpected delays. A simulation analysis provides a so-called Criticality Index, which is the likelihood that an activity will become critical, based on the number of scenarios in which it was observed to be critical. The criticality indices can then be used to prioritise attention when monitoring activities for possible delays.

A simulation analysis can also reveal which activities contribute most to delays, both in terms of whether or not they have an impact, but also how big the impact is. The latter is not captured by the criticality index, and depends on the risk inherent to each activity. Activities that score highly in this respect are sometimes called crucial activities, to distinguish them from critical ones. A tornado diagram is typically used for identifying crucial activities. For example, Figure 3 shows the criticality and cruciality for each of 16 activities. Criticality is expressed as a percentage or likelihood of becoming critical during project execution, and cruciality is shown as a bar with a size proportional to the activity's impact on the project. For this project, procuring process equipment is the most crucial activity, although it is not certain that it will be critical, indicated by its 70 per cent criticality index. This is due to the large uncertainty with respect to its duration, or in other words, if this activity becomes critical, its impact on project delays can be huge. Between 1993 and 2000, the Swedish-Danish _resund Consortium was responsible for building the world's largest cable-stayed bridge, connecting the Danish capital of Copenhagen with Malms in Sweden. Although clearly an engineering marvel, the project especially stands out because it came in within budget and five months early. From the beginning, the project management team worked to identify uncertainties, quantify their possible impact, prioritise risks as the basis for action planning, and establish contingency plans. Focus was on the opening date, considered the most critical element to project success. Simulation was used to assess and manage the timeline risks, with an initial risk analysis performed in 1993 showing that the chances of opening in 2000 were less than 10 per cent. Plans were put into place to mitigate the major uncertainties, with subsequent risk analyses showing a higher and higher chance of completing on time. After a fourth risk assessment exercise in 1998, the positive results prompted management to push the opening date forward by five months, and this was realised when the bridge opened on July 1, 2000. Although there was a cost involved to fully implement risk management, it was only a fraction of the benefit of opening ahead of schedule.

Buffer management Besides adding a time contingency or buffer at the end of the project between the expected completion date and the deadline, time buffers can also be inserted at specific points in a project's schedule to prevent an unexpected delay in an activity impacting project delivery. Such buffers should be inserted whenever critical tasks require non-critical work to be completed first. In that case, one should ensure that there is some safety time between the non-critical task and the critical task depending on it. These so-called feeding buffers prevent delays in non-critical paths of the project spreading to the critical path.

Budget risks Budget risks can be analysed in a similar way to timeline risks, with three estimates given for each activity: a pessimistic; optimistic; and likely cost estimate. A simulation analysis will then reveal the expected cost and contingency required so that the budget should be sufficient to cope with unexpected cash outlays. A tornado diagram will also highlight those activities that are responsible for the major budget risks.

Portfolio risk Risks embedded in projects contribute to the overall risk profile of the organisation in which the projects are carried out. Therefore, project risk management should not only be performed for each project individually, but also for the organisation's overall portfolio. Project portfolio risk management is concerned with making decisions on which projects to pursue, which to initiate and which to terminate, based on a financial and strategic assessment of the expected benefits and associated risks. Such an analysis is typically based on a net present value analysis, enhanced with sensitivity analysis, scenario analysis and simulation analysis in which the impact of the technical and commercial risks is assessed. Based on the risk appetite of the organisation, a specific portfolio of projects is proposed. Consider for instance the pharmaceutical industry. Drug discovery and development is an extremely risky, time- consuming and expensive process. The average time from compound to market has grown to more than 12 years, with recent estimates indicating that the cost of developing a medicine is around Dollars 1bn. The main issue, however, is the low chance of a drug in development actually reaching the market. The vast majority of drugs in development does not make it through the stringent scientific and regulatory procedures required and is terminated. And of the drugs that do reach the market, only 30 per cent achieve the commercial success necessary to recover the development costs to yield a healthy return. Large pharmaceutical companies such as Pfizer, GlaxoSmithKline and Novartis are highly advanced in their portfolio risk management processes, which are believed to be a core success factor in establishing and maintaining profitability. Recently, smaller biotech companies have also embraced risk management, considerably reducing the huge risk that is typically associated with these ventures.

Summary Project risk management is an essential tool to prevent an abundance of uncertainties and risks affecting a project's success. Various methods and tools are available that can assist the process of identifying, assessing and managing project risks. Such tools include likelihood-impact matrices, risk registers, scenario analyses, sensitivity analyses, simulation, criticality and cruciality indices, project and feeding buffers and contingency budgets. The goal of these tools is to increase the chances of delivering the project on time, within budget and to the full satisfaction of the client, something that is very rarely seen in most projects nowadays.