

11 Managing Corporate Knowledge to Create Strategic Opportunities

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Evidence exists showing that markets and investors reward corporations that manage and act on corporate expertise to create shareholder value. I intend to show you that it is possible to measure the market's valuation of corporate expertise. The implication from this observation is that markets expect corporations to use that in-house capability to add value to assets and grow their business revenue. The example used to illustrate this observation comes from the energy industry.

Second, I will use a simple example from the pharmaceutical industry to illustrate the application of corporate expertise to product creation. Many of us have been searching for a financial tool that will quantify the intangible value of technical know-how and research activities. My example will apply a new valuation and decision management technique that some of you may have already seen in the finance and business literature, Real Options analysis. Not only can we use it to value the creation and application of knowledge, but also to value knowledge management activities and the efforts of knowledge managers.

Introduction

We are all aware of the difficulties and failures of traditional valuation techniques based on discounted cash flow (DCF). These techniques are unsuitable for valuing risky opportunities in which success is based on the arrival and application of new knowledge. The techniques re-

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quire the use of chance factors for success that are nearly zero, reflecting the risky nature of the investment. Other investments that require long time frames between the initiation of a knowledge-driven program to its successful implementation are penalized heavily based on the time value of money concepts in DCF. As a consequence we have become accustomed to hearing that investments in knowledge have little or no financial value.

But we know that corporations routinely ignore the guidance of traditional value techniques. There are many examples of investments in opportunities that provide flexibility for managers to respond to the arrival of new knowledge about the project, the implementation of new technologies in the project, and new market needs. Clearly these investments reflect corporations' instinctive valuation of growth opportunities and recognition of the embedded ability to manage the project's risk.

To exploit these opportunities and manage the associated risks, corporations must sustain and manage business and technical expertise so that it is readily available for application. Growth opportunities depend on creating new knowledge, exploiting existing knowledge in new methods, and protecting hard won knowledge from exploitation by competitors.

These efforts must be measured in terms of new products, ability to add value to existing assets, and growth of revenue and profits. Here is where the traditional valuation techniques fail to support our instinctual insights. Applying financial tools that give a more realistic representation of the business processes of risk management through the application of knowledge management will show the value we believe has always been at hand but was never quantifiable.

Market Rewards for Corporate Knowledge Application

The first example we will consider looks at how the availability of corporate technical expertise in developing new pharmaceuticals can be incorporated into a Real Options analysis of a research and development (R&D) project. In this example, we will see how improvement in valuation can make the justification of a good project much easier.

There is evidence that markets reward companies for their ability to sustain and apply technical expertise to growth opportunities. In turn, these opportunities lead to the traditional measures of shareholder value. I will demonstrate one example of this reward process using an example of a multinational energy company's management of its oil and gas production portfolio, and its share price on the New York Stock Exchange.

Applying Knowledge Management to Identify High Value R&D Opportunities

Pharmaceutical R&D is driven by the company's exploitation of its scientific expertise. New compounds are tested for their curative potential against a disease over several clinical stages. Each stage has a high risk of failure. Taking the pharmaceutical from the discovery stage to commercialization requires multiple years of costly effort. Later stages build upon prior work and stages cannot be skipped. Ultimately, if a drug survives each stage, the company can earn many years of patent-protected profits in return for its efforts.

As with most R&D investments, the cumulative risk of failure across the many stages to commercialization lowers the likelihood of receiving the profits of a successful commercialization. Even more difficult on the valuation is the extended period between initial, costly R&D investments and the beginning of revenue from sales. Traditional discounted cash flow usually cannot justify the investment in a promising new pharmaceutical. The project's net present value (NPV) will be negative.

It is becoming more and more commonly recognized that stage-wise R&D projects, like the one described above for the development of a new pharmaceutical, can be considered as a collection of option purchases bundled with the acquisition of knowledge. We can view the first stage of the project as the purchase of knowledge about the relationship of drug efficacy versus toxicity or side effects in a small subject group plus the option to invest in the next stage of development, which is larger scale tests. The option gives the company the right, but not the obligation, to undertake the next stage. If the first stage is a failure, the company is not required to purchase (invest in) the next stages. However, the company cannot undertake the second stage without purchasing the knowledge that comes with completion of stage one.

Consider a simplified example built from a valuation study that I recently conducted for a major U.S. pharmaceutical manufacturer. The company believes that a new compound has the potential to treat a significant neurological illness in older patients. If this compound can pass through the four stages of testing and approval, its worldwide market potential is approximately \$500 million in after tax earnings over its patent life, discounted back to the year of its initial introduction. The discounting of revenues each year in the future uses the company's weight-averaged-cost-of-capital as a discount rate.

There is considerable uncertainty in the pharmacologists' minds regarding the potential for success in the early stages of study. As the compound successfully moves from one stage to the next, the overall risk for the project decreases. However, the cumulative risk is so high that a traditional financial analysis of the project indicates a negative return on investment. The NPV is negative. In spite of this unattractive financial metric, pharmaceutical R&D managers routinely undertake investments like this. They disregard the existing financial indicators and invest based on their instinct and experience in the industry.

Management makes a decision to invest or overlook the pharmaceutical's potential in phase one. The outcome of phase one is either good or poor. This leads to the next decision, to invest in phase two if the outcome of phase one was good, or to abandon the project if the outcome was poor. This invest-learn-evaluate-decide cycle continues for each of the four phases in the pharmaceutical's development. The manager has the right, but not the obligation, to invest in the next stage, only if the prior stage was purchased.

How does corporate knowledge and its management enter into the valuation of the option and guide management's decision to invest in the R&D project? An option is the purchase of a period of time to learn more about the value (potential) of the underlying asset, which is, in this case, the new pharmaceutical. The uncertainty around the value must be quantified and then resolved during the time that the option is "alive." If the resolution is completed and the result is favorable, management is guided to exercise the option, i.e., purchase the next phase of the R&D program. If it is unfavorable, the option expires unexercised and the program is abandoned. Similarly, if the uncertainty is not resolved within the option's life, the guidance is to abandon the program. Project experts must provide a quantification of the uncertainty of each investment phase. Their insight into the initial degree of uncertainty and how that uncertainty will be resolved over time is the critical input to the option valuation. By drawing upon project experts and corporate know-how archived in data warehouses, we can value the R&D phase relative to the amount of risk it removes from the project's outcome.

While the results are not guaranteed, we have a measure of the value of attempting to remove uncertainty, and that is what Real Option analysis quantifies. Consequently, we find that technical expertise and the ability to create and manage knowledge adds value to an investment opportunity. This is just the financial tool that we have been looking for!

But how much value does a Real Option analysis reveal for this three phase pharmaceutical R&D project? If the DCF analysis was negative for both phases one and two, then the value of the project does not become positive until stages one and two have removed enough risk that the NPV becomes positive. If management follows the standard investment rule, neither of these phases will be funded and phase three would have never occurred.

The Real Options analysis, on the other hand, indicates that all phases have a positive value. The value estimated for phases one and two is predominantly option value. The knowledge gathered in these phases was not of high enough value to independently result in a positive return on investment. But the option for further investment, if phases one and two were successful, was quite valuable. By phase three most of the uncertainty in the project has been resolved by knowledge creation in phases one and two. Consequently, most of the option value has been converted to tangible value. Using Real Options analysis, management would have been guided to invest in phase one and two with the expectation of receiving value in excess of its cost.

Adding Value Through Technical Know-how

Multinational energy companies maintain large staff groups skilled in the technologies of exploration, development, and production of oil and gas. These groups represent several hundred years of combined experience in maximizing exploration efficiency, optimizing development designs for lowest cost, increasing safety in production operations, and increasing recovery efficiencies from oil and gas reservoirs. The companies' economic success is tied to these staffs' capabilities.

Each year an energy company produces a significant fraction of their hydrocarbon reserves inventory. If these assets are not replenished the company is effectively in liquidation. It will go out of business within the decade. Consequently, shareholders pay very close attention to discoveries and reserve replacement reports from each company.

New reserves create flexibility and the opportunity to exploit the company's technical expertise in developing and producing hydrocarbons as efficiently as possible. If the company's business skills are inadequate to capture the opportunities to explore and develop, the expertise

is wasted and atrophies away through lack of use, resignations, and retirements. Adding new reserves creates the opportunity to:

- discover additional hydrocarbon reserves in adjacent geologic structures,
- increase production from those reserves through the application of new drilling and production techniques, and
- lower production costs by sharing expensive production facilities among several fields.

The addition of new reserves leads to more opportunities and amplifies value creation.

If we look at information provided in annual reports by the multinationals, we can correlate their reserve additions, value creation, and share price over a multi-year period. I have done this for twelve of the largest companies and found a repeating relationship between the three measures. Further, there is an important correlation between reserve addition and share price.

If we were to create a plot of reserve replacement (y-axis) and inventory value change (x-axis), we would see the axes cross at 100 percent reserve replacement and zero percent change in reserve inventory value. Annual performance by the company that replaces more than 100 percent of the reserves it produced and sold is favorable. Below 100 percent represents liquidation. Similarly, a positive change in inventory value is favorable to shareholder wealth creation, and a negative change is unfavorable. This suggests that companies will strive to be in the upper right hand quadrant—growing inventory reserves and value. Outcomes in the lower left quadrant are unfavorable representing a poor performance by management.

Note that in the expansion phase it was creating future opportunities but reducing the value of its portfolio by adding lower valued assets. In the exploitation phase it was adding value to the inventory in spite of its shrinkage. Application of technical knowledge was increasing producible reserve volumes and lowering costs. Reiterating, in the late 1980s, the company was spending capital to create the options for application of its technical expertise. In the early 1990s, it was exploiting those options and adding value to the portfolio with higher valued assets. By the mid-1990s, the company was again spending capital to create new options by expanding its inventory.

We would expect the market to reward the value creation stage, i.e., the early 1990s. But data suggests the opposite is true. The market rewarded the company for creating opportunity to add value through its technical expertise. During the early 1990s, when value was being added to the portfolio, the market was neutral to those events.

My interpretation of this is that the market expects companies to sustain their production position within the competitive framework of the industry. Reserve replacement and a gradual growth of value in the asset base is expected, not rewarded. When a company's management creates opportunity for its organization to apply technical and business expertise to increase the value of existing assets, the market responds with a higher valuation. This company has highly regarded technology and excellent business knowledge; it needs the opportunities to apply those skills. When management acquires the opportunities, the embedded knowledge of the corporation can create value for the shareholder, and the market responds accordingly.

Adding lower valued reserves did not diminish the company's value in the eyes of the market, but it did create opportunities for the company to grow. This reflects the mission of a corporation with an extensive technical and business knowledge base: to take lower valued assets, apply technical resources and add value to the asset, thus creating additional new opportunities.

Conclusion

While we all intuitively recognize the value of knowledge creation and management, there has been little validation of that intuition through financial metrics. Since so much of our R&D and knowledge management activities reside in the corporate domain, this lack of financial quantification has strained the willingness of management and shareholders to invest in these activities.

We have demonstrated that viewing investments in knowledge and knowledge management as the purchase of options on future revenues leads to increased valuation and new revenues for a corporation through two examples in this presentation. Quantifying the value of this option creation can be done through the application of Real Options analysis. As expertise with this technique increases, I believe more and more investments in knowledge and knowledge management will be justified financially. Corporations and governments will use this approach to identify valuable opportunities to create value for their constituents.