Technology Acquisition and Project Management Test Case

Story

The VP of Mergers and Acquisitions (the VP) for a major manufacturer of hard drives felt he had little information on which to base analyses of the acquisition prices of small firms with novel intellectual property. He thus typically negotiated by simply trying to reduce the asking price by a significant amount, say 25%, thereby feeling and being perceived within his company as if he had saved money.

Once an acquisition was made, a project manager (the PM) would take control of developing the new product opportunity made available by the acquisition. With no other guidance and an incentive system built around "success", the PM would aim to maximize the chances of getting the product to market in the time-frame required to gain significant market share, regardless of the cost.

The VP was confident that there must be a way for him to determine the true value of the acquisition to his company so that he could enter negotiations confident of his maximum buying price. He was also concerned that projects, once started, would often drag on well after opportunities for profitability had passed, and that using high-priced consulting teams to maximize the chance of success was cutting into profits.

The VP modeled a representative acquisition with Provisdom's help. All available relevant information about the possible project development was modeled to value the acquisition. This information included repeated choices between halting the project to save costs and either hiring the product group's engineering team or an internal consulting team, who rove between product groups as needed. The model also included the anticipated learning about future sales for a new hard drive that would occur during the development of the product.

Business Problem

The VP decided upon the following information regarding sales for the new drive. In practice, this would come from market research and his experiences.

- The window of opportunity for this drive will end in one year.
- Beginning sales are uncertain and additional market research at the end of the first quarter will give a better estimate, cutting the uncertainty in half. For now, the best information is that if the new drive is in the market in 2 quarters, sales will be, on average, 500K units per quarter. The standard deviation of that estimate is 250K units per quarter.
- Sales have a 10% positive correlation with the Market.
- If the drive is one quarter late to market, sales will be reduced by 25%.
- Once sales begin, they will continue to be uncertain with 47.24% volatility and 0% expected growth rate. Each unit sold generates a profit margin of $5.

Based on past experience with similar projects, the PM created the following development situation for the new drive.

- Both a design and prototype phase will be needed, each lasting at least one quarter but not more than two.
- Towards the end of the design phase, the team will discover whether the prototype phase will be harder or easier than normal. If easier, it will definitely be completed in one quarter.
- Changing teams between phases will decrease the probability of finishing the hard prototype phase in one quarter by 10%.
- For each team, the costs per quarter, chance of completing design phase in one quarter, and chance of completing hard prototype phase in one quarter are shown in the table below.

GROUP	Cost per quarter	Design Phase	Hard Prototype Phase
Engineering	$240K	40%	25%
Consulting	$800K	50%	50%

Product Management Strategy

Optimal

The shareholder value of the optimal strategy was found to be $1.52M. We find that it is optimal to always choose the engineering team except in three situations:

- There is no chance of completing the drive by the end of the third quarter.
- Design phase is finished quickly (i.e. in one quarter), sales estimate increases, and prototype phase seems hard. In this case, use consultants for first quarter of prototype phase.
- Design phase takes two quarters, sales estimates decrease greatly, and prototype phase seems hard. In this case, stop the project.

Maximizing "Success"

To maximize the chance of bringing the notion of success to projects, the PM would typically develop a new product as quickly as possible within his granted budget. For this representative project, the PM indicated that he would bring in the consulting team for both the design and prototype phases. This strategy would have a probability of success of 88% but a shareholder value of only $0.65M. Compare this with the optimal strategy, in which the completion probability is 76% but the shareholder value of the acquisition is $0.87M greater (over twice as large). The incorrect goal function ("maximize project success") can lead to major losses in shareholder value. This illustrates a common fallacy of project management, where one often encounters the rationale that abandoning a project is unacceptable ("we already spent all that time and money, we can't quit now!"). Provisdom's system makes it clear that maximizing the chance of success comes at a high cost, which is not justified by the increased future revenue possibilities.

Maximum Buying Price of the Acquisition

Armed with an optimal product management strategy and a maximum buying price of $1.52M (up from $0.65M), the VP can now go into negotiations confidently of where to draw the line instead of relying on the other party's first asking price.

Feedback and Analysis

To ensure the model matched his intuition and vice-versa, the VP was curious about how important each variable was to the shareholder value, how the product management strategy would change as the sales estimate is updated at the end of the first quarter, and how much less expensive the consultants would have to be to choose them to work on the design phase.

Variable Sensitivity

To answer the VP's first question, a derivative analysis was performed, examining the magnitude and direction of the change of the NPV as a function of the model properties. In the table below are the results from the analysis of the model properties that are given in terms of percentages.

Model Property	d(NPV)/d(Property %)
Probability finish design quickly (Engineering)	$27,770
Probability of 'Easy' Prototype	$17,852
Risk-Free Rate	(-$16,219)
Percentage of sales retained when late to market	$11,897
Probability finish 'Hard' Prototype quickly (Engineering)	$7,107
Expected growth of Sales	$6,665
Sales correlation with the Market	(-$4,625)
Probability finish 'Hard' Prototype Quickly (Consultants)	$4,331
Drop in probability of quick finish from switching groups	(-$4,331)
Volatility of Sales	$1,802
Probability finish design quickly (Consultants)	$0

Not surprisingly, the NPV was most sensitive to the probability that the engineering team finishes the design on time. Choosing the engineering team for the design phase is optimal, and if they do not complete the design in the first quarter, the project's value is greatly reduced (by $1.92M when the sales estimate decreases to 318K and by $3.68M when the sales estimate increases to 620K). Conversely, since the choice of the consultants during the design phase is non-optimal, the corresponding completion probability has no effect on the NPV.

Turning to the parameters for sales, we find that the expected growth rate is the most important. However, the Market correlation is of nearly equal importance, emphasizing the crucial role of Market information in correctly estimating shareholder value. Further, we find that the sales volatility has a positive influence on the NPV, contrary to conventional management wisdom ("uncertainty is bad"). This is due to the imbedded "option" value.

The table below shows the results of the model properties that are in terms of dollars.

Model Property	d(NPV)/d(Property $)
Marginal profit per unit sold	$442,581.00
Quarterly cost of Engineering	(-$2.54)
Quarterly cost of Consultants	(-$0.10)

We can see from the results that a small change in the marginal profit per unit sold would make a substantial difference in the value of the acquisition. For example, if the marginal profit was merely $5.10 instead of $5.00, the NPV would probably be about $44K larger. A change in the cost of the engineering team would also have a sizable impact. If the quarterly cost was $250K instead of $240K, the NPV would probably be about $25K smaller.

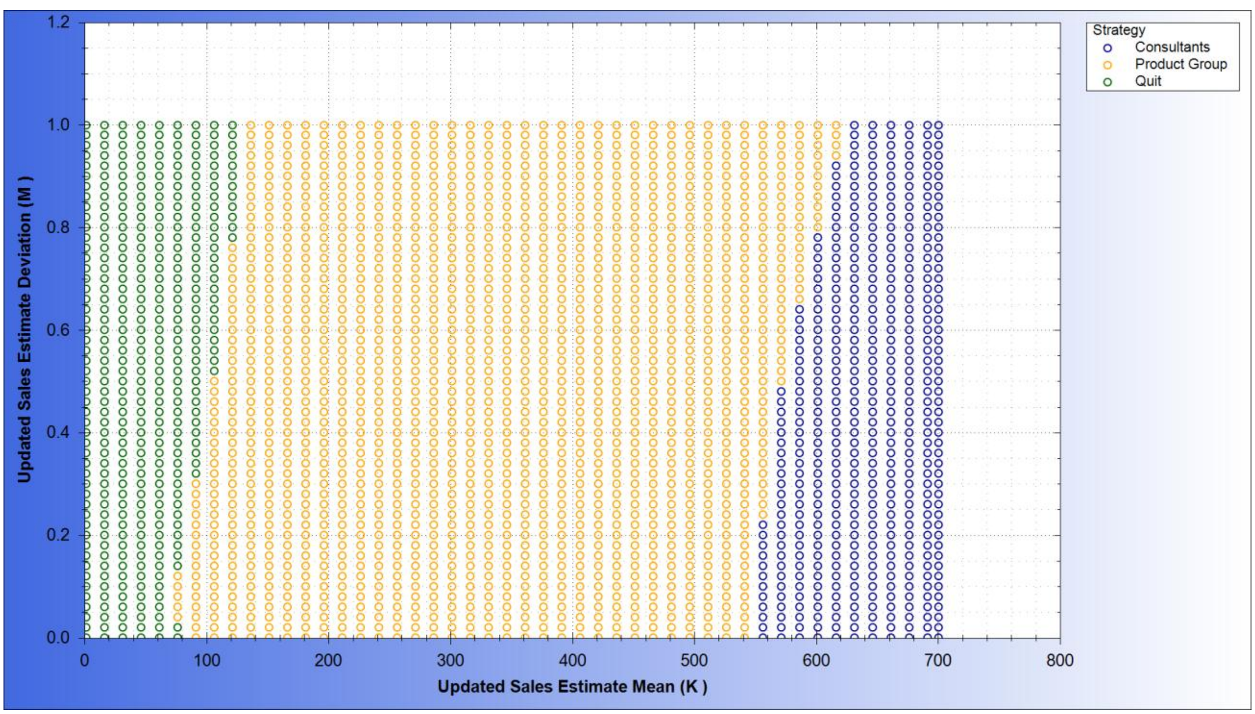
The last table shows the results of the remaining model properties.

Model Property	d(NPV)/d(Property)
Sales Estimate Mean	$4.47
Sales Estimate Deviation	(-$0.08)

As expected, the sales estimate impacts the value greatly. The standard deviation has little impact on the value, but plays a large role in determining the optimal strategy. Without a strategy that considers the impact of the uncertainty, the standard deviation would have a very large negative impact on the value. With a strategy that considers uncertainty, the impact can often be largely positive as the strategy takes advantage of contingent opportunities.

Updated Strategy

To answer the second question, below is a graph of the optimal strategy when the design phase is completed quickly and the prototype phase is hard. The strategy is plotted against the updated mean and deviation of sales at the end of the first quarter.



This graph shows that when the updated sales estimate is high, it is worth the cost to use the consultants. It also shows the region in which it would be optimal to stop the project.

Consultants' Cost

To answer the VP's final question, a break-even analysis was performed on the quarterly cost of the consulting team, indicating the cost at which using the consulting team for the first quarter would yield the same NPV as using the engineering team. We found that the break-even point occurs if the consultants' quarterly cost drops to $602,539. If the VP or the PM could negotiate for a rate below this point, the optimal choice would be to use the consultants in the first quarter.

Conclusion

The resulting strategy showed that the PM's choice of team would change based on market research about the future sales of the new drive and the progress of the development. The analysis showed clearly why the maximum buying price was $1.52M based on the information at hand. Knowing the shareholder value ensures that well-priced acquisitions are made and potentially saves the company millions from purchasing over-priced firms.

The full model integrates information from both parties, accounts for future decisions, and maximizes shareholder value. The VP and the PM each have different information relevant to the problem, and neither should perform their analyses in isolation. The VP's valuation of the acquisition depends on the project management aspects, and the PM's project management strategy depends on future sales information. Consistency and transparency across management levels are achieved when the VP and the PM (and shareholders) share the same goal.

Lack of vertical consistency in goals and analysis methods clearly makes a big difference in how the acquisition is valued. With the traditional methods, the PM has a goal which is clearly not in the best interest of the shareholders, as evidenced by the significant discrepancy between the shareholder value of the optimal strategy and the maximize success strategy.

Extended Case Study

We will now extend the above test-case as a case study. To simplify the model for demonstration purposes, we'll remove the option to be late to the market.

Strategy and Valuation

Optimal

In this case, the maximum buying price of the acquisition is $930K. We find that it is optimal to always choose the engineering team except in two situations:

- If either phase is not completed quickly, stop the project.
- If the sales estimate increases and the prototype phase seems hard, use the consultants for the prototype phase.

Maximizing "Success"

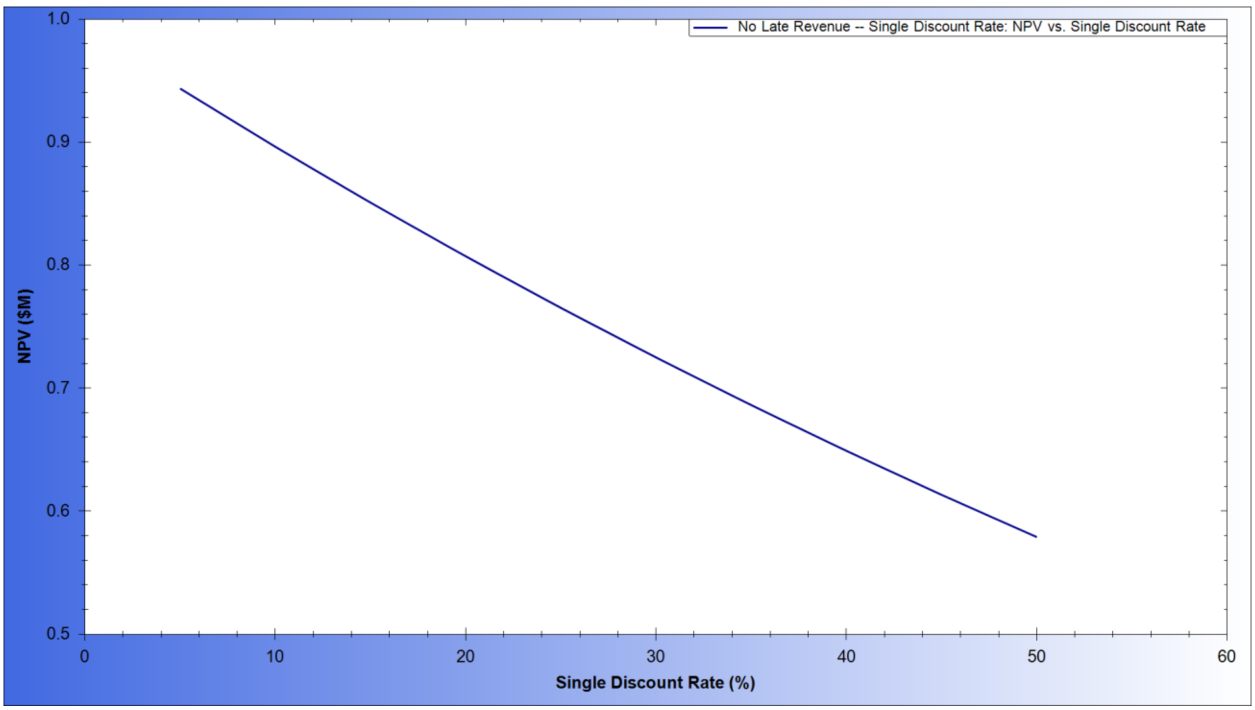
In this example, the strategy of maximizing project success by using the consulting team for both the design and prototype phases has a probability of success of 38% but a shareholder value of only $639K.

Compare this with the optimal strategy, in which the completion probability is 27% but the shareholder value of the acquisition is $291K greater.

Single-Rate Discounting

Suppose that we decided to use a "corporate standard discount rate" of 25% in all cases. This is clearly at odds with the shareholder value, since a single discount rate misprices even a simple asset like a risk-free bond. This approach ignores the information we have about a particular model's uncertainties. The proper approach is to derive discount rates based on the relationships between the model's unknowns and the Market.

A single 25% discount rate applied throughout the model yields an NPV of $765K. A graph of the NPV vs. discount rate is shown below.



Single-Point Forecasting and Single-Rate Discounting

Again suppose that the PM decides to maximize success and chooses the consulting team (obtaining an NPV of $639K). In addition, the VP takes the PM's cost estimate, performs a simple expected-value analysis to forecast sales, and applies a single 25% discount rate, so chosen in an attempt to account for "risk" (like not completing the project). By not explicitly considering the chance of failure, this analysis places a value of $2.596M on the acquisition, which means the VP could overpay for this acquisition by almost $2M ($2.596M - $639K = $1.957M).

Conclusion

Traditional methods of valuation and devising strategies are seen to be gross oversimplifications compared to the optimal strategy and valuation, leading to potentially significant losses in shareholder value.