**What Is the Real Value in Real Options?**

Whether you realize it or not, you are a practitioner of real options analysis.

Real options analysis is an attempt to quantify the value of future, ancillary opportunities that derive from undertaking a given course of action. These opportunities may arise from serendipitous discovery of something of value. For instance, while setting out to discover a medicine for cardiovascular disease Pfizer serendipitously discovered Viagra. Another manifestation of real options value is that undertaking one activity will put you on a path that will provide you with an entrée to pursue a series of similar activities. For example, Apple's development of the iPod provided a platform for the development of iPhones and iPads.

So, what makes you a practitioner of real options? If you handed your employer your resignation when offered a promotion and pay increase in order to go back to school or start a business, you probably unknowingly performed a real options analysis. From a discounted cash flow perspective, you just committed an irresponsible act since you forbad a higher net present value of income in return for the certainty of a near term loss (i.e. the expenses of going to school or starting a business). However, in the real world we all make these kinds of decisions. Such a decision could easily have been rational if you believed that you currently worked in a dead-end industry or for a dead-end company and if you believed that learning new skills would equip you to qualify for a more promising career in a burgeoning industry.

While you most likely periodically consider real options value in the decisions you make, putting a numeric value on real options is inarguably squishy. The purpose of this article is not to discuss the methodology of calculating real options value. An example of a real options calculation, based on the Black-Scholes framework, is provided as an exhibit to this article. However, what I would like to do with this article is to discuss a number of discounts that should be applied to the real options values that you calculate. Thus, the following are issues that should be taken into account when discounting the real options value resulting from a Black-Scholes analysis:

**Degree of Exclusivity** The degree of exclusivity you have in achieving real options value is an important consideration. If your company's patent position, access to scarce raw materials or a lock on rare but highly-skilled labor effectively renders it is the only company with a license to research gallium arsenide applications for semiconductors, then only your company may find some serendipitous solution that gallium arsenide provides. Thus, you would not discount your real options value or only discount such value to a small extent if there is limited competition in the given sphere of research. On the other hand, if you are taking a stroll on a beach with a rake in hand hoping to discover valuable treasurers, then there is nothing proprietary about this activity and therefore the real options value should be eliminated or greatly discounted.

**Research Incipiency** You should consider the incipiency of the given field of research. More mature fields of research are less likely to be the source of serendipitous discovery than less "picked over" fields of research. Among the ways of determining the degree of incipiency that exists in an area of research is to consider metrics such as:

- Number of years that have elapsed since the first invention. The fewer, the less discounting required.

- The extent of discovery in the space as evidenced by markers such as patent count (filing and granted) and the number of scholarly articles published. The fewer, the less discounting is required.

- The degree to which venture capital is flowing into the space. The less, the less discounting is required.

**Ecological Ripeness** While the above indicators help us identify areas of research that are ripe for surprises, we want to make sure that we don't focus on areas that are too distant time-wise from achieving commercialization. We don't want to place a high value on research that is akin to the potential of Brazil: Brazil is the most promising country of the next 100 years, and it always will be. After all, we want our investment decisions to pay off in the not too distant future; or, at least while patent protection can remain in force. We should heed Edgar Bronfman when he said of one of his disappointing initiatives, "We were very, very early. That is the same as being wrong."

In order to determine the nearness of commercialization potential of a new discovery, one can consider the ripeness of the surrounding business ecology. The answers to questions such as these should provide self-evident guidance:

- Does the invention address a pain point? What alternatives do consumers have?
- Are there companies that can supply the necessary materials?
- Are there enough potential workers with the requisite skills to produce the newly invented product?
- Can the product be produced at price points that are affordable for a sufficiently large segment of the customer base?
- Is it likely that sufficient finance can be obtained to produce the products?
- When can requisite regulatory approval be expected to be received?
- Are there other inventions that could eclipse the invention in question?

**Researcher Funding Model** There is more real options value if the funding for the research projects more closely resembles the Israeli universities or Howard Hughes Medical Institute's (HHMI) method of funding research than the National Institute of Health's(NIH) method of funding research. The Israeli / HHMI method is to fund the researcher while the NIH method is to fund the research project. Since researchers funded by Israeli universities or HHMI are freer to explore where there is potential while NIH researchers are required to seek approval for deviating from the approved research path, the Israeli / HHMI researchers are more likely to generate real options value.

**Size of Organization** Mid-sized organizations are more likely to produce valuable inventions. Research organizations should not be so small that diversity is by definition lacking. Neither should they be too

large since such organizations have too much specialization, are too compartmentalized and are burdened with excessive bureaucracy.

**Financial Stability** Real options analysis will retain more value when the organization undertaking the research is financially stable and when the commitment to the research budget or endowment is consistent and predictable. Similarly, the ability to withstand more inconsistent and lumpier revenue streams is suggestive of higher real options value.

**Organizational Isomorphism** The culture of a research organization has a significant impact on the propensity of serendipitous discovery coming out of such institution. The following are factors that are conducive to unexpected discovery:

> **Organizational Discipline** The organization is loosely run. In other words, the research processes are not overly proscribed or regimented. Also, there should be a tolerance for a variety of research methods employed as well as a high degree of acceptance of failure.
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> **Inventor Recognition** Research organizations should not be so loosely run that inventions are allowed to leak out, for example, in the form of the investigator absconding with his invention. One way to prevent this and to encourage researchers to maximize their inventiveness is to recognize their achievements. Such recognition can be evidenced by the granting of awards, monetary compensation, titles bestowed, and liberal patent filing policies.
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> **Power-Distance Index** The Power-Distance Index relates to the degree of hierarchy or formality that exists in an organization. Organizations such as the military or cultures such as those in Korea are more hierarchical than those of a Silicon Valley social media company. Thus, it is less likely that serendipitous discovery will be found in the former compared to the latter.
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> **Leader Dominance** Organizations that are overly dependent on a domineering founder are less likely to grant their researchers the latitude that is conducive to serendipitous discovery.
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> **Leader Rotation** Excessive turnover among the organization's CEOs and research directors renders it challenging for those responsible for innovation to determine a clear direction or gain any real innovation momentum.
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> **Researcher Diversity** The more diverse the areas of experience of the scientists or engineers, the more likely their cumulative ideas will lead to a truly unique discovery. The more diverse the research staff is in terms of national origin, outside interests, and travel experiences, the more likely they will be able to identify new applications for their inventions.
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> **Commercialization Focus** There must be a commercialization focus at the research organization to ensure that the inventions are being matched with market opportunities. Otherwise, promising technologies will be allowed to linger on the shelves of research centers. (A concern with research at universities is that the researchers sometimes continue researching areas where there is little potential.)

Of course, judgment is required to determine when excessive doses of the above-positive traits can become self-defeating. For instance, overly-decentralized and dysfunctional research facilities should not be scored highly. Nor should laboratories that are hyper-diverse.

**Tightness of Timelines** Research projects that are given longer timelines are more likely to produce unexpected discoveries than projects that are given tight timelines. This is because in the former scenario, researchers can approach the problem from multiple directions. In the latter scenario, researchers are pressured to take the most direct course of action. Thus, skunk works such as Google allowing its engineers to spend 20% of their time pursuing their own initiatives is more likely to produce serendipitous discovery than highly directed research.

**Conclusion** As valuation analysts, we must be certain to refrain from double counting for real options. One step to take in this direction is that when we are evaluating which projects to fund and thus choose such projects that offer the prospect of delivering real options value, we must remember to remove the options value when the project ends. Failing to do this will yield inflated estimates of project and enterprise value.

Secondly, managers must not allow the notion of real options value to become an excuse for making poor decisions. This can happen when we believe that real options value is created when the value of lessons learned from a mistake exceeds the cost of the mistake. For many years, British Petroleum embraced this notion and was very forgiving of its geologists when dry holes were drilled. However, after millions of dollars were literally sunk in the ground with little net present value results to show, British Petroleum announced that it would be far less forgiving when dry holes were drilled. The result of the new policy was that the ratio of productive-to-dry wells drilled soared.

Real options has been derided by some as being a lot of hot air. However, as the example at the beginning of the article illustrates, we all implicitly use real options to make important decisions. I hope this article has provided a framework for distilling the real value of real options by discounting the surrounding hype. Indeed, in the example below, when we applied the discount factors discussed in this article, the value of real options was deflated by 75%.

**Exhibit – Preliminary Real Options Value**

Below is a modification of a Black-Scholes Option Calculator which yields real options value before discounts.

# Real Options Calculator

| | | |
|---|---|---|
| Numbers in millions. | | |
| Enter the current market value of the underlying asset = | $5,250 | |
| Enter the strike price on the option = | $3,600 | |
| Entet the volatility of asset | 30% | 55% |
| Statutory Patent Life | 12 | |
| Licensing Contract Life | 13 | |
| Economic Life of Invention | 13 | |
| Technological Life of Invention | 14 | |
| Time to expiration on the option (in years) = | | 12 |
| This will result in a dividend yield of | | 8.33% |
| Enter the riskless rate that corresponds to the option lifetime = | 3.20% | |
| Probability of Project Success | 20% | |
| **Real Options Value, Before Discounts** | **$237.68** | |
| www.cpva.info | | |

We applied the discounts discussed in this article below. In our Real Options Calculator (accessible at www.cpva.info), we preset ranges of applicable discounts that the analyst may enter into the blue cells in order to ensure the integrity of the results. Note that the application of various discounts should be multiplicative, not additive.

# Real Options Discount Analysis

| Discount Factors | Discount Rate | Net Value of Real Option | Comments |
|---|---|---|---|
| Degree of Exclusivity | 90% | $213.9 | |
| Research Incipiency | | | |
| Ecological Ripeness | | | |
| **Total Maturity / Ecological Readiness Score** | 75% | $160.4 | |
| **Researcher Funding Model** | 75% | $120.33 | |
| Size of Organization | 91% | $109.50 | |
| Financial Stability | 80% | $87.60 | |
| Tightness of Timelines | 85% | $74.46 | |
| **Organizational Isomorphism** | | | |
| Organizational Discipline | | | |
| Inventor Recognition | | | |
| Power-Distance Index | | | |
| Leader Dominance | | | |
| Leader Rotation | | | |
| Researcher Diversity | | | |
| Commercialization Focus | | | |
| **Total Isomorphism Score** | 80% | | |
| **Real Options Value, After Discounts** | | **$59.57** | |
| **Percent of Real Options Value Eroded by Discounts** | **75%** | | |

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Postscript

**Paris Hilton and Real Options Methodology**

Real options theory is a very interesting and appropriate framework for valuing emerging technologies and patents.

(I wrote a fairly extensive article on real options which was published by the Licensing Executive Society's Les Nouvelles in early 2012. That article is also part of the course materials for the Certified Patent Valuation Analyst training.)

While the article above goes into much more detail, real options helps put a value on something when you don't know what that something is. For instance:

* We know that if a pharmaceutical company is pursuing heart disease research it may serendipitously discovery a cure for another disease. We don't know what the serendipitous discovery may be but we know that there is some degree of likelihood that such a discovery will be made (as was Rogaine and Viagra). When serendipitous discovery is made the unknown product will have some value. Real options helps articulate that value.

* When valuing a portfolio of patents and patent applications, there is some degree of chance that a continuation will be filed that will seek to cover something beyond what the current patents and patent applications are covering. The ability to file a continuation patent has some option value which real options can help articulate.

* Further, suppose a consultant sends out New Year's card to his colleagues. In doing so he is not pursuing any particular piece of business. He doesn't know where business might come from or what shape it will take. From a discounted cash flow perspective, sending out greeting cards is irrational. Why invest time and money when the sender readily admits that he has no ability to articulate where resulting revenues may come from? However, real options helps quantify the value that may result from maintaining contact with one's colleagues.

So what does real options have to do with Paris Hilton?

Paris Hilton had a contract to promote the film "National Lampoon's Pledge This". The investors alleged that Ms. Hilton did not fulfill her duties to promote the film and that as a consequence, profits were lost. The investors sued for consequential damages holding that had Ms. Hilton performed her contractual duties, there could have been much more buzz around the film which could have provided for other licensing opportunities as well as sequels. While Ms. Hilton did not have to pay consequential damages, the legal notion of consequential damages seems to sync up with the notion of real options.