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Managing the Cost & Schedule Risk of Offshore Development Projects

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The Need for Project Risk Management

As projects move into deeper waters and higher levels of technical sophistication, complexities and, consequently, risks tend to increase as well. Project Risk Management (i.e., managing the risks of cost and schedule overruns during the drilling and facility development phases of the project) has now become an important tool to ensure project success.

With the drilling and development cost of deepwater projects often exceeding $1 billion, owners, partners, and contractors need, more than ever, the ability to:

- set realistic yet reasonable cost and schedule contingencies;
- know the probability of cost overruns and schedule delays;
- know the probability that the sanctioned cost and schedule will be achieved;
- understand the accuracy of a cost estimate or schedule; and
- ensure that project teams identify risks and implement a Risk Mitigation Plan.

In spite of the importance of Project Risk Management, many projects have been frustrated by traditional methods that are time-consuming, confusing and produce questionable results. As a result, decisions to invest in high-risk offshore development projects are still often based on cost estimates and schedules whose accuracy and contingency requirements are little more than “guesstimates.”

Risk is a Project Variable just like quality, cost, schedule, safety, health or environmental impact. And risk can be managed using good project management methods, similar to these other variables. This is the essence of *Project Risk Management.*

However, when Project Risk Management is done ineffectively, or (as is often the case) not at all, we can call this *Project Risk Mismanagement.*

Characteristics of Project Risk *Mis*management

The 10 key indicators discussed below are characteristics of an organization that suffers from Project Risk *Mis*management. (Use this checklist to evaluate your organization!)

1. Projects are authorized primarily based on financial criteria such as profitability, with little quantitative consideration of a project’s cost and schedule risk relative to other potential projects. The result is decision-making based on incomplete awareness of potential risks.

2. The corporate culture encourages project “champions” whose perceived priority is to “sell” the project to management. These “champions” are unlikely to recommend killing a project when it is no longer attractive. The result is projects whose unsatisfactory results are only recognized after they are complete.

3. Management seeks to minimize project cost and time by punishing project managers and teams whose projects overrun the approved budget or schedule. The inevitable result is that estimates of cost and time are “padded” to ensure a low probability of overrun.

4. Management rejects the concept of cost or schedule “contingency” and either forbids it to be included in estimates and schedules, or will accept it only if it is a small amount. The result is hidden contingencies that drive up cost and impair effective project controls.

5. Projects are managed and judged individually and not as a portfolio. Therefore, project managers want to be assured their project will not overrun.

6. There is no common language for Project Risk Management. Terms such as “contingency,” “risk,” “uncertainty,” “management reserve,” “estimate accuracy,” and “probability of success,” are not defined,

understood, or used in a consistent way. The result is poor communication and often distrust.

7. There is no common, consistently applied method for setting or administering cost and schedule contingency. Every project manager, planner, resource manager and cost estimator has their own way of determining how much contingency they require and their own way to incorporate it into the schedule or budget. The result is that projects competing for funds cannot be compared on a common basis.

8. There is no common, consistently applied method for determining or communicating estimate accuracy. The result is that the quality of estimates of cost and time cannot easily be measured, and optimistic assumptions of accuracy can be made.

9. There is no common, consistently applied method for identifying, assessing, and analyzing risks. The result is often an overly optimistic view of the project.

10. There is no common, consistently applied method for Risk Mitigation. The result is that risks that could have been mitigated are allowed to impact the project.

Many of these indicators of Project Risk *Mis*management are the result of attempts to control project risks, and the rest are essentially the result of ignoring them. Yet they all contribute to the reverse of the desired result: risks are increased, projects cost too much and take too long. Yet the solution is not that difficult. It simply requires that we move from Project Risk *Mis*management to an effective program of Project Risk Management.

A Program for Project Risk Management

Implementing a Project Risk Management Process. It is important to remember that the goal of a Project Risk Management Process is to gain competitive advantage by increasing the return on investment from the project. To accomplish this goal, the Project Risk Management Process must achieve the following objectives:

- Reduce project costs and durations by:
  - eliminating the use of hidden contingencies;
  - reducing the required contingency through effective risk mitigation;
  - improving project manager and team effectiveness by replacing an atmosphere of distrust with open communication on the subject of risk and uncertainty.

- Increase the probability of success by:
  - identifying and mitigating risks in all phases of the project; and
  - providing a method to manage risk as effectively as other project variables such as cost, schedule, quality and safety.

- Improve portfolio performance through better investment decision-making resulting from better information for optimizing project risk and return.

To accomplish these objectives, a Project Risk Management Process is required, as well as organizational changes to ensure the process is successful.

The recommended Project Risk Management Process is illustrated by the flowchart in Figure 1, end of paper.

Each step in the Project Risk Management Process is discussed below, assuming a sample project consisting of an offshore floating production facility (eg, Spar, Semisubmersible, FPSO). Note that drilling, subsea pipelines and wells etc. are excluded from the example. In an actual project, these would be treated as subprojects, like the floating production facility, and analyzed separately.

- The contingencies for each of these subprojects, when added, will give the total project contingency.

- The probability distributions of each of the subprojects can be combined by running an additional simulation, in order to get the probability distribution of the total project cost and duration.

The preferred way to carry out these steps is in a facilitated project team workshop with all project participants contributing and exchanging information. These participants should include key members of the owner and contractor project teams, and particularly those responsible for preparing the cost estimate and schedule. Note that this is a departure from a frequently –used technique in which project team members are interviewed separately, after which the risk analyst runs a simulation program and calculates the results. Our experience suggests that having the key members of the owner and contractor teams participate together in a workshop with a neutral facilitator has the following advantages:

- The workshop format provides a much richer discussion of risks and their potential impact on cost and schedule.

- The discussion provides a way to calibrate the level of the base estimates of cost and duration so that everyone understands what is in the estimate and what must be covered by contingency. This avoids the frequent "double dipping" of estimate allowances on top of which contingency is applied.

- The entire team has a sense of ownership of the resulting cost and schedule contingency levels.

- The entire team collaborates on using the results of the risk analysis to generate a Risk Mitigation Plan to which they are all committed.
- Results can often be generated in a single day.

Step 1: Risk Identification

The objectives of Risk Identification are as follows:

- encourage an open dialogue about the risks to project success;
- get the input of all project participants about their perception of risks;
- identify and categorize project risks; and
- provide a basis for Risk Assessment.

To accomplish this, the project team and other stakeholders are asked, in a group setting, to brainstorm possible risks to project success. The most efficient way to do this has proven to be to provide the team with risk categories, and have them develop risks in each one. For example, see Table 1, at end of paper.

Step 2: Risk Assessment

The objectives of Risk Assessment are as follows:

- establish the range of each cost and schedule element due to each risk category acting alone;
- provide a basis for Risk Analysis.

To accomplish this, the same team members who participated in Risk Identification now assess the impact of each risk category on each cost or schedule element, as if that risk category were acting alone. This is done using a Risk Assessment Matrix as shown in Table 2, at end of paper.

Note that this approach overcomes the traditional problem associated with range estimating: people find it very difficult to set ranges. If we ask a project team how much higher or lower the $60MM estimate for Installation might be, they might well say: “We have no idea.” But if we ask how much higher this cost might be due to each of the external risks they just defined on the Risk Identification Table acting alone, they will begin to describe scenarios and attach cost implications to them, thereby setting the range shown in the Risk Assessment Matrix.

The Risk Assessment Matrix presents a Project Cost Model as reflected in the row headings of the matrix. The Project Cost Model will provide the basis for Monte Carlo simulation. Note that it is a simple model based on the following idea:

$$\text{TOTAL PROJECT COST} = \Sigma \text{ (cost elements)}$$

To satisfy the need of the Monte Carlo analysis that the variables (that is, cost elements) be independent, it is best to keep the number of cost elements small (that is, <20) and ensure that they will vary fairly independently. When cost or schedule variables have some degree of correlation, as is often the case, this must be accounted for in the analysis or the contingency will appear to be too small, and the accuracy too great.

Risk Assessment for schedule is done in much the same way. Our preferred approach is to break the schedule into a series of key milestones, such that the total project duration is the sum of the durations between these milestones. The Project Schedule Model, which will provide the basis for the Monte Carlo simulation of schedule, will look like this:

$$\text{TOTAL PROJECT DURATION} = \Sigma \text{ (schedule elements)}$$

The Risk Assessment Matrix for the schedule then looks just like the cost matrix, and uses the same Risk Categories.

Step 3: Risk Analysis

The objectives of Risk Analysis are as follows:

- establish the cost and schedule contingency required for the total project as well as for each cost and schedule element;
- define the contingency associated with each cost and schedule element as well as with each risk category;
- define the Cost and Duration Cumulative Probability Curves; and
- establish the basis for the Risk Mitigation Plan.

Monte Carlo simulation is generally the preferred method to accomplish these objectives. A number of relatively easy to use software packages are available to perform the Monte Carlo simulation. The steps in Monte Carlo simulation are as follows:

1. The Cost and Schedule Risk Assessment Matrices are prepared in a spreadsheet format.
2. The Monte Carlo software is set up to operate on each cell in the matrix that contains a range. This setup requires that a type of probability distribution be selected. Most software provides a selection of distributions. We recommend a triangular distribution as it more closely reflects the variation in typical project data. In the

triangular distribution, a straight line relationship is assumed between the minimum value (at which the probability is zero), up to the most likely value (at which the probability is greatest), and from the most likely value down to the maximum value (at which the probability is zero).

3. The Monte Carlo software is then triggered to run the simulation. At this point the software produces the frequency distribution curve for total project cost and duration. It does this by using the probability distributions in each cell of the Risk Assessment Matrix together with a random number generator to simulate thousands (we recommend at least 6000) of possible outcomes of the project. When these values are analyzed, the result is the desired frequency distribution.

4. The output of the simulation is presented in the formats described in Figure 2, at end of paper. From this information, contingency, accuracy and other decision – support information can be gained.

The following definitions are useful in understanding and using the results of the Risk Analysis:

- *Base Estimate*
  The *base estimate* of cost or duration represents the most likely outcome if everything on the project happens exactly in accordance with the given information and assumptions on which the estimate was based. Since experience shows us that the actual execution of the project will vary from the base estimate, and since such variations (eg, design changes) are more likely to add time and cost than to reduce them, the cumulative probability of the base estimate is usually quite low. The base estimate should be devoid of all forms of *contingency.*

- *Contingency*
  Contingency is the provision made for variations to the basis of an estimate of time or cost that are likely to occur, and that cannot be specifically identified at the time the estimate is prepared. Contingency is not meant to cover scope changes, or extraordinary random events. Most corporate managers agree that contingency should be the amount required to bring the estimate to the point at which it has a 50/50 chance of overrun or underrun.

- *Cumulative Probability*
  Cumulative probability is usually expressed as the probability that the project's final cost or duration will be equal to or less than a given value. For example, a project manager might advise management that there is an 80 percent probability that the project's final cost will be equal to or less than $250 million. When expressed graphically, a cumulative probability curve usually looks like an "S", since it is simply the familiar normal distribution, or "bell – curve" expressed a different way. (Note: some practitioners prefer to express cumulative probability as the probability that the final cost or duration will be equal to or greater than a given value).

The output from the software will also indicate which cost or schedule elements require the most contingency, and which risk categories contributed the most to contingency. This information will be used in the Risk Mitigation Plan.

If proper preparation is done, it is often possible to run the risk analysis during the same meeting during which Risk Identification and Assessment were done. (The participants can take a break during the 15 minutes or so it takes to run the simulation). This gives results right away while the team is still assembled. The meeting participants can then proceed directly to develop the Risk Mitigation Plan.

Step 4: Risk Mitigation

The objectives of Risk Mitigation are as follows:

- increase the probability of success by reducing the probability that high – probability risks will impact the project and/or reducing the impact if they should occur;

- address the most critical risk categories and cost or schedule elements; and

- provide a path forward plan, including steps to be taken, responsibilities and dates, for mitigating risks.

Risk Mitigation planning begins by reviewing the results of the risk analysis to determine what the highest priority risks are for mitigation. The Risk Identification table will also be helpful in this regard. The project team should then proceed to develop a Risk Mitigation Plan as shown in Table 3, end of paper.

The resulting Risk Mitigation Plan can usually be implemented immediately and should be periodically updated.

Summary

The cost, complexity and risk of offshore projects continues to increase. Yet, when Project Risk Mismanagement is effectively applied to offshore projects, the following benefits will be realized:

- Projects cost less and take less time since budgets tend to be lower and schedules shorter when unnecessary contingencies are eliminated.

- Projects have a higher probability of success due to the Risk Mitigation Plan.

- Communication between project teams and management is improved. Risks are discussed more openly, and high-risk projects can be eliminated early, before there is no turning back.

- Better decisions are made, increasing the value of the project portfolio.

This paper has presented the elements of a Project Risk Management method that is quick and easy to use, and has been proven on major international offshore developments.

Author Biography

Richard Westney, PE, PMP, is CEO of Westney Project Services, a Houston – based project management consulting, training and outsourcing firm he founded in 1978. Westney Project Services supports international energy organizations in the application of project management best practices for offshore developments. Mr. Westney is the author of five books on project management, and has served as faculty for executive programs at Texas A&M and Stanford Universities. He holds a BS in Engineering, an MS in Management Science, is a registered professional engineer (PE), and a certified Project Management Professional (PMP). Richard Westney can be reached at R_Westney@westney.com.

Project Risk Management Process

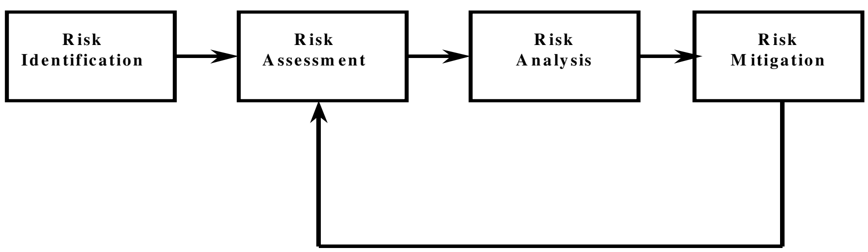

Figure 1: The Project Risk Management Process provides a feedback loop such that the beneficial results of Risk Mitigation are reflected in the updated Risk Assessment

Sample Risk Identification Table, With Categories, Table 1

External Risks	Technical Risks	Project Management Risks	Site – related risks
Unfavorable market conditions raise prices and decrease availability of critical equipment	Current drilling system design proves inadequate to meet new conditions	Lack of Strategic Project Planning results in unresolved issues that delay the schedule	Met-ocean conditions require significant redesign
Labor shortages delay the schedule	Changes in assumed reservoir conditions cause revisions to topside design	Scope proves to be poorly defined and extensive changes cause delays	Existing infrastructure proves inadequate
Changes in legislation require significant design revisions	Dynamic modeling necessitates changes to floating facilities design	Contract planning and administration problems cause delays, disputes, and cost overruns	Interference from other projects in the same time-frame and location causes disruption and delays

Table 1. The Risk Identification Table organizes the risks identified through brainstorming. Sample categories and risks are shown as they might be developed during a Risk Identification session for an offshore production facility.

Sample Risk Assessment Matrix for a Floating Production Facility, Table 2

Cost Element	Base Estimate ($M)	External Risks	Technical Risks	Project Management Risks	Site – Related Risks
Topsides & Deck	200	-10%/+50%	-25%/+75%	-15%/+50%	-5%/+30%
Hull	165	-5%/+10%	-10%/+50%	-5%/+20%	-10%/+10%
Offshore Installation	60	-5%/+10%	-5%/+50%	-5%/+15%	-10%/+10%
Hookup & Commissioning	30	-5%/+10%	-0%/+20%	-0%/+15%	N/A
Engineering & Project Mngmnt.	45	-5%/+10%	-5%/+50%	-5%/+15%	-10%/+10%
Total Base Estimate	500				

Table 2. The Risk Assessment Matrix sets the range for each Cost Element when influenced by each Risk Category acting alone.

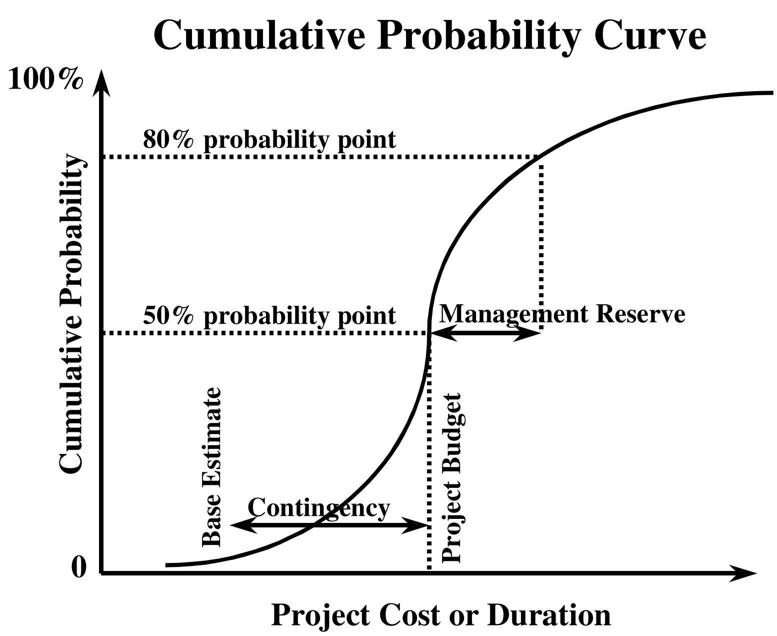

Figure 2. The Cumulative Probability Curve is output from the simulation and used as a decision – support tool.

Risk Mitigation Plan, Table 3

Risk	Action to Mitigate	Cost to Mitigate (H/M/L)	Probability Mitigation Succeeds (H/M/L)	Do Mitigation? (Y/N)	Who Is Responsible?	Date to Complete
Equipment pricing could exceed estimate due to supplier shortages	Accelerate orders for critical equipment (reduces probability of occurrence)	L	H	Y	Hy Pricing	15 May
Topsides design experiences changes due to changing operations requirements	Set up a Configuration Management Program and expedite kickoff meeting (reduces both probability and impact)	M	M	Y	Natalie Attired	10 April
Resource shortfalls resulting from demands from other projects	Develop a program – level plan showing the resources required for each project from the shared resource pool (reduces both probability and impact)	L	H	Y	Justin Tyme	30 April

Table 3. The Risk Mitigation Plan develops mitigation steps and assigns them to project team members. (Note: H=High, M=Medium,L=Low)