INCORPORATION RISK ANALYSIS AS AN ESSENTIAL DECISION MAKING COMPONENT OF SUBSEA CABLE PROJECTS

Donald W. Welch, PhD, Wayne Hughes, Chuck Collins, George Seltzer, Larry Mackey and Tim Axelsson

dwelch@3utech.com

3U Technologies, LLC, 11681 Leonidas Horton Rd., Conroe, Texas 77304

Abstract: Effective system life cycle risk management is critical to the sustained success of an underwater telecommunication system. Three propositions are presented. First, effective system level risk management practices focused on Return on Investment (ROI) should be the over-arching project decision making tool. Second, effective maximization of ROI requires risk management to begin in the Feasibility Study and third, this risk analysis must include all of the phases of the system life. The use of a modular Monte Carlo Simulation is presented to equip decision makers with critical data beginning in the Feasibility phase and extending through the life of the system.

1 OVERVIEW

Identifying, evaluating and addressing risk factors throughout the life of a submarine telecommunication project can significantly impact system cost and reliability over its planned life. Risk analysis at all levels should be undertaken during the early phases of feasibility for a cable system. Risk management considers the possible outcome of future events and actions that can positively influence those uncertain outcomes. Dealing with risk uncertainty requires identification of possible outcomes and analysis of event probabilities versus the consequence of occurrence. The goal is to identify risks that warrant mitigation intervention. In previous SubOptic presentations Cook (2004) and Allan, et.al. (2004) provide a good synopsis of risk management.

Three basic propositions are presented in this paper:

1. **Proposition 1:** Effective system level risk management practices focused on stakeholder Return on Investment (ROI) should be the over-arching project decision making tool.
2. **Proposition 2:** Effective maximization of ROI requires system level risk management to begin in the Feasibility Study phase.
3. **Proposition 3:** System level risk analysis must include all of the phases of the system life up to decommissioning.

1.1 Proposition 1: ROI Should Be Over-arching Decision Making Tool

The primary tenet of this proposition is that Return on Investment (ROI) is the sole driver for the viability of the project and that the over-arching project risk is that the system 'investors' or 'stakeholders' will not achieve their Return on Investment (ROI) over the life of the project.

This tenet dictates a hierarchical structure to risk with ROI risk being at the highest point. All other risk elements are subordinate to this primary risk driver. Figure 1 depicts this hierarchical representation.

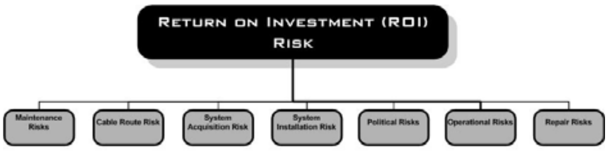

Figure 1. Hierarchical Risk Structure

All project decisions should be based on and measured against this over-arching ROI risk.

1.2 Proposition 2: Effective Risk Management Begins at Feasibility Study

In most projects the close examination of many risk factors does not begin until the Desktop Study, which may be long after the Feasibility phase is complete. This risk analysis is rightly focused on the planned cable route and installation, although, some Operation and Maintenance (O&M) issues are addressed. There are three critical limitations to this approach. Firstly, this approach does not take a system life ROI focus to the examination of risk. Secondly, risk management is not used as the primary decision making tool for the entire project and thirdly, the examination of risk begins after critical project decisions have already been made in the Feasibility phase. This can be too late.

This proposition is centered on the desirability to bring forward an effective risk analysis methodology to support more informed decisions by the stakeholders during the Feasibility phase. At a very top level, ROI models are built around the cost of system acquisition and operation, the longevity and volume of transmission traffic and the ability to price services to meet or exceed the expected rate of return. The more accurate and complete these models are at the feasibility phase the more informed the project decisions will be. The modeling system presented in the paper is capable of providing a much broader and more accurate data set on which to base critical Go/NoGo decisions.

1.3 Proposition 3: Risk Analysis Should Include Full System Life Cycle

ROI analysis is based on the expected return on investment over the entire planned system life. It is absolutely essential that all of the project elements are examined as system level decisions are made. Decisions are made during the feasibility phase which will set the project course and which address major risk considerations associated with the project. It is critical that these decisions are made with the knowledge of how they will impact each phase of the system life. The information exists today to create a whole life system model during the feasibility phase which will allow the decision makers to establish the project strategy based on a much larger and more complete picture of the entire project. In order to do this effectively each element of the project must be modeled and as decisions are made the impact of those decisions are simulated in order the that full impact can be predicted. Very few 'decisions of consequence' are so stove-piped that they do not impact other project functions. It is essential to understand the ripple effect before final implementation.

The fact that early decisions can and do impact the entire project should drive us to establish the project risk continuum early and continually take vertical views through all project elements to examine the impact of the risk allocation profile on ROI.

Fidelity increases as the project progresses and with the proposed model system it is easy to insert more detail and greater levels of accuracy. Decisions under consideration are then inserted into the model; the impact on all project elements is established and then measured against the over-arching ROI risk.

As these functions are drawn forward into the Feasibility stage it is easy to see that the level of model accuracy is highly dependent on the data being used. All of these propositions are driven by data. While some of the data is project specific and must be generated there are numerous open data sources that can significantly enhance the critical decision knowledge base for a project. This critical data can and should be available during the feasibility stage as decisions are being made and the framework of the project is being established. It used to be that the lack of data was the limiting factor, but anymore, it is the preponderance of data that is the issue. The challenge is how to extract accurate data from multiple sources and formats and reduce the data to an actionable level to support feasibility phase decisions. 3U has firsthand experience with data mining and reduction tools which allow stakeholders real time access to ship traffic data, transmission volumes, pricing points, regional seismic activity and fault information, historical and projected growth patterns and many other elements that are critical to making key decisions in the feasibility phase. This type of data is critical when looking at projected volume sales, potential failures, and the competitive environment.

The final aspect to be considered is who should be responsible for setting up and running the risk model(s). Given the drive for system life ROI maximization, 3U's experience is that the only party that can or should effectively control this model are the system stakeholders – consortium, telco, etc. Parties that have a vested interest in specific elements of the project are not in a position to provide an unbiased, totally objective view that is completely driven by stakeholder ROI. To put them in this obvious conflict of interest is a disservice to both them and the project.

2 INTRODUCTION

There are two main project characteristics which 3U's experience has shown thwarts the ability for a project to meet its objectives. The first is the general uncertainty surrounding the duration and costs of the individual tasks, and the second is the set of risk events that may occur which impede the smooth progress of the project. Simply stated it is the risks associated with planned events and the risks associated with unplanned events which continually plague complex projects. In short, the issue is risk. With co-existent qualitative and quantitative risk management methodologies we can effectively reduce the probability of deviation from the project plan and even when deviations occur, in most cases, their impact can be significantly reduced.

There are a number of risk analysis methodologies which can be applied to complex undersea projects. Undersea projects are particularly suited for analytical techniques which account for durations and costs using probability distributions instead of single value determinations. Each schedule and cost item has a probability distribution associated with it. It is a welcome, but usually rare event, for an item to exactly meet its expected schedule and/or budget. What usually happens is that these discrete events fall within a range of values which most of the time means longer and higher. The higher the fidelity of the event, the smaller the range. It is important for decision makers to understand the probability of deviation and the associated consequence, not only on the specific event involved, but on subsequent interdependent events.

At the core of any risk analysis methodology is the goal of revealing all the risk elements, the assignment of the probability of occurrence, and evaluation of the consequence of occurrence. Events which have a high probability of occurrence and have a high consequence are the first targets for mitigation intervention. Risk mitigation is evaluated in terms of the benefits relative to the cost of intervention.

One of the most proven and accepted methodologies for analyzing the probability and consequence of these events is the Monte Carlo Simulation modeling technique. This technique is a quantitative risk analysis technique in which uncertain inputs in a model are represented by probability distributions. The simulation performs multiple iterations (thousands) using different randomly selected sets of values from probability distributions set by the project team. The result is a distribution of possible outcomes – the range of possible outcomes that could occur and the likelihood of occurrence.

This technique also allows managers to account for the critical interdependencies of the project tasks. It is critical to understand and account for the potential ripple effects of interdependent events. This is especially critical with serialized schedule events where a delay in one critical element drives delays in subsequent events which in turn impact other project elements.

One of the challenges of employing a quantitative methodology is that it drives managers to translate qualitative factors into quantifiable units – usually in terms of schedule and/or cost. This is an essential exercise, but must not be carried to an extreme.

The drive to reduce all elements down to schedule and/or cost elements provides a closely coupled correlation with the ultimate project driver – Return on Investment (ROI). This modeling technique provides an effective way to address the quantifiable factors of schedule and cost which have a huge and long term impact on ROI.

At the end of the day it is inevitable that decision makers must deal with other factors that may not be quantifiable. The goal of this approach is to provide the decision makers with an effective, accurate, and flexible tool which will support the determinative project decisions.

3 METHODOLOGY

The objective of this methodology section is to outline a general risk analysis approach for undersea telecom projects. It is important to note that each project is different and the risk analysis process should be tailored to meet the unique project requirements. The intent of this presentation is to outline some of the common elements for undersea projects. The details, sequence and specific approaches will vary with each project.

It is also important to note that no analytical tool can take the place of or should be implemented without taking full advantage of the critical element of experience. To maximize the effectiveness and applicability of these, or any other analytical tools, undersea project experience must be a primary input factor and a constant sanity check. Teams steeped in experience should be assembled to address every aspect of a project.

It is critical that this risk analysis process be started at the inception of the project. The major projects parameters and factors are established early and once established are very difficult to change. Much time and money has been wasted on developing a plan to fit unrealistic expectations that were set at the onset of the project. The project phase that has all too often been slighted is the planning stage. Yet it is this phase of the project that sets the stage for the acquisition, installation and establishes the critical factors that will impact the entire service life of the system. The decisions that will dictate the project ROI are set early. This is the project phase that needs more attention and a greater level of focus.

Another vital element of this methodology is the integration of all the system life elements at the inception of the project. As all the functional paradigms – contract, insurance, installation, operation, maintenance, repair, etc – are opened for examination it is essential to account for all the impacts that decisions will have on other system elements and the system life as a whole. Given the fact that at any given time the total amount of risk is fixed this approach allows the team to take discrete vertical view through all the project elements in order to examine the complete risk allocation profile.

The following steps may vary in sequence and intensity, but most of them are applicable, at some level, to all undersea projects.

Project Objectives. Prior to making any plans it is critical to fully develop and understand the project objectives. This plan should be written and developed to the level of detail which will enable lower tier plans to be accurate and complete. This plan is the driver for the entire project.

Project Design. One of the methods for developing the details of the project objectives is to convene a select group of Subject Matter Experts (SME's) to brainstorm solutions. It is important that all project elements be open to discussion and modification as it fits the project. The output of this effort will be top level execution plan that will be presented to the stakeholders. In many instances, using Venn diagrams and event trees can facilitate this effort.

An example of what this group might consider is the issue of risk allocation. It is imperative to look at when risk transfer and/or risk sharing make sense. It is a commonly held belief that transferring risk to others is the goal. However, in many instances transferring risk is inefficient and very costly. In general, the more one can allocate risks and opportunities to those that control them, the better. Realistic risk sharing should be closely examined within the context of the total project impact.

Risk Management Plan. After the basic project plan is accepted it is critical to establish a Risk Management Plan that outlines how the project risk will be analyzed and managed. This plan will examine the available data and will lay out the top level assumptions for the project. The definition of the project assumptions is critical. This plan should address the strengths and weaknesses of the models, including quantitative and structural assumptions.

Establish the initial risk models. There are three essential models – the business model; the schedule model and the cost/budget model.

Business Model – This model encompasses all elements of the project ROI – acquisition, installation, operation, maintenance, repair, cash flow, sales projections, cost of money, exchange rates, pricing parameters and any other relevant business factors. In addition, it is important to note that ROI will be defined differently for each project. For instance, the ROI for a public utility will very likely be different than the ROI expectation for a system owned by private investors.

Cost Model – This model includes all the cost elements associated with the system life, including operation and maintenance. The cost model is set up on a line by line basis with budget and contingency allocated to each cost item. Each line item then has the same probability of coming in within budget or exceeding the budget.

Schedule Model – The Scheduling model is set up similar to the cost model on a line by line basis except that it must address the added complexity of modeling the task interrelationships.

In some instances it may be beneficial to combine the schedule and cost models into one iterative model. The challenge to this approach is that the interdependencies and correlations can become quite complicated. Because of this the relational elements must be set up very carefully.

These models should include all elements of the project from acquisition through the system operational life. As the data matures the models are expanded to accommodate the greater detail and the increasing level of fidelity. Cost and duration models lend themselves to comparing predictions with reality. In addition, the Monte Carlo Simulation allows the project team to analyze the total impacts of a defined set of risks. Risks can be coupled based on probability and their cumulative impact on the project examined.

Based on the specific project requirements and circumstances, there may be other models that can provide value or subsets of these primary models that can be used. Again, the risk management plan must be tailored for each project.

Examination of Data. It is necessary to examine the available data, identify gaps, and determine how long it will take for the desired data to be assembled and how this acquisition time fits within the decision timetable. Additional information is only valuable if it has the potential to change the decision makers preferred strategy. These data requirements can be included in the desktop study, the survey and/or other project functions.

Model Updates. These models are dynamic tools which must be continually updated in order to determine the impacts on the project ROI. The input of "what if" scenarios and the subsequent running of iterations allows the model to predict what impact risks and opportunities have on the ROI. This is vital to the decision making process.

This approach is dynamic throughout the entire project and through system life. Obviously, the level of activity will change during the life of the project, but the models should be updated as necessary.

The advantages of the Monte Carlo Simulation technique are:

A. Probability distributions within the model can be easily and flexibly used without the need to approximate them,

B. Correlations and other relations and dependencies ('if' statements) can be modeled without difficulty, and

C. The behavior of and changes to the model can be investigated with great ease and speed.

The Monte Carlo Simulation provides the project management team with a dynamic, quantitatively based decision tool that allows the team to access and predict risk event impacts on the project.

4 SUMMARY

The bottom line is that using probability distributions rather than determinative allocations provides a much more accurate and realistic representation of a subsea project. Using ROI as the ultimate project risk driver sets the project tone and the evaluation standard early and consistently throughout the project.

Implementing this methodology early in the inception phase provides stakeholders and manager the opportunity to proactively manage the project risks rather than being victims of risk events and forced to be reactive. This equates to a higher level of effectiveness and efficiency which equals a greater Return on Investment.

5 REFERENCES

Cook, A., Risk Management, Conference Proceedings of SubOptic 2004.

Allan, P., and Comrie, R., Risk Assessment Methodology and Optimisation of Cable Protection for Existing and Future Projects, Conference Proceedings of SubOptic, 2004.