



White Paper

Forecasting Under Uncertainty Using Portfolio Navigator[®]

By Don Creswell, Co-Founder SmartOrg Inc.

Let's start with an emphatic statement: there are no facts about the future, therefore you cannot forecast with accuracy. The longer the planning horizon the less precise your forecast will be. Hit your numbers and you are lucky. No wonder so many projects and products fail to meet projections or fail altogether—as high as 70% say some surveys. That's a lot of money and, most likely careers, "down the drain."

"But, you say, I have to forecast sales, revenues, profits and so on. If what you say is so, how do I deal with this?" Good question. I will provide answers to this question, based on several decades' experience where uncertainty abounds: R&D and new product development.

People aren't dumb. One way to get around uncertainty is to make conservative forecasts, raising the probability that you will win, but killing innovative growth. Another way is to inflate your numbers, get the project going and hope for the best. Good for the individual; bad for the company. Yet another way is to develop highly sophisticated economic models and simulations that provide a degree of comfort and a shield when the numbers fail to pan out. Unfortunately decision makers have no clue as to what is in the models and either take results as presented or disregard the numbers and go with their gut feel.

So What Do You Do?

First, acknowledge that you cannot put a single number on a future event. If you are the boss and someone comes to you with a sales projection for several years out that consists of a single number—especially if that number goes to the first or second decimal place—toss him or her out of your office. Same deal if someone tries to snow you with complex spreadsheets that you do not understand.

Second, recognize that all numbers about the future are uncertain to some degree; some are very uncertain like the size the market and the share you can obtain for a new product. Others are less uncertain, like the cost of a product where you have decades of experience.

Third, understand that the structure of business models used to develop forecasts at the planning level can be—and should be—relatively simple. Let's look at a typical model—in the form of a "value map"—for a new product:

Portfolio Navigator showed us what our portfolio could deliver in meaningful, bottom-line terms, giving us real insight into which projects to fund.

**Portfolio Manager,
Major Oil Company**

There are three components that make up a typical model:

1. Development: "Can you do it?"

What is the probability that you can successfully complete each phase and proceed to the next phase? What is the range of cost and time it will take (duration)?

Project Evaluation Through Phases

- Idea
- Prototype
- Productize
- Commercialize

Probability of Proceeding to Next Phase

- Cost
- Duration

New Product

- New product margin
- Peak market share
- Ramp-up duration
- Peak share duration

Base Market

- Base market size
- Base market growth rate

2. Commercial: "Given that you can do it—what is it worth?"

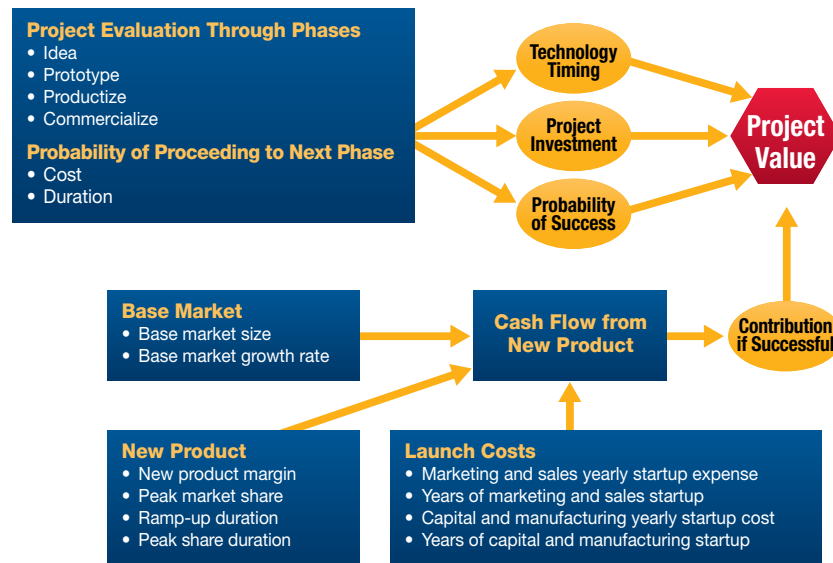
Answering this question involves identifying factors that contribute to developing cash flow; each will require assessing a range of values depending upon your current knowledge, experience and available data.

3. Launch Costs and Time

Launch Costs

- Marketing and sales yearly startup expense
- Years of marketing and sales startup
- Capital and manufacturing yearly startup cost
- Years of capital and manufacturing startup

A Complete Model



The blue rectangle (Cash Flow from New Product) represents the cash flow developed from revenues and costs. The yellow ovals represent calculations from the technical, commercial and cost sections of the model. The red octagon is the result of hundreds of calculations that develop the expected net present value; NPV weighted for the impact of uncertainty.

While this appears to be a fairly simple model, the model basically contains most of the factors you need to develop a forecast of the economic value of a project or product.

- How does the model handle uncertainty?
- Where do the numbers come from?
- What does the computer do?
- What information and direction does the computer provide from the evaluation?
- What is the math underneath?

Dealing with Uncertainty and the Numbers

There are varying degrees of uncertainty around each of the variables in the business model; basically, you know a lot about some variables such as unit cost but may know very little about other variables like market size and the share you can obtain. To the best of your knowledge, you want to capture “what you know” and “what you do not know.” (When I use the terms “you” and “your” I am referring to the collective “you and your”—the best judgment of experts in key functions such as marketing, sales, finance and R&D. Throughout this article, I will refer to the collective as “the team.”)

Value Maps like the one above enable team members to get their heads around, and understand, the model structure—the first step in getting everyone on the same page and achieving buy-in. The objective is to encourage stakeholders to engage in meaningful discussions around each model variable.

Templates display each variable in the Value Map, serving as the entry point for data. Stakeholders typically develop data inputs during team meetings, in person or via the web. On the development side, there are generally a number of phases the project must pass through to achieve development success. In the example below,

Phase	Probability of Success	Description	Basis of Assessment	Last Change
Phase A	1.00	Idea Phase: Identify target market		admin [03/11/2011] 0.00 => 1.00
Phase B	1.00	Prototype Phase: Develop prototype and test market		admin [03/11/2011] 0.00 => 1.00
Phase C	0.70	Productize Phase: Develop whole solution, validate product and market		admin [03/11/2011] 0.00 => 0.70
Phase D	0.80	Commercialize Phase: Scale up and launch		admin [03/11/2011] 0.00 => 0.80
Probability of Development Success		0.56		

Phases A and B have been successfully completed (1.00 probability); the team’s judgment is that there is a 70% chance of achieving the goals of Phase C and an 80% chance of achieving Phase D.

The computer calculates the overall probability of development success as 56% (the four probabilities multiplied 1.00 x 1.00 x .70 x .80).

Note that for review and tracking purposes, the basis for each value assessment and a notation of the details of each change are captured by the computer.

The team next addresses cost and schedules for each of the development phases (template not shown) and turns to the more challenging task of assessing the uncertainties around Commercial Contribution (the combination of revenue and costs). Unlike the development numbers where each phase has a probability of success (you achieve results or you do not),

market and related variables each have ranges of values that represent “what you know” and “what you do not know.”

Template Inputs	Units	Low	Base	High	Description	Basis of Assessment	Last Change
Base New Product Market							
Base New Product Market Size	millions of dollars	350	400	475	Initial size of the base market segment to which the new product applies	admin [11/13/2009]	350, 400, 500 - 350, 400
Base New Product Market Year	calendar year	2010			The year defining the base market segment assessment		
New Product Growth Rate	decimal fraction	0.05	0.07	0.08	Growth rate to be applied to the base new product market segment assessment	admin [11/13/2009]	0.05, 0.07, 0.08 - 0.05, 0.07
Our New Product Margin	decimal fraction	0.3	0.5	0.6	Profit margin on new product revenue	admin [11/13/2009]	0.3, 0.5, 0.5 - - 0.3, 0.5, 0.6

The [SmartOrg] approach forced us to get clear and specific about each element of the portfolio, which was something we had great difficulty doing before.”

Director of Strategic Planning and Modeling, HP

To conserve space, only a portion of the Commercial Contribution template is shown above; the complete template contains all of the variables in the Value Map. The example shows the variables for the base new product market, including market size, launch year, growth rates and margin.

It is important to note that each of the variables is set to a Low, Base and High number within the range. These ranges are developed during often spirited discussions among the stakeholders, experts and other team members. Where there are important differences of opinion and a wide range of uncertainty it is vital that this range be captured for it truly reflects “what we do not know.”

In the example, there is a range of \$125 million between the Low and High value assessments for Base New Product Market size, which as will be shown later, can have a significant impact on the profitability of the product.

How does one get to these numbers, avoiding pulling assumptions out of the air? You need to challenge people to think as broadly as possible, given that there is a natural tendency to provide narrow ranges. Ask questions about the Low and High numbers and insist that the persons responding provide as much evidence as possible for the assessment. For instance, “You have assessed the Low market size as \$350 million. Can you think of a situation where the market could be lower than this?” This question may result in considerable discussion and either the \$350 million will be accepted or lowered. The same approach needs to be applied to the High market size, “Can you think of a situation where there is a 10% chance that

the market could be higher.” As with each of the numbers in the model, the idea is to encourage in-depth discussion around the range of values.

It is important to note that it is the discussion around the model variables that provides the most value to decision making.

When all variables have been assessed and data entered into templates, it is time for the computer to go to work.

Let’s jump ahead to the last question above, “What is the math underneath the Value Map?” Value Maps, while graphic in nature, represent a very sophisticated set of decision analysis-based equations that interpret the impact of each variable and its range of uncertainty on the final value measure: “expected net present value (ENPV)”: ENPV is traditional NPV adjusted to reflect the uncertainties in the model. The mathematic model is technically called an “influence diagram,” a methodology developed by SmartOrg chairman Jim Matheson and his colleagues at SRI and Stanford University during the 1960s.

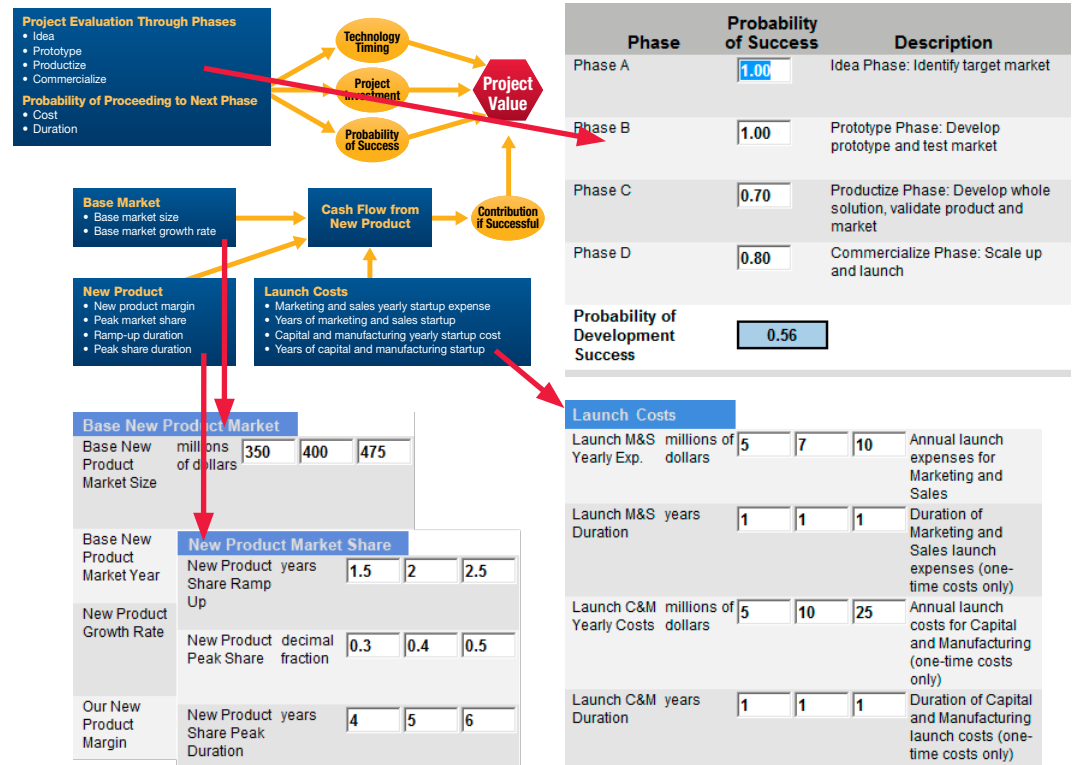
(Note: a corollary to this type of analysis is called “Monte Carlo” analysis, a similar but less robust approach.)

A typical influence diagram: I show a diagram to emphasize that this is serious business! It’s there but you don’t have to worry about it.

Like driving a Porsche, you want to know how fast it goes, corners and gets you there not how the valves and power train function.



As mentioned above, users enter data into templates that represent each of the factors in a Value Map (business model). A typical map and an abbreviated set of input templates are shown below.



Users enter data via templates for each factor (variable) in the Value Map.

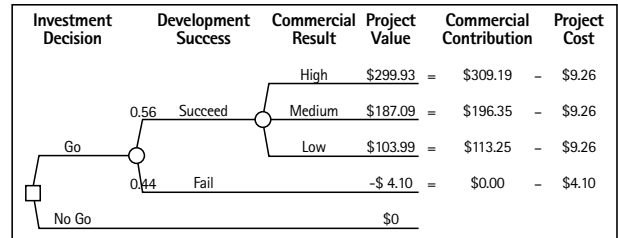
For the “probability of development success” users enter the probability of moving through each development phase. The computer multiplies the probabilities to attain the overall probability of success. During development users will update the data at reviews or stage gates.

Factors that influence cash flow, such as size of the market, share, margins, and cost are entered as Low/Medium/High ranges.

The computer calculates results based on the inputs, producing a set of outputs at Project and Portfolio levels.

Project Level Evaluation Results

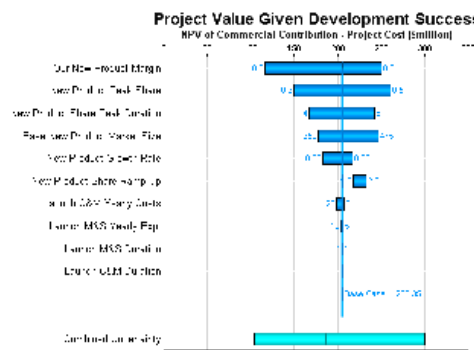
Estimated Project Value	\$108.67
Project cost given development success	\$9.26
Expected project cost	\$6.99
Probability of development success	0.56
Commercial contribution given success:	
High	\$309.19
Medium	\$196.35
Low	\$113.25
Expected	\$206.54
Investment productivity	15.55



Results are summarized in a table as well as in decision tree form.

Three to four variables often account for over 90% of the uncertainty in a typical business model. These are the variables upon which you need to direct resources to mitigate downside risk but, more important, to improve your chances for producing higher value.

Tornado charts identify key variables. They are produced by calculating all possible combinations of the Low, Medium and High entries in the templates and displaying them in the order of their impact on value.



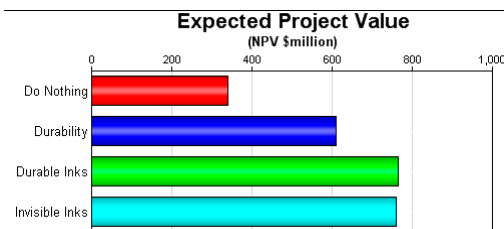
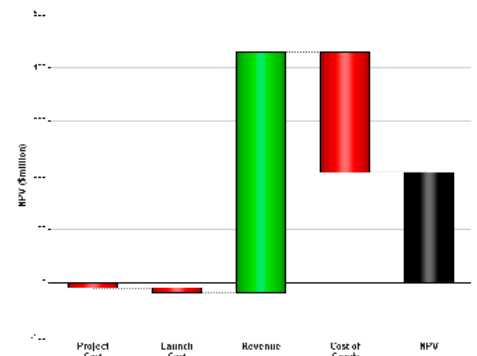
For instance, New Product Market Share can swing the NPV from under \$150 million to over \$250 million, challenging your team to find ways to gain market share.

In this example, the tornado identifies four variables that have the greatest impact on value. For instance, New Product Market Share can swing the NPV from under \$150 million to over \$250 million, challenging your team to find ways to gain market share.

Waterfall charts (below) summarize the factors that make up NPV.

The waterfall shows Costs (red) and Revenue (green) that make up NPV (black).

Finally, a project can be compared to alternative forecasts based on probability of development success, commercial value and other variables in the value map. The chart compares the expected value for four project alternatives.



A comparison of the Expected Project Value of four alternatives.

In the foregoing sections, I discussed forecasting project value under uncertainty, exploring how to get your hands around selecting the most promising products for development based on their expected economic value to the company. This is not the end of the story. A product in itself may be valuable, but it may not support the economic objectives of your product portfolio. The project also needs to be evaluated in light of its impact on portfolio value.

Basic Portfolio Concepts

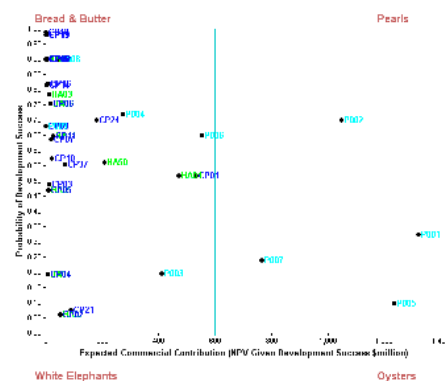
Why do you need a portfolio in the first place? Because of uncertainty, you cannot consistently pick individual winners. Hey, if we could do this we would all be billionaires! Over time some of your products will exceed expectations, others will fail to meet expectations and a number will fail altogether. Problem is that you don't know which. By assembling a mix of projects (portfolio) you can optimize the overall expected value delivered by your product development process by balancing risk/reward.

Following the analytic process set forth earlier, you will have taken a vital first step by applying a consistent process to project evaluation, enabling apples-to-apples comparison at the portfolio level.

Portfolio Navigator provides dozens of ways to compare projects. Because of space limitations, I will limit this discussion to a set of outputs commonly used by our customers: the Innovation Chart, the CFO chart, and project comparison charts. Data that produces these results derives from the template inputs described above.

Innovation Chart

The Innovation Chart displays each project in the portfolio based on two dimensions: the Probability of Development or Technical Success vs. the Expected Commercial Value given



success. The chart basically represents risk vs. reward.

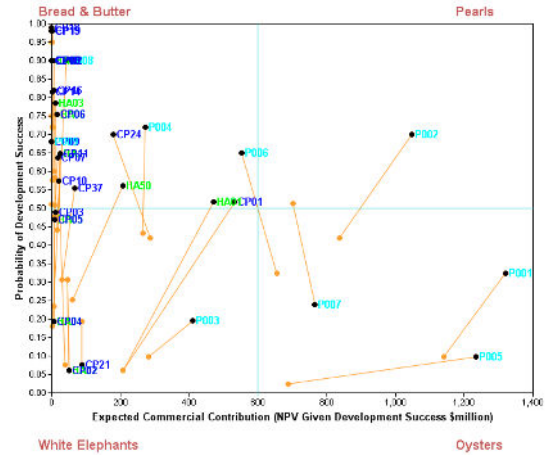
The Innovation Chart, like other charts in Portfolio Navigator is dynamic in that changes made at the project level—when accepted and saved to the portfolio—update the portfolio displays, supporting real-time tracking and “what if” scenario analysis.

The graphic shows a typical four-quadrant Innovation Chart. The vertical axis shows the probability of development success and the horizontal

axis shows the expected commercial value given development success. The explanation of the four quadrants, below, is excerpted from my colleagues' book, *The Smart Organization: Creating Value from Strategic R&D* (Harvard Business School Press).

Bread and Butter—the upper left quadrant represents projects with high probabilities of success and good commercial value. These “bread and butter” projects fulfill the need to produce regular results for existing business units and to support shorter-term objectives.

Pearls—the upper right quadrant contains projects with the greatest potential for both commercial and development success. Pearls address revolutionary commercial applications, and they deal with proven technical advances. Pearls are relatively rare in real life and only found by opening a great number of oysters; the same with new product development!



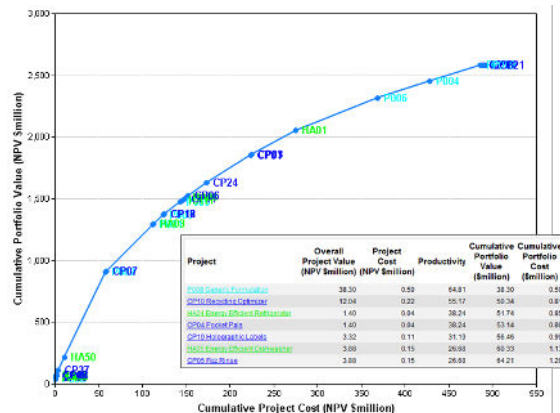
Oysters—the lower right quadrant represents early stage projects designed to produce new strategic advantage. They have blockbuster potential but breakthroughs are needed to unlock this potential. The majority of projects in this quadrant are expected to fail; but those that do succeed should win big.

White Elephants—projects in the lower left quadrant are “white elephants.” They consume resources, displace more promising projects and are unlikely to enjoy development success or produce substantial commercial value. They are candidates for killing.

The yellow lines in the graphic track changes from one evaluation to another.

CFO Chart

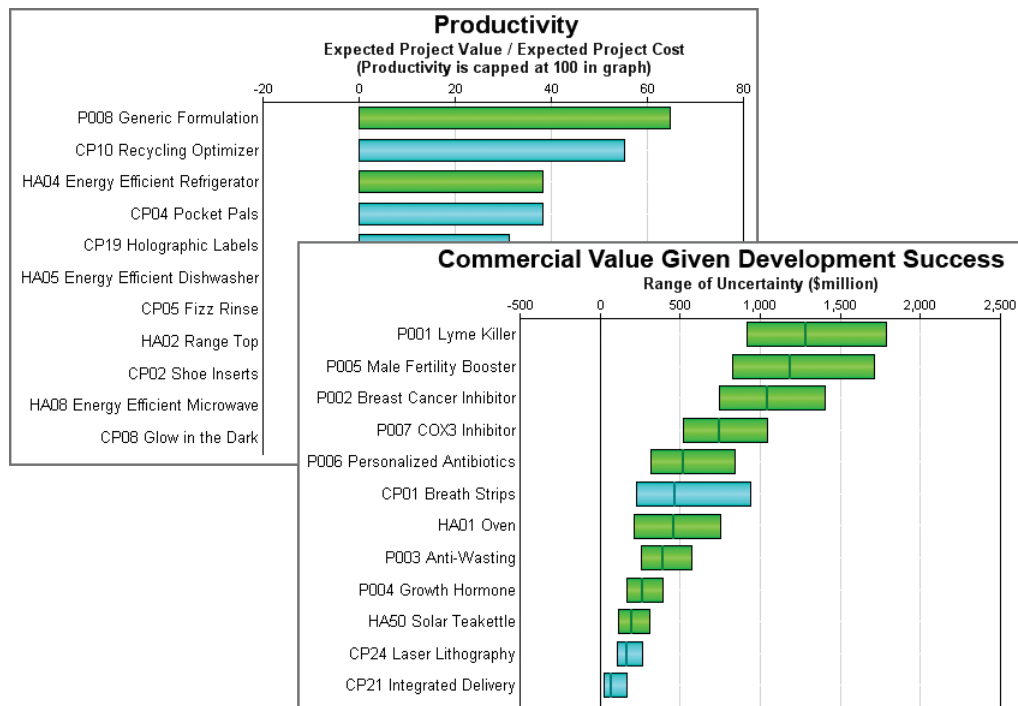
The CFO chart—sometimes referred to as an efficient frontier chart—arrays each project based on its productivity—“bang for the buck”. Projects to the left are more productive than projects to the right. This curve supports decisions about cutting projects when budgets are tight, adding resources to projects that produce higher value and other decisions designed to maximize the return on investment.



The CFO chart is particularly useful when reducing budgets or making a determination about reallocating resources to focus on projects that have high value potential. Results are displayed in graphic and table form (the table has been truncated to conserve space). The computer also tracks and plots changes as project data is updated.

Project Comparison

Projects need to be compared against each other on various dimensions, including probability of success, cost, expected economic value and other factors. (Expected economic value is NPV adjusted for the impact of uncertainty.) The figure shows a sample of two such comparisons.



Projects compared on probability of technical (development) success and commercial value; color coding reflects various categories.

Tracking, Updating and Developing “What If” Scenarios

Portfolio Navigator is a dynamic system. Users can update project data at any time (given appropriate permissions) to evaluate the impact of new information on portfolio value, review project/portfolio status at stage or phase reviews, and develop “what if” scenarios.

About SmartOrg

Since 2000, SmartOrg Inc has helped companies create exceptional value from R&D, New Product Development and Innovation through a unique combination of Value-Based Management consulting and decision support software. Our flagship product, Portfolio Navigator identifies and tracks key value drivers and the risks and uncertainties that must be managed to optimize economic value. Our PPM Optimization Workbench™ combines Portfolio Navigator with SAP project/portfolio management software to support strategy and implementation from ideation to commercialization. SmartOrg clients include large companies like Boeing Commercial Airplanes, Chevron Technology, Dow AgroSciences, Hewlett-Packard, and Cisco Systems. And smaller companies like Zimmer, Catalent and TEVA Neuroscience.

855 Oak Grove Avenue
Suite 202
Menlo Park, CA 94025
T: +1.650.470.0188
F: +1.650.328.1612
info@smartorg.com