

The background of the page features a series of abstract, flowing blue lines that create a sense of movement and depth. These lines are layered and semi-transparent, with some appearing as sharp, dark blue streaks and others as softer, lighter blue washes. They originate from the top right and flow downwards and towards the left, creating a dynamic, organic shape that frames the text on the left side of the page.

White Paper:

**THE ROLE OF SIMULATION
IN STRATEGIC PLANNING**

**ProModel's
Approach to
Strategic Portfolio
and Resource
Capacity Planning**

The Role of Simulation in Strategic Planning

TABLE OF CONTENTS

- [Introduction – The Challenge of Strategic Portfolio Planning](#).....3
- [Obtaining Reliable and Risk-Related Estimates in Portfolio Planning](#).....5
 - [How Traditional Software Tools Handle Uncertainty and Risk](#).....7
 - [The ProModel Solution to Handling Uncertainty and Risk](#).....8
- [Bridging the Communication Gap between Strategic Planning and Execution](#).....8
 - [Traditional Approaches to Bridging the Communication Gap](#)9
 - [The ProModel Approach: Integration of Top-down and Bottom-Up Planning methods](#)..... 13
- [How ProModel's Portfolio Simulator Works](#) 15
 - [A Brief Demo of Portfolio Simulator](#) 15
 - [Portfolio Simulator Summary](#) 22
- [The Next Step – How to Evaluate Portfolio Simulator](#) 23
- [References](#) 23
- [Related Resources](#) 24

INTRODUCTION – THE CHALLENGE OF STRATEGIC PORTFOLIO PLANNING

Strategic planning is more than writing a mission statement and sticking it up on your waiting room wall... It's a living document that helps your organization and its people make important choices. It's a tool for finding your organization's best future and the best path to get there. ⁽¹⁾

According to this definition, the first step in strategic planning is to determine where an organization wants to be sometime out into the future. This is followed by creating a road map that starts from where the organization is now, and clearly outlines how to get to where it wants to be.

If strategic planning decides the future goals for an organization and determines the best path to get there, then strategic portfolio planning can be defined as the process of selecting the future initiatives or projects a company wishes to engage in and determining the best allocation of time, money and resources to execute these initiatives. Knowledge of the derivation of the word *strategy* may be useful in understanding how this definition works. According to business strategist Fred Nichols:

Strategy is a term that comes from the Greek "strategia", meaning "generalship." In the military, strategy often refers to maneuvering troops into position before the enemy is actually engaged. In this sense, strategy refers to the deployment of troops. Once the enemy has been engaged, attention shifts to tactics. Here, the employment of troops is central. Substitute "resources" for troops and the transfer of the concept to the business world begins to take form. ⁽²⁾

Decisions regarding the best deployment of resources for executing an organization's product or project portfolio are fraught with risk. What if the portfolio plan fails to make the best use of resources? What if the right resources are not available when needed? What if forecasted budgets, schedules and revenue targets are not met? These are crucial questions that portfolio planners must consider, and missing the mark on any one of them can have a dramatic impact on the financial performance of an organization. Additionally, forces external to the organization come into play. Consider the following economic calamities resulting from events that were likely unforeseen:

- The 2008 housing, manufacturing and financial industry crises
- When Lipitor was first synthesized in August 1985, Warner-Lambert had no idea it would turn into a major block buster. It was following Merck's Mevacor and Zocor, so there were concerns it could be a "me-too" drug. Mevacor was already well along in its final round of clinical trials and they still didn't have a process for manufacturing Lipitor in commercial quantities, which took two years. By 1989, the fear was that it was too late for another cholesterol reducer.
- By the end of 2007 Lipitor was by far the largest selling drug in history with \$12.7 billion in annual sales. Who knew?
- Pfizer's development of Torcetrapib, a drug that increases production of HDL (i.e., "good cholesterol"), which reduces LDL thought to be correlated to heart disease, was cancelled on Saturday, December 2nd, 2006. The reason was that during a

clinical trial test that involved 15,000 patients, more patients than expected died as a result of taking the medicine. A 60% increase in deaths was observed among patients taking Torcetrapib and Lipitor versus taking Lipitor alone; there was no suggestion that the results called into question the safety of Lipitor. Pfizer has lost nearly \$1 billion in investments on the failed drug. ⁽³⁾

- Wyeth as part of the Women's Health Initiative sponsored by the National Institutes of Health. A large-scale clinical trial for Hormone Replacement Therapy showed that long-term use of progestin and estrogen may increase the risk of strokes, heart attacks, blood clots, and breast cancer. Following these results, Wyeth experienced a significant decline in its sales of Premarin, Prempro (conjugated equine estrogens) and related hormones from over \$2 billion in 2002 to just over \$1 billion in 2006. The results from the study were significant enough that Wyeth terminated the trials early due to a fear that their participants may be at risk. ⁽⁴⁾
- Boston's Big Dig, a large urban construction project, was originally estimated to cost \$2.8 Billion in 1985. When construction started in 1994, the cost estimate jumped to \$5.8 billion. According to a 2008 article in the Boston Globe it ended up costing more than \$22 billion. The estimate was off by \$19.2 billion. ⁽⁵⁾
- Biogen withdrew Natalizumab on February 28, 2005. Biogen Idec and marketing partner Elan Pharmaceuticals voluntarily suspended marketing of Natalizumab, and also suspended dosing in all ongoing clinical trials. Natalizumab had been approved in the US in November 2004 for treatment of patients with relapsing remitting MS. The two companies announced the suspension after two participants involved in one study were diagnosed with a severe brain condition, progressive multifocal leukoencephalopathy (PML), after two years of combination therapy with Biogen's version of interferon beta-1a. Biogen Idec stock lost more than 40% of its value when the drug suspension news was released. ⁽⁶⁾
- Merck pulled Vioxx from the market on Sept. 30, 2004, because a new study had found a higher rate of heart attacks and strokes in patients taking the drug than in those on a placebo. The move was a stunning ending for a blockbuster drug that had been marketed in more than 80 countries with worldwide sales totaling \$2.5 billion in 2003. ⁽⁷⁾

While every crisis can't be averted, there is unquestionably a need for better tools and techniques to help mitigate risks and quantify them so that more fully informed decisions can be made about the future. Additionally, there is an increasingly greater need in portfolio planning to bridge the communication gap between strategic planners, who look at financial metrics, and the tactical team, who concern themselves more with operational metrics. Given the complexity and potentially confusing nature already inherent in portfolio planning systems, effective communication to ensure strategic alignment is of utmost importance. This paper addresses two major challenges in strategic portfolio planning that are keys to achieving greater financial success in an organization:

1. How can reliable and risk-related performance estimates be obtained in portfolio planning?
2. How can the communication gap be bridged between upper and lower management in the portfolio planning process?

Each of these challenges will be discussed separately in terms of why it poses such a major challenge, why traditional approaches offer little help, and how ProModel provides the needed solution. We'll end with an overview of Portfolio Simulator and present some of its other unique features such as its powerful scenario analysis and its enterprise, web-based architecture.

For over 20 years, ProModel has been providing leading-edge, simulation-based, decision support solutions designed to improve performance throughout the enterprise. The knowledge we have gained in delivering these solutions has helped us develop more application-specific, "mission critical" software solutions by embedding our predictive simulation technology into solutions such as Portfolio Simulator. Our goal continues to be to provide solutions that are easy to use and implement, but still have the power to provide realistic, predictive analytics which empower organizations to make better decisions faster.

OBTAINING RELIABLE AND RISK-RELATED ESTIMATES IN PORTFOLIO PLANNING

Ideally, planners and managers would like to be able to have a reliable estimate of the cost, time and resource requirements needed to execute a portfolio plan. They would also like to be able to quantitatively assess the risk associated with a given plan. This will help ensure that they maximize ROI.

For simple project plans with little or no variation in task times, accurately predicting the cost, time and resources that will be required to complete the project is no big task. Where scheduling alternatives are limited there are also few scenarios to consider. This simplicity quickly disappears, however, for those organizations having business portfolios consisting of multiple products or projects running in parallel, all sharing common resources and having variable task times and uncertain outcomes. The strategic planning of such portfolios, where cost, time, resources and projects must all be juggled, can be daunting (see Figure 1).



Figure 1. Portfolio Planning, a Complicated Juggling Act

In addition to the complexity of the issues involved in portfolio planning, another challenge is accounting for uncertainty. In this high stakes game of strategic portfolio planning, the one certainty that all planners and managers can count on is uncertainty. And the further into the future one plans, the more uncertainty and risk exist. It is imperative that an organization understands this uncertainty and avoids making decisions solely on over-simplified average estimates.

One of the dangers in making decisions based on averages is that actual performance rarely hits the average. It is like making a decision to dive into a lake based on knowledge that the *average* depth is 10 feet. (see Figure 2). With portfolio planning, the situation is even worse, since the variances in task times are cumulative making the variance for the project completion equal to the sum of all the variances along the critical path. In addition to the uncertainty associated with each individual project, there are nearly always multiple projects occurring simultaneously, which increases the amount of uncertainty and risk by orders of magnitude.

This compounding effect of variability makes it easy to understand how one small variation in a task or process can have a ripple effect on many other aspects of the organization. It is extremely difficult to accurately account for these variations, particularly in long-term planning where there is so much uncertainty. This creates a major challenge for executives and planners to confidently forecast how multiple projects and initiatives will perform over time and how they will impact the organization's goals.

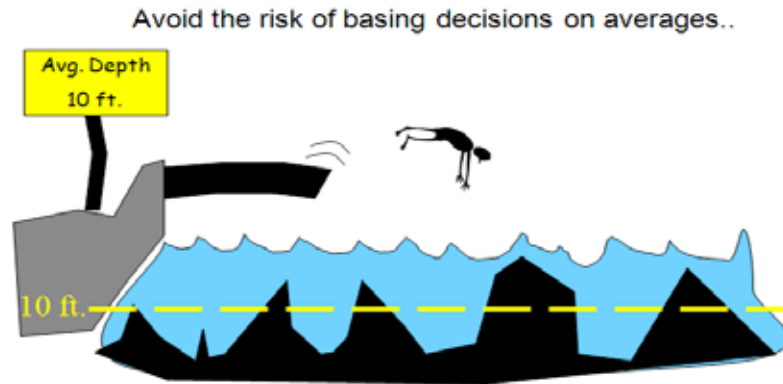


Figure 2. Danger of Making Decision Based on Averages

Variability is related to many factors in a portfolio which, when internal to the organization, may be controllable, but only to a degree. Think about how long it takes a Pharma company to develop a new drug. Does it always take the same amount of time to get through development? Is it always successful? Does this uncertainty and risk have an impact on the overall success of the business?

Think about how long it takes contracting companies to deliver large long-term projects. Do they know exactly how much time, cost and resources it will take to perform each task? Does the scope ever change? Does this uncertainty and risk impact overall business performance?

A large degree of the uncertainty and risk in portfolio planning originates from unpredictable and uncontrollable market, environmental and economic forces; all of which can have an enormous impact on strategic resource capacity and portfolio planning decisions. Consider the following:

- What if a competitor is first to release a new offering?
- What if a new regulatory law is passed that has an impact on your pricing model?
- What if the economy makes a dramatic shift?
- What if you can't find the key resources you need to execute your plans?

Because of these unknowns, there is a tremendous need for organizations to have the ability to analyze the risk and uncertainty that external conditions, in combination with the variability and interdependencies from internal factors, place on their future forecasts.

So far we have been using the term 'risk' to convey a sense of potential harm resulting from uncertainty. It is instructive to look at the formal definition of risk. Risk is defined as "the precise probability of specific eventualities (wikipedia)". Of course we typically think of negative eventualities, such as financial loss or missed schedules.

The important thing here is to recognize that risk *can* and *should be* quantified for it to be of use in making management decisions. According to the Canadian Management Centre:

Risks can then be assessed to quantify and prioritize them according to their impact on a project. The assessment process should determine the (1) likelihood of the risk occurring, (2) range of outcomes, (3) estimated timing of the risk, and (4) the frequency with which it will occur. ⁽⁸⁾

The complexity of most portfolios requires the use of software tools that have the analytical capability to account for uncertainty and provide risk calculations. Traditionally, however, these tools have fallen short in providing these capabilities.

HOW TRADITIONAL SOFTWARE TOOLS HANDLE UNCERTAINTY AND RISK

Traditional planning tools based on project planning software and Monte Carlo analysis offer some help in making strategic decisions about future portfolios, but many of them fail on key counts. These deficiencies can be summarized as follows:

1. Most solutions cannot account for important dynamics that occur in the execution of a portfolio such as contention for resources, prioritization of resource tasks, and other complex resource behaviors. As a result, they don't provide valid estimates of what outcomes to expect. Logic needed to model this complexity and dynamic interaction is often lacking and therefore tools are unable to accurately or even approximately represent the true behavior that occurs in portfolio execution.
2. Many solutions do not consider, or at least fully consider statistical variation in portfolios and, therefore, give inaccurate estimates of performance. Statistical variation in performance is due to variation in operational factors such as task times, resource availability and milestone outcomes to name a few. As noted above, variation in overall performance is the compound result of variation throughout the portfolio execution so that small fluctuations in the beginning can have a significant impact in the end.
3. Because many solutions account for little or no variability in the plan, they provide no reliable measure of risk when predicting performance estimates. As noted above, the key to assessing risk in a portfolio is to replicate it multiple times across the full range of variable inputs including project task times, success rates, cost estimates, and future revenue forecasts. Otherwise, the predictions may be numerically precise, but representative of only one potential outcome with complete oblivion to risk.

As a result of these deficiencies, decisions are often made based on subjective estimates that tend to rely on oversimplified assumptions.

THE PROMODEL SOLUTION TO HANDLING UNCERTAINTY AND RISK

To overcome these deficiencies, an enterprise needs to have the capability of identifying and reflecting future risk combined with short-term, fixed plans in their strategic portfolio planning. ProModel's solution can increase an executive's confidence in the organization's strategic decision-making process by accounting for the risk and integrating it with short-term, fixed plans, thus more accurately and objectively answering questions such as:

1. What is the best corporate portfolio product/project mix?
2. What is the best prioritization strategy?
3. What resources are required to meet the plan?
4. What initiatives result in the best ROI?
5. How risky is the plan?
6. What is the optimum plan to maximize ROI and NPV?

The ProModel solution combines a uniquely effective methodology with powerful simulation technology to produce a realistic, risk-adjusted view of the future. It incorporates short-term, well-defined information (or detailed plans) with longer-term, uncertain forecasts in one common platform. It allows for quick and easy comparison of multiple possible future scenarios or strategic options. Providing a range of potential performance outcomes with their associated probabilities and confidence levels gives executives greater information to make better decisions faster and thus maximize organizational performance now and into the future.

BRIDGING THE COMMUNICATION GAP BETWEEN STRATEGIC PLANNING AND EXECUTION

In addition to the challenge of developing reliable and risk-related performance estimates, the other major issue that jeopardizes the success of a company's future is the communication gap between strategic planning and an organization's capability to execute. These two functions typically use different metrics and different tools that are difficult to align.

Strategic planners focus on issues such as long-term enterprise goals and identifying which direction the corporation should head to give them the best opportunity to achieve them. They are concerned with the "big picture" and deal with long-term time horizons that are generally 1 to 15 years. The Key Performance Indicators (KPI's) that are typically used are financial centric, such as; Revenue, Profit, EBITDA (Earnings Before Income Tax) and Net Present Value, or more difficult to quantify metrics like strategic fit. MicroSoft® Excel® based programs are the most commonly used tools for this type of planning.

Operational and functional lines focus on the execution of the tactical plans. Planners and managers at these levels deal with much shorter-time horizons of days to 18 months. KPI's are usually communicated in terms such as resources, capacity, tasks, cycle times, throughput, inventory levels and project schedules – a very different language than used at the strategic level. MicroSoft® Project®, Enterprise Project Management® (EPM), Project Portfolio Management (PPM), Enterprise Resource Planning (ERP), MicroSoft® Excel® based programs or finite capacity planning programs are the most popular tools used in these areas.

The different KPI's and tools used by strategic and operation planners invariably lead to a communication gap (see Figure 3). This gap makes it exceedingly challenging to effectively and objectively collaborate or align actions towards meeting the overall goals of the enterprise. Thus, project/functional line leaders are prioritizing and executing projects/activities many times in a vacuum without understanding the true long term impact on the enterprise objectives. Conversely, strategic direction is set without understanding if the organization is capable of executing the plans.



Figure 3. Communication Gap Between Upper and Lower Management

TRADITIONAL APPROACHES TO BRIDGING THE COMMUNICATION GAP

The concept of strategic planning was introduced as an attempt to bridge the organizational management gap, and account for the risk involved in leading a business successfully into the future. It has been ProModel's experience in working with clients, that there are two major approaches that companies generally use in the long term planning process; top-down and bottom-up. Both methods have advantages and disadvantages, but so far neither has sufficiently overcome the challenges of combining long-term planning variability with short-term operational plans.

Top-Down Strategic Planning

How it works:

The top down approach to strategic planning usually consists of the following major components:



- Defining long term enterprise level goals and objectives in financial terms such as revenue growth, NPV, ROI, profit margin or in market terms such as “number of products to market in the next five years,” percent of market share, and others.
- Developing market strategies and investment initiatives designed to reach those goals.
- Using a high-level stage gate and low level of detail approach to tracking and forecasting project performance.
- Communicating these goals and initiatives downward to the rest of the organization for execution.

Planners using a top down approach will step back and look at the company from a distance, determine future strategic direction and attempt to forecast its likely results. They view the “big picture” and pursue large-scale, long-term objectives by projecting current programs and potential future programs onto a model of the external world.

Strategic planners normally use one or a combination of three types of tools to aid in the planning process:

1. Programs designed specifically for evaluating the impact of future proposed projects at a very high level,
2. PPM management software designed for short term more detailed scheduling/planning, or
3. Spreadsheet programs with or without Monte Carlo simulation capability to add risk.

Decisions are typically made by comparing results of one portfolio versus another and selecting the one that looks like it will have the best fit for the organization based on financial performance, strategic fit, and other key attributes. Some have bubble charts and “efficiency frontier” charts that help visualize the trade off(s) of different portfolios. These are great tools for defining different high-level options and setting company direction, but have some limitations.

Limitations to the top-down approach:

Often, a long-term plan or the “optimal portfolio” is set without a true quantifiable understanding of how it aligns with the current and future potential operational capacity. This can contribute to the gap described earlier where there is a severe disconnect between the expectations at the strategic level and the actual capability of the organization to deliver results. This disconnect is often the direct result of deficiencies in the planning tools themselves. For examples:

- Tools often help planners define a future strategic direction, but they lack the scenario comparison capability needed to understand the true impact on key resources.
- They often use only single-point estimates to predict future results, without the ability to model multiple possible realistic future project behaviors and capture long-term variability and risk. The results are therefore almost always “precisely” wrong.
- They typically are not designed to easily combine different future potential project options with the real-time actual project information available from the PPM systems, which tend to ultimately lead to plans that an organization can’t execute.
- Many times they look at value, cost, and resource requirements as one number, which masks the operational impact over time.

In resource allocation for instance, most organizations and top level management already pay a great deal of attention to the money required for effective implementation. This is the first resource you should look at. Money is important, but it is usually less important than time when it comes to strategy implementation. Ironically, few companies devote even half as much attention to time as they devote to money. ⁽⁹⁾

Bottom-Up Planning

How it works:

The bottom-up approach to long-term planning usually consists of at least the following major components:



- Operational and tactical level planners define project plans that the organization is or will be working on for the next year to 18 months.
- Uses detailed-level plans to represent projects with tasks and to estimate resource requirements.
- Stores the schedules/plans from throughout the organizations in a PPM, data base repository or spread sheets for upper level management, functional lines, and planners to access.
- Top management can access the repository of detailed plans to see how the company's overall portfolios of projects are progressing and see expected projected outcomes for the next year or so.
- The systems can be used to set up budgets, evaluate resource capacity constraints and understand how the portfolio will perform by rolling up information from the low-level plans.

The myriad of PPM programs available today are great at project management, tracking and scheduling portfolios of active projects. They are also good for setting up annual budgets and for understanding what key resources will be required to execute the projects over the next 6 to 18 months.

Limitations to the bottom-up approach:

While beneficial for seeing the portfolio horizons extending up to a year or so, beyond 18 months, PPM programs lose their effectiveness. The further out you plan, the more unrealistic the forecasts become for the following reasons:

- A plan's accuracy could vary dramatically depending on the motivations of the planners. If an organization rewards project teams for meeting budgets & deadlines, then inevitably project teams will develop "**conservative plans**" with buffers of time, resource requirements, and cost to ensure a high degree of confidence that they will meet the deadlines. On the other hand, if a team is trying to justify the existence of a current project or receive approval for a new one, they would most likely develop an "**optimistic plan.**" This would typically involve streamlined costs, minimal resource requirements, and aggressive timelines so as to make it look attractive to management. So depending on the status of a project within the organization and the mindset of the team, the plan's resource requirements, costs and timings could be dramatically different. This problem is then magnified as you add more diverse project teams from multiple departments and locations across the enterprise.

- Compounding the impact of planners' motivations on forecasting a project's future are other human factors that affect project outcomes. Examples are the "**Student syndrome**" which refers to the phenomenon that many people will start to fully apply themselves to a task just at the last possible moment before a deadline and "**Parkinson's Law**" the adage that "work expands so as to fill the time available for its completion. In Project Management, Parkinson's Law coupled with the Student syndrome, individual tasks are nearly guaranteed to be late." (Wikipedia)
- PPM systems use single-point estimates for activity times and resource requirements, without the ability to understand the range of time it takes to do tasks and the variation around the amount of resources required to do the work. This results in less realistic forecasts the further out into the future you look.
- Most systems don't understand the concept of attrition, or failure. By the nature of why companies undertake projects, inherently (and rightly so) people plan for success. In reality, projects can terminate or fail and if the systems don't account for that, then realistic views of the long term forecasts are difficult to replicate.
- The high level of detailed information applied in these types of tools that work very well with short-term planning, can be extremely cumbersome for use in analyzing and developing long-term strategies. The overwhelming amount of detail makes it very difficult and time consuming to maintain future estimates.
- Finally, many PPM systems are "live" systems with product development and/or projects currently underway and actively being managed. As a result, future portfolio scenario comparisons and "what-if" analyses are often secondary or after-thoughts to the core functions.

One Size Doesn't Fit All

After seeing how hundreds of companies work over the years, it has become evident that one-size-fits-all methodologies don't work. Every organization has its own unique situation and level of maturity in planning & project portfolio management. The key is to define a solution that can grow with the organization. The technology should be flexible and easy to migrate over time as the organization matures in data collection and methodology. Having stated that, there are a number of common issues that companies struggle with.

1. Many organizations perform resource planning by rolling up detailed plans from Project Portfolio Management systems. This approach is okay for getting a rough-cut picture of resource requirements over time, but the plans that are rolled up are often single-sample plans based on single-estimate values and thus provide neither the accuracy nor the range of possible outcomes for any given portfolio.
2. Strategic planners in organizations often develop strategic plans primarily based on financials and strategic fit without understanding the impact of other key constraints. They assume operations will get the work done as long as the money is available. This can create a gap between an organization's long-term planning function and its tactical and operational functions.

THE PROMODEL APPROACH: INTEGRATION OF TOP-DOWN AND BOTTOM-UP PLANNING METHODS

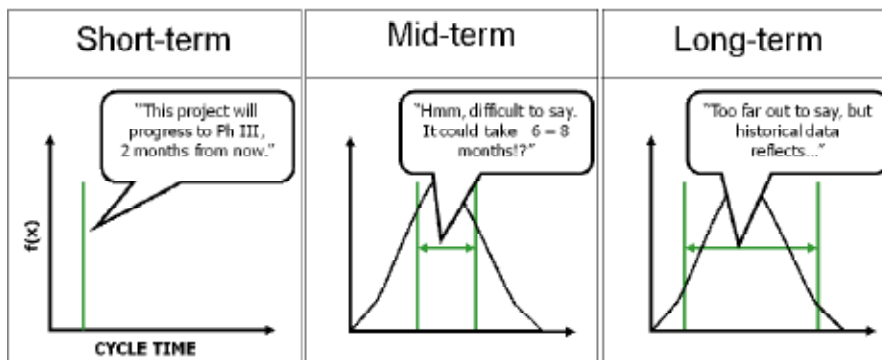
Bridging the Communication Gap

The misalignment between strategic and tactical planning puts organizations at risk of failure in meeting their goals, objectives, and plans by not having the right resources in the right place at the right time. Organizations attempt with varying degrees of success to bridge this gap with a combined approach, where planning information is shared in both directions. However, the communication gap between corporate strategists and tactical managers makes it very difficult to do this effectively. The reason for this lies in the language barrier between these two different planning levels as well as the lack of tools and common methodology to effectively connect them. As outlined earlier in this paper, the language barrier exists because top-level planning functions according to financial metrics, while bottom-level management speaks in tactical and operational terms.



ProModel has developed an integrated solution using simulation-based technology to bridge the gap. The key to the solution is the ability to merge short term “known” information with long term risk and uncertainty.

Typically, the longer the time horizon, the lower the confidence one has in estimates, which translates to higher risk and uncertainty.



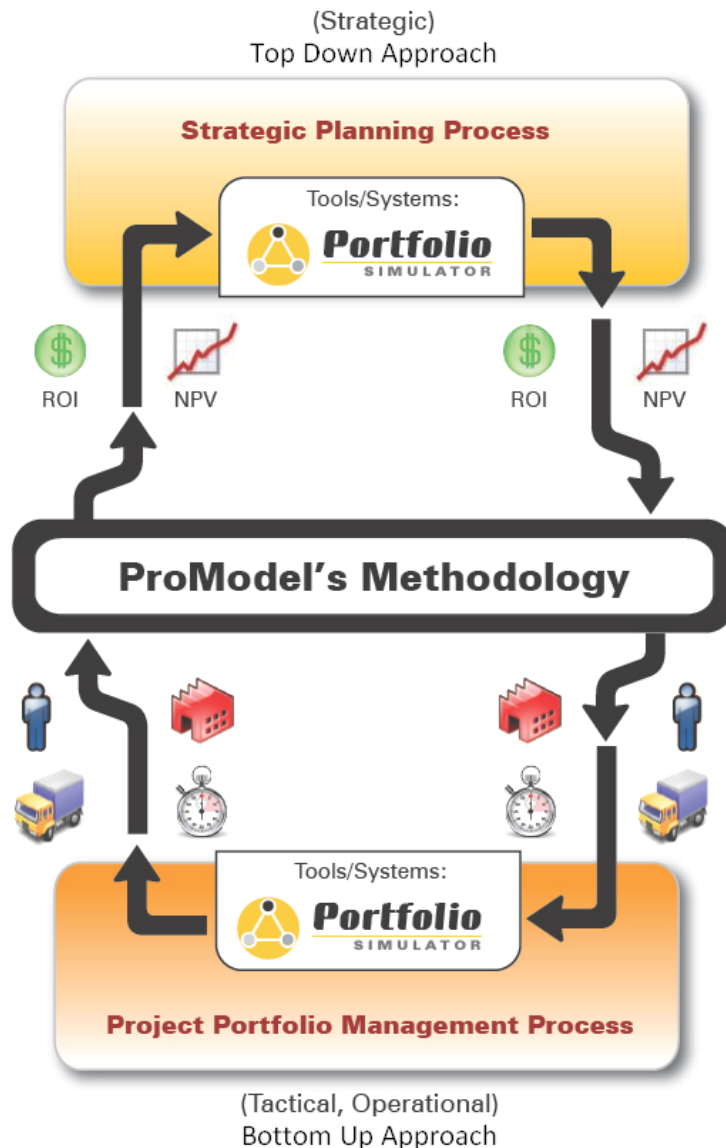
PROMODEL’S BRIDGE FOR THE COMMUNICATION GAP

ProModel has developed a unique solution to effectively tackle the uncertainty and risk inherent in strategic resource capacity and portfolio planning. The solution bridges the gap between upper and lower management, and incorporates predictive, analytic simulation tech-

nology. The methodology integrates the best of the top-down and bottom-up approaches and facilitates the capability to mix short-term detailed plans with long-term strategic direction options. By connecting the lower-level, short-term detail with the higher-level, strategic planning attributes, it allows you to use the right level of information to appropriately answer questions based on the planning time horizon.

By properly implementing ProModel’s methodology, a client can develop an improved organizational planning structure which enables improved internal communication and the connection of IT platforms to create a common trusted environment for predictive analysis.

With this type of methodology, strategy formation and implementation become an on-going, integrated process, allowing continuous re-assessment and reformation to support portfolio and resource optimization. It enables the higher and lower levels of management to work together seamlessly, by addressing both the strategic and operational needs of the company. This distinctive approach not only supports high-level decision making, but also produces a real awareness of an organization’s true resource capability. With this knowledge, both top-and bottom-level planners will have a better understanding of what to really expect in the future and what proactive steps to take to assure optimal performance.



HOW PROMODEL'S PORTFOLIO SIMULATOR WORKS

ProModel's Portfolio Simulator brings simulation technology to Portfolio Planning which opens up possibilities that didn't exist before in portfolio planning tools. Simulation is a dynamic analysis tool designed specifically to deal with dynamic (i.e., time-based) problems, such as a portfolio plan. Consequently, it can capture complex dynamic relationships and mimic the progression of projects over time. Through iteratively experimenting with different project scenarios simulation provides quantitative comparisons of performance so that the optimal plan can be determined.

Adding simulation technology to portfolio planning is truly innovative because it allows decision makers to eliminate guesswork and replace it with reliable quantitative information expressed in a statistical range of answers, with confidence levels and estimates of risk. Simulation enables companies to accurately model their most complex business operations and then participate in dynamic and collaborative forecasting and predictive analysis.

Rather than leave decisions to chance, simulation provides a way to validate whether or not the best decisions are being made, and the key to sound management decisions lies in the ability to accurately predict the outcome of courses of action. Simulation provides that kind of foresight and helps management avoid the expensive time consuming nature of traditional trial and error techniques. ⁽¹⁰⁾

In the context of strategic and portfolio planning this technology affords strategic planners the freedom to try out different ideas for improvement, risk free, with virtually no cost and no disruption to current operations. By playing with "what-if" scenarios in a representative portfolio plan, managers can emulate the performance of a portfolio over time, taking into account variability and complex interdependencies such as resource contention. When multiple scenarios are emulated, planners can review an unlimited range of possible portfolio options and configurations, as well as the inherent risks involved. This gives management additional insight to help them make the best strategic decisions for their organization.

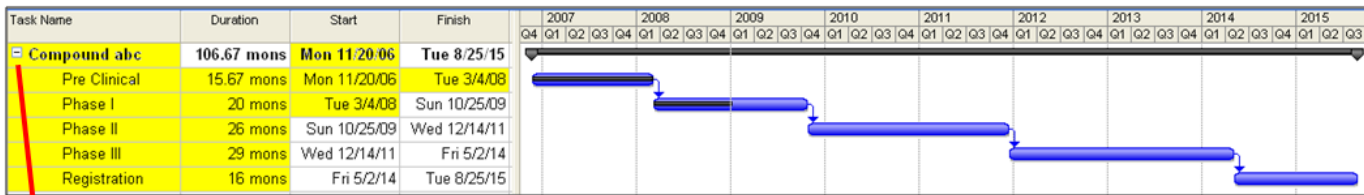
A BRIEF DEMO OF PORTFOLIO SIMULATOR

To demonstrate the use of Portfolio Simulator in making strategic portfolio decisions, let's look at a simple example of a drug compound going through several phases of discovery. We'll assume we have a compound presently in Phase I and the company would like to understand:

- When it might complete Phase III?
- What key resources will be required to support the project until registration?
- What is the NPV of the project?

Below is a view of how task or stage data might be entered in the Project Portfolio Management system (PPM) and how that would map to ProModel's Portfolio Simulator.

Project as it resides in the PPM system: updated as of 1 Jan 2009



Project as it resides in Portfolio Simulator: updated as of 1 Jan 2009

Task Name	Cycle Time				Time Unit	Historical Tracking			Use Template	Survival Base Percent	Revenue Base Yearly (\$)
	Estimated	Min	Distribution	Max		Start Date	Finish Date	Time In Progress			
1 Compound abc					mo	11/20/2006	None	25.4 mo	<input checked="" type="checkbox"/>	100	U(45000000, 100000000)
2 Pre-Clinical	15.67	15	T(15, 15, 15)	15	mo	11/20/2006	3/4/2008	15.67 mo	<input type="checkbox"/>	100	0
3 Phase I	20	17	T(17, 20, 22)	25	mo	3/4/2008	None	9.95 mo	<input checked="" type="checkbox"/>	70	0
4 Phase II	26	21	T(24, 26, 32)	32	mo	None	None	0 mo	<input checked="" type="checkbox"/>	80	0
5 Phase III	29	24	T(26, 29, 37)	37	mo	None	None	0 mo	<input checked="" type="checkbox"/>	90	0
6 Registration	16	14	T(14, 16, 24)	23	mo	None	None	0 mo	<input checked="" type="checkbox"/>	100	0

Data pulled in from PPM

Data from templates

Data from other sources

Add Risk Variability for task Durations

Add Probability of Success

Add Peak Revenue Range

The ProModel solution can automatically pull data in from your existing planning systems or be manually entered and merged with templates or other data sources that contain risk properties like:

- Variability risk for how long it takes to complete the tasks (phases)
- Probability of success (Survival)
- Revenue forecasts
- Resource requirements

An important part of the methodology is then to determine what data you want to use from the PPM system, what data you will use from the templates and what data you might want to override.

In the case above we decided not to use the template for the Phase I duration and survival because we had better information from the team, however we still wanted to add some risk for the cycle time of 17 to 22 months and the Probability of Success at 70%. We also added a peak yearly revenue range of \$45 to \$100 million for the compound if it makes it to market (that would follow a yearly revenue curve which could include ramp up, ramp down or loss of exclusivity timing).

Below is a view of how resource assignment data would be entered in the PPM system and how that would map to ProModel's Portfolio Simulator. The resource assignments could also be manually entered, reside in templates or come from other sources like special algorithms developed in Excel® and merged with the PPM and template data.

Resource Assignments entered in the PPM system

Resource Name	Assignment Units	Work
Unassigned		0 hrs
Site Manager		425,520 hrs
Phase I	0.5	7,200 hrs
Phase II	5	93,600 hrs
Phase III	15	313,200 hrs
Registration	1	11,520 hrs

Resource Assignments in Portfolio Simulator

		General	Summary	Resource Requirements	Start Conditions	Terminate Conditions	Curves	Fixed Costs
Task	Resource	Use Template	Assignment Type	Units				
				Estimated	Min	Distribution	Max	
<no filter>	Site Managers		<no filter>					
3 Compound abc\Pre-Clinical	Site Managers	<input type="checkbox"/>	Fixed Units	0	0	0		
8 Compound abc\Phase I	Site Managers	<input checked="" type="checkbox"/>	Fixed Units	0.5	0.3	T(0.3, 0.5, 0.7)	0.7	
13 Compound abc\Phase II	Site Managers	<input checked="" type="checkbox"/>	Fixed Units	5	3	T(3, 5, 7)	7	
18 Compound abc\Phase III	Site Managers	<input type="checkbox"/>	Fixed Units	15	12	T(12, 15, 20)	20	
23 Compound abc\Registration	Site Managers	<input checked="" type="checkbox"/>	Fixed Units	1	0.5	T(0.5, 1, 2)	2	

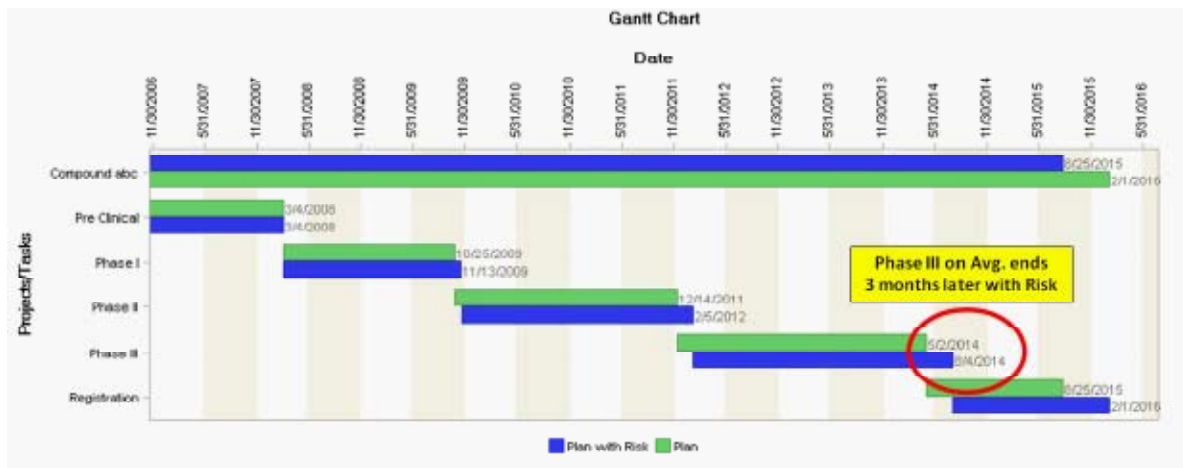
Data pulled in from PPM
Data from templates
Data from other sources

Add Risk Variability for Resource Requirements

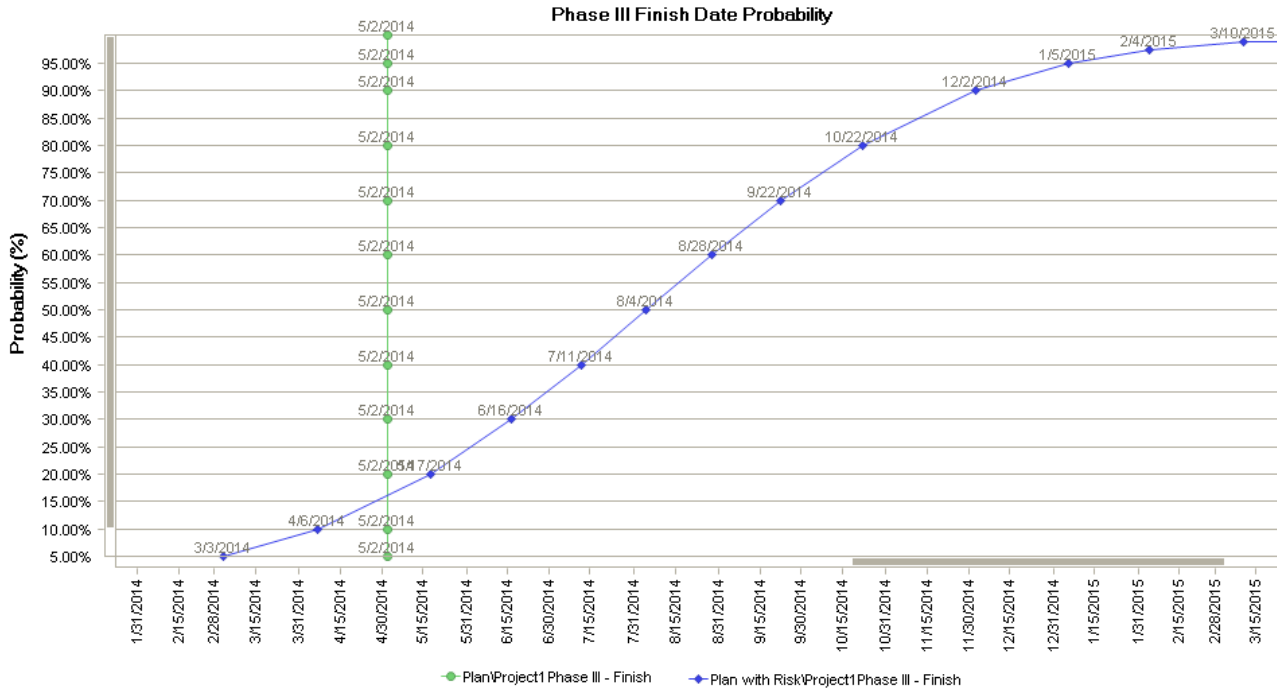
Are the Average Answers Close enough? Let's see...

If we answer the questions by simple reporting on the project as it is entered in the PPM system, we will get dramatically different answers than from the simulated results. This is due to the compounding effects of variability discussed above.

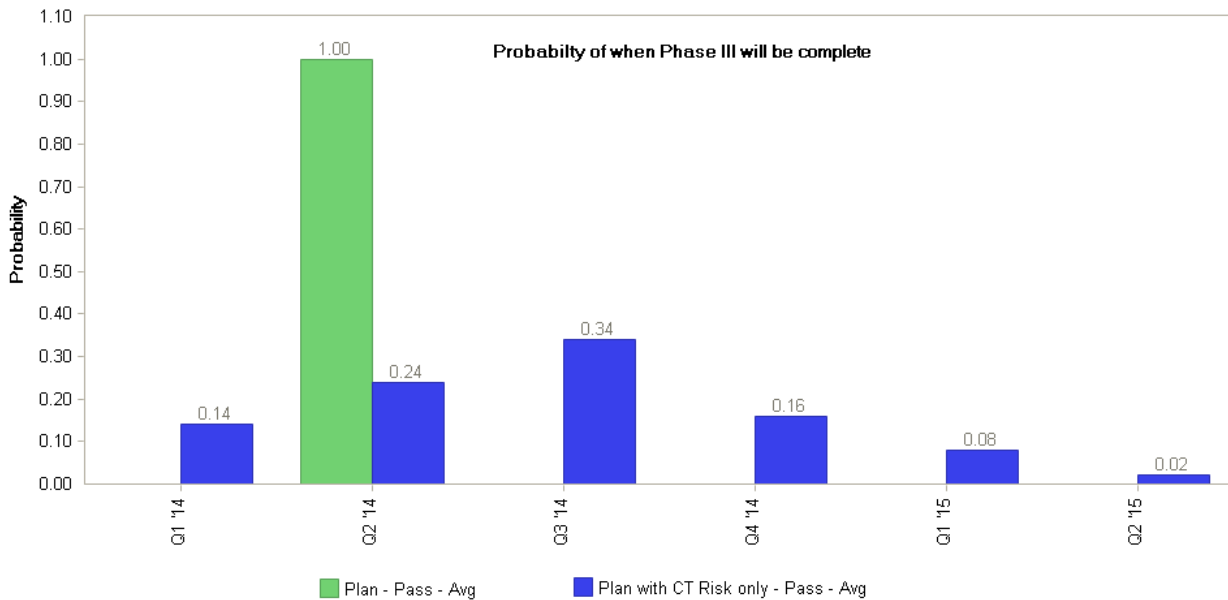
- **When will the project complete Phase III?**



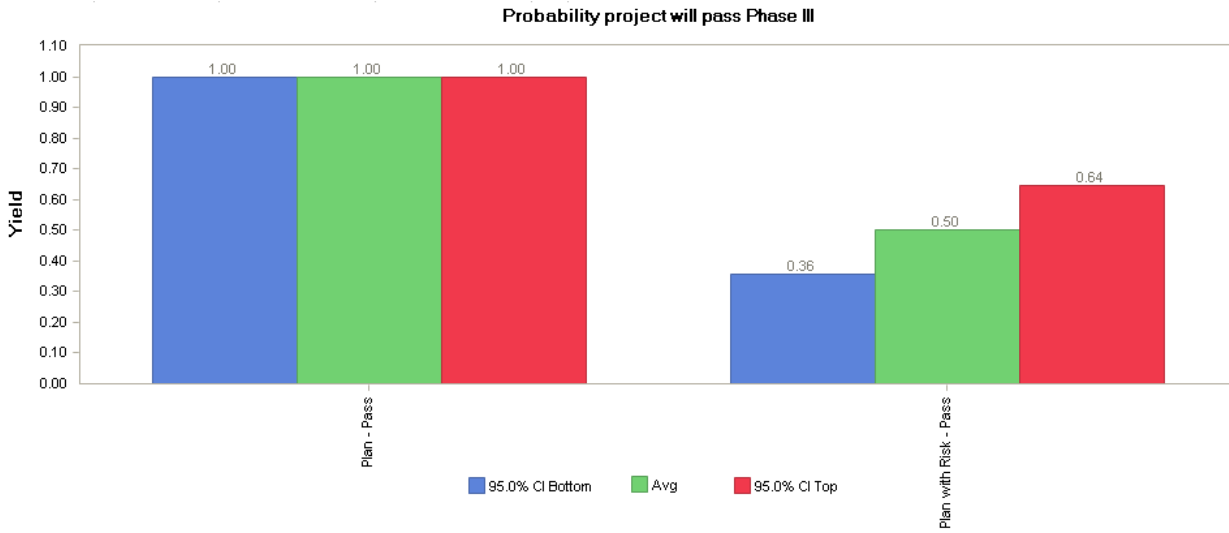
If we look at the output data probabilistically in the chart below, Phase III could finish in 2014 or 2015. The chart shows that 50% of the time it will finish three months later. However, if we want to be 95% confident with the projection the answer is January 2015, eight months after plan.



Below is another way to demonstrate the possibilities of when Phase III will finish. Notice the Plan finishes 100% of the time in Q2 of 2014, whereas the simulated results shows the probability of which quarter it would finish based on the cycle time uncertainty.

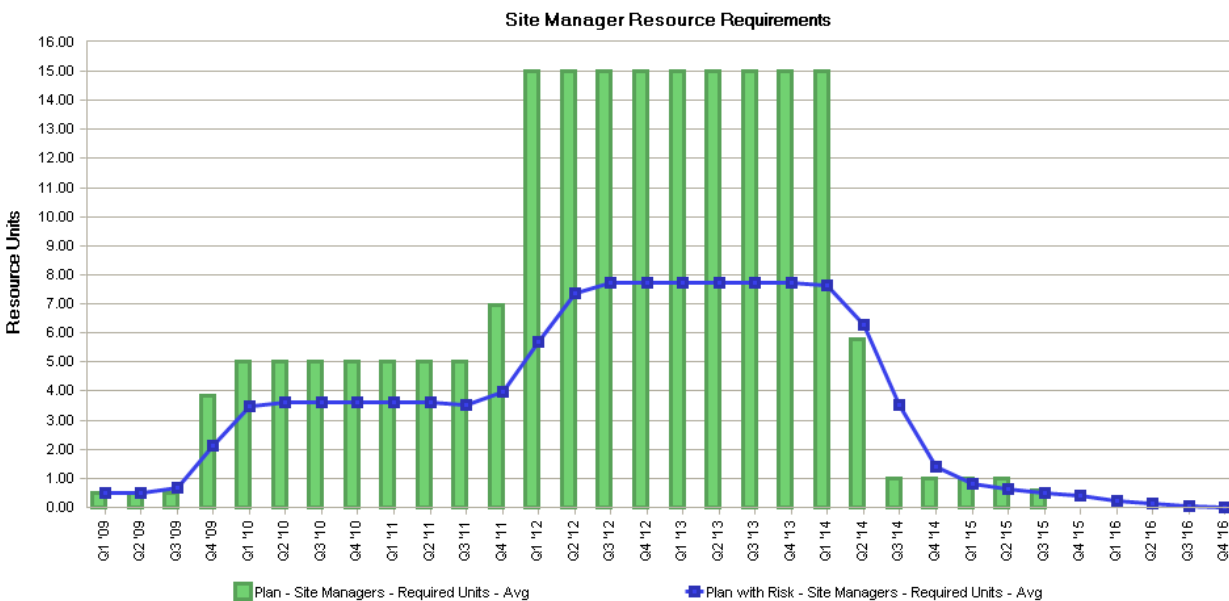


The chart below shows the probability that a project will pass Phase III. Notice in the risk-adjusted simulations it passes on average 50% of the time with a 95% confidence range between 36% and 64%.

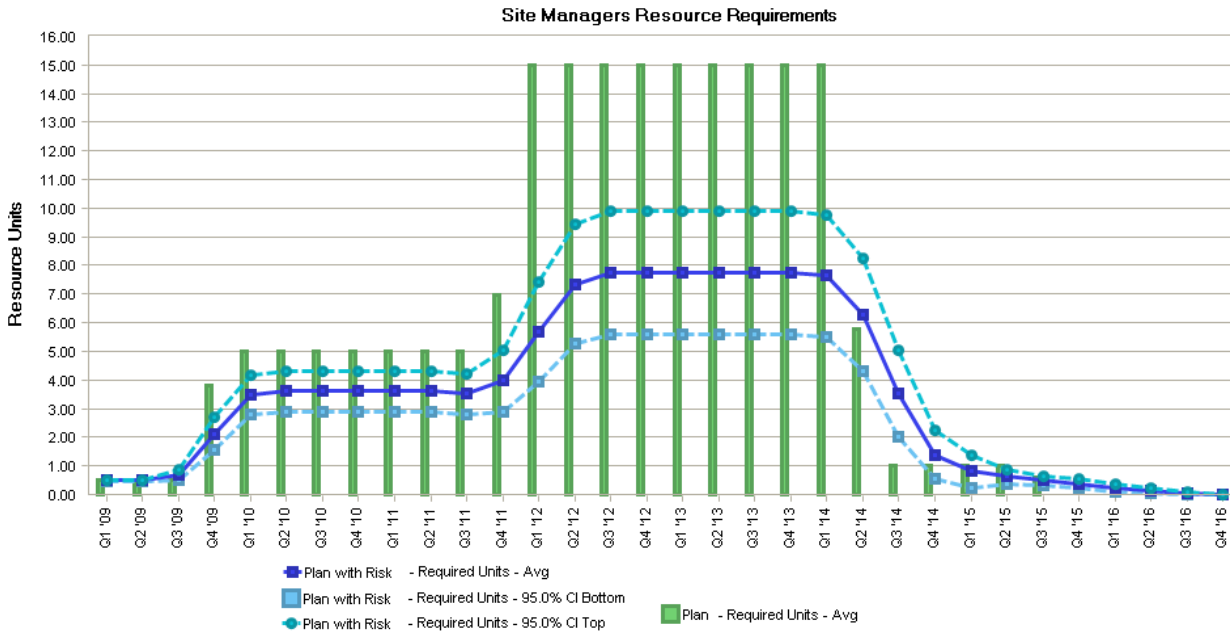


- What key resources will be required to support the project until registration?

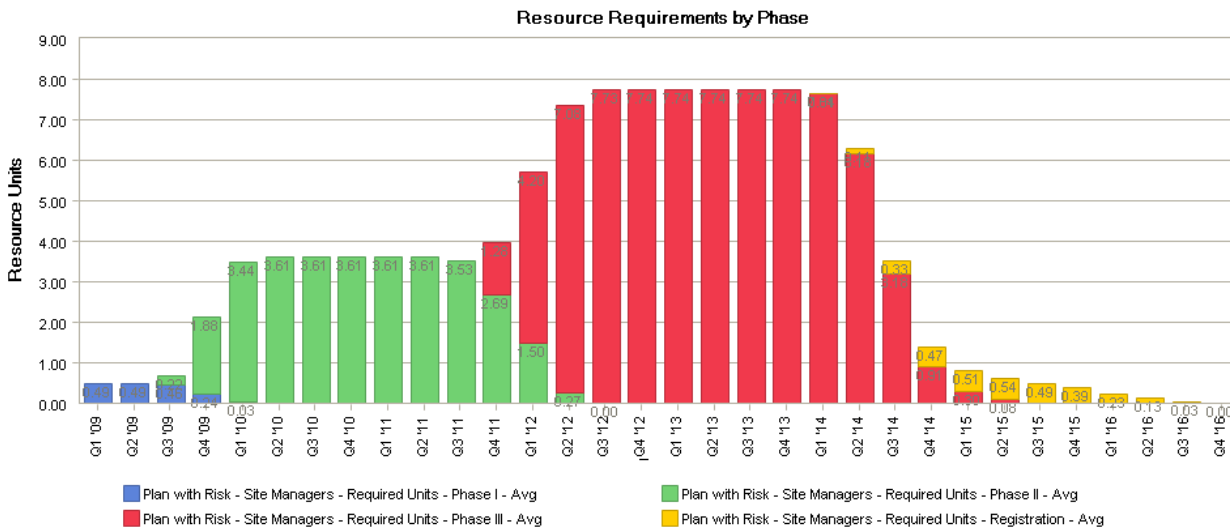
The plan (as illustrated below) shows an average site manager requirement of almost 2x greater than the risk-adjusted average in years 2012 and 2013, however in Q2 to Q4 2014 it shows less. This is referred to as the “Bow Wave Effect” that is common when using PPM solutions to predict resource requirements.



If we look at the data probabilistically, the results show the range of requirements based on the variability in time, resource requirements and probability of success, versus the point estimates in the plan.

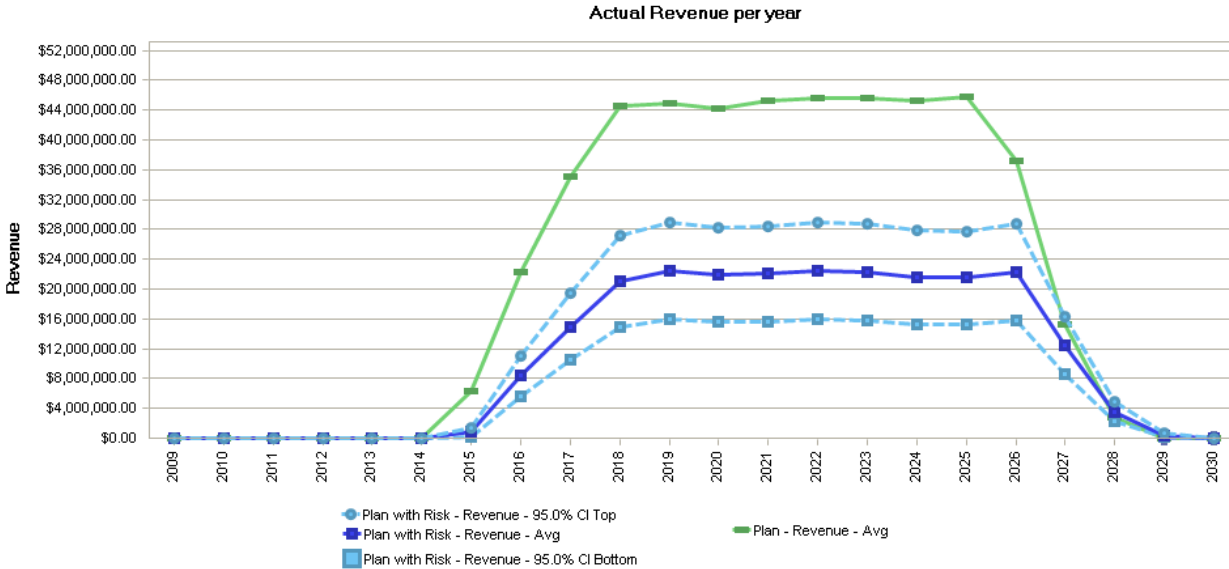


The solution will also allow you to slice the data by any attribute or metric. Below is an example of how the results would appear when the resource is required for each Phase, Study, Project, etc.

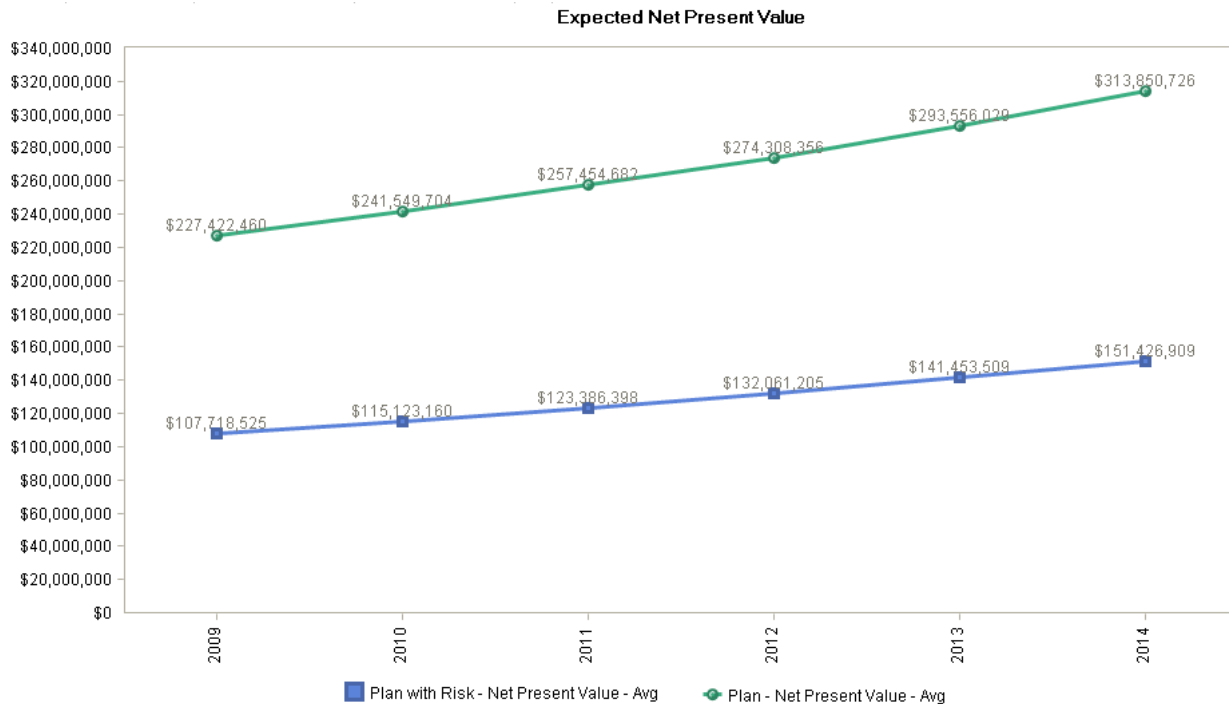


- What is the NPV of the project?

The plan (as illustrated in green below) shows a 2x revenue stream starting a year earlier than the simulated results. The major difference is due to the probability of success (POS) at various phases of the project; however the variability in task times also has a big impact on the timing of the revenue.



The resultant NPV estimates are also substantially different due to POS and the delay in time.



This simple example illustrates that without reflecting the impacts of risk and uncertainty, the answers we produce can be questionable at best. As you can imagine, the problem can become exponentially more difficult with the addition of more projects and resources. Simulation allows planners to quantify the “range” of both financial and operational impact so the best decisions can be made. It provides the ability to trouble shoot and take corrective action on potential problems before they occur, whereas using traditional approaches, management teams are at a high risk of being led to make bad decisions.

PORTFOLIO SIMULATOR SUMMARY

Portfolio Simulator is a full-featured application providing scenario management and simulation capability, so your organization can visualize, analyze and optimize its portfolio of projects without jeopardizing the actual execution system. This unique technology provides powerful, easy-to-use “What-if” capability using simulation as the predictive engine. ProModel’s powerful scenario manager provides optimization capability in which alternative project mixes and schedules can be analyzed to find the one that optimizes for time, cost and resources, thus maximizing ROI.

In addition to a stand-alone client deployment, a version of Portfolio Simulator will soon be available featuring a powerful, web-based, enterprise architecture, which leverages the information in an organization’s current PPM tool, and combines it with the domain knowledge of each member of a planning team. Using existing, authoritative data, individual project plans can be obtained from the hands-on project management team members, while the knowledge from members with an understanding of the organization’s resource capabilities can be seamlessly combined with other’s expertise in the uncertainty and risk in current and future projects. Finally, those team members who plan for the portfolio may combine the bottom-up, tactical information with the top-down, strategic direction to determine an optimal set of plans considering multiple possible outcomes, all within the Portfolio Simulator enterprise system.

With Portfolio Simulator Technology and the ProModel Methodology, you can ***make better decisions—faster:***

- Find and eliminate bottlenecks and constraints
- Visualize portfolio diversification options
- Analyze prioritization options
- Optimize resource allocation
- Evaluate and select the best portfolio of projects based on company goals

THE NEXT STEP – HOW TO EVALUATE PORTFOLIO SIMULATOR

ProModel provides licensing and professional services for Portfolio as well as its other process-improvement simulation tools. We extend a complimentary on-site consultation offer to all companies interested in learning more about ProModel's solutions and how they can help strategic planning efforts.

To find out more about this offer and ProModel please visit www.promodel.com or contact the ProModel team at 1-800-816-5338 or portfolioVAO@promodel.com

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