EXECUTIVE DECISION-MAKING UNDER CONDITIONS OF UNCERTAINTY: LESSONS FROM SCENARIO PLANNING, REAL OPTIONS ANALYSIS, AND THE KUU

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Abstract

This paper provides overviews of two major concepts and methodologies --- Scenario Planning (SP) from Strategic Management and Real Options Analysis (ROA) from Finance. The paper draws on the KUU (Known, Unknown, and Unknowable) framework to demonstrate the commonalities and differences among these two approaches and calls for their synergistic use.

KEY WORDS: Finance, KUU framework, real options analysis, scenario planning, strategy

INTRODUCTION

Boards of Directors, executives, and strategic planners all have fiduciary responsibilities for oversight in a corporation. To carry out these responsibilities, the decision-makers must more fully understand how to identify, evaluate, and manage the risks and uncertainties facing the corporation. Yet the complexity of many industries makes this task difficult. Every firm has multiple risk factors that in the short-term contribute to the variability in the firm's earnings, and in the long-term can determine the firm's survivability. A thorough understanding of these risk factors will enhance the abilities of Board members and executives to anticipate competitive, environmental, regulatory, and legislative changes and their impact upon the firm. Firm executives and Board members are increasingly being called upon to be responsible for meeting financial expectations, managing risk to stabilize earnings and increase the firm's potential survivability. Thus, managing the firm's risk and the firm under conditions of uncertainty becomes critical. [Alessandri, Ford, Leggio, Lander, and Taylor, 2003]

The fields of Strategic Management and Finance have contributed much the field of risk management. Yet practitioners and theorists in these two fields have often been at odds with one another, each trumpeting the shortcomings of the other field --- the traditional dichotomy being strategy's emphasis on the long-term and qualitative approaches and Finance's emphasis on the short-term and quantifiable approaches. This paper uses the KUU framework to point out commonalities and differences. Commonalities include objectives and purposes. The commonalities and differences provide opportunities for synergistic use of both fields.
The authors argue that reciprocal appreciation and appropriate synergistic use of available decision-making and analysis tools will assist executives in coping with the inevitable acceleration of uncertainties in the Twenty-First Century. The first section of the paper draws a process from the field of Strategic Management --- Scenario Planning (SP). SP is a process for dealing with total company long-term risk. The second section turns to the field of Finance for and overview of Real Options Analysis (ROA). In recent years ROA has seen increasing use as part of the strategic decision-making process under conditions of uncertainty. The third section compares SP and ROA using the KUU framework. The final section calls for increased synergistic use and integration of tools and methodologies drawn from Strategic Management and Finance.

**STRIVING FOR STRATEGIC FLEXIBILITY USING SCENARIO PLANNING (SP)**

“…chance favours only the prepared mind.” Louis Pasteur [More, 2003]

Drawn from the field of Strategic Management, SP is a qualitative process for dealing with long-term uncertainty at the firm or business unit levels. SP is about envisaging potential futures and developing strategies to assist organizations in dealing with these potential futures. The process is thus about managing risk and uncertainty and exploiting opportunities. SP involves understanding both internal and external factors. It incorporates trends, national and global phenomena, the environment, and other factors that may not appear specifically relevant for today’s decisions, but could potentially impact significantly on future outcomes for the firm. Thus SP is a process tool for helping organizations consider future possibilities, plan for uncertainties, and prepare contingent plans in order to be better prepared for whatever may occur.

Through the SP process, executives can engage in “forward thinking”, considering future potentialities and the impact on their organization. However, detailed planning for the future is fraught with potential for errors. The further in the future one plans the greater the likelihood of incorrect data. Traditional strategic planning, i.e., planning for the next one to three years, takes primarily a linear approach. This approach works well in a stable environment, but does not prepare the organization for discontinuities, i.e., significant changes. The further out planners go in the future the less useful the traditional techniques. Thus, what to do? During the late 1960s, a group of strategic planners at Shell Oil in London developed SP.

**SP’s ORIGINS AND EVOLUTION**

SP was originally developed for military applications during WWII. It was based on Herman Kahn’s work at RAND and later at his own Hudson Institute. After WWII, war-planning scenario companies adapted processes to be used as a business-planning tool. Application of SP in the corporate world dates to the 1960s and early 1970s when Royal Dutch Shell adopted the military technique to enhance the firm’s strategic flexibility under conditions of uncertainty. A strategic planning team led by Pierre Wack encouraged executives throughout the firm to utilize the process to generate alternative plausible scenarios regarding the longer-term future of the external environment [More, 2003]. By 1972, Shell was using the approach worldwide. A simplified process involved constructing plausible scenarios of the future environment and then designing alternative strategies that would be appropriate under those scenarios.

Wack was not alone in adapting SP to corporate applications. Ian Wilson at GE and Peter Schwartz at SRI International were also engaged in redesigning the scenario approach. They redefined scenarios as alternative outcomes of trends and events by a target year regardless of the precise sequence of events. Their scenarios were descriptions of future conditions rather than accounts of how events might unfold. Thus scenarios offered firms a set of distinct alternative futures, emphasizing that the business environment was uncertain, events were potentially discontinuous, and the future could evolve in totally different ways. The scenarios provided a context for developing long-term corporate strategic plans as well as near-term contingency plans [Millett, 2003].

Shell’s planning process evolved after WWII. For the ten years following the War, the company had concentrated on physical planning, i.e., scheduling of increases in long-term production capacity to meet the ever-increasing demand. From about 1955 to about 1965, the firm moved to an emphasis on financial planning, primarily on a project basis, i.e., capital budgeting of long-term assets such as tankers, depots, pipelines, and refineries. In 1965 the firm’s planning began focusing on coordinating details of the entire
chain activity of moving petroleum from the group to the retail outlets. Like other companies during the fairly stable environment of that time period, the planning emphasis had been primarily on “more of the same.”

Beginning, in the late 1960s, Shell executives determined that the six-year time horizon then used for planning purposes was too short. Efforts focused on finding ways of exploring what the competitive environment for the firm might look like as much as thirty years hence, i.e., in the year 2000. Wack was familiar with Herman Kahn’s work on SP for the military. He assisted in creating a SP approach which would allow Shell executives meet their planning objectives and concerns.

The value of the SP process became apparent when OPEC decreased wellhead production creating a shortage of petroleum. Of all the major petroleum firms, Shell was best positioned in terms of strategic flexibility, clearly a result of using SP in the entire company. At the onset of the crisis, Shell had already identified its strategic options for discontinuous conditions [Wack, 1985]. The firm’s executive network was emotionally ready to tackle the difficult circumstances and its contingent plans were in place while Shell competitors groped for solutions.

Many major firms have adopted SP over the last three decades. Somewhat out of favor in the 1980’s, SP was used more extensively in the 1990s. Complete SP approaches are expensive. Estimates of cost range upwards of half a million dollars. SP exercises require facilitation and profound, intuitive knowledge of the industry, qualities seldom found in one person. Available consultants who have expertise in both areas are expensive. Successful application of SP requires intensive involvement by of senior executives. The SP process works best when creativity and imagination is applied rather than assigning probabilities to outcomes. It encourages a dialogue among the executive team that creates an opportunity for more systematic examination of the exogenous variables that impact decisions.

**WHAT IS SP?**

Understanding SP requires first defining the term scenario. A scenario is a description of a possible future outcome that can be used to guide current decision-making. In some sense, it is a map of the future where the map has internal consistency and integrity [More, 2003]. SP process experts suggest the creation of three to no more than five scenarios. The technique is used most appropriately at the corporate or strategic business unit level. The process of establishing the scenarios generally involves the following phases:

- Identification of critical factors affecting the external environment of the firm (i.e., driving forces)
- Selection of significant forces (or sets of forces)
- Utilization of the forces to establish scenarios
- Writing of “stories” or scripts, i.e., outlining of the characteristics of the resulting scenarios
- Establishing signposts (i.e., leading indicators suggesting that the environment might indeed be changing in the direction of a specific scenario)
- Designing strategies that are appropriate for each of the scenarios

SP is long-term in its orientation and places emphasis on identifying external, high impact variables. The variables are qualitatively assessed in terms of their impact and their inter-relationships. The external forces with the strongest potential impact might be depicted in the four cells of a two by two matrix, i.e., four scenarios. If impactful and highly related, variables are grouped on a continuum to make up one side of a matrix and another group makes up the other axis of a matrix.

A pure SP exercise discourages any discussion of the probability of a particular scenario’s occurrence. Why? Because the purpose is to hold all scenarios plausible. The word plausible doesn’t mean equally likely, but it does mean likely enough that it is worth decision-makers’ time to think through the implications of each scenario and consider what the firm’s contingent strategy should be under each of the identified possible future states. In some sense, accepting the scenarios may require suspension of disbelief in order to examine “wild card futures”, i.e., to consider factors that are most impactful and most uncertain. In this process, establishing probabilities is tantamount to prioritizing the scenarios. Doing so risks politicizing the process, i.e., that the executives most likely to benefit from a scenario are more likely to advocate the likelihood of it occurring. Using plausibility as the legitimizing criterion helps to mitigate the tendency to politicize the process.
AN APPLICATION OF SP IN THE ELECTRIC POWER INDUSTRY

In a scenario planning exercise for the electric power industry the participants were asked to:

- Establish a strategic question
- Identify the critical dimensions that would impact upon the question (and then)
- Create "stories" or scenarios that were plausible and internally consistent.

The group chose the what the firm should do regarding nuclear power generation given that the firm was part owner of a major facility. In the scenario matrix the dimensions were grouped as no nuclear acceptability (i.e., combining social and political factors) and cost of alternatives (predicated among other factors on technology advances). The four identified scenarios were given the names “Fossil Heaven,” “Greenville,” “Diversification,” and “Nuckies Rule”. Once the scenarios were written the executive group could begin the process of discussing strategies appropriate for the scenarios.

SP BENEFITS AND DRAWBACKS

Advocates of SP argue that the purpose is to assist in making decisions today. The process encourages managers to envision plausible future states of the operating environment of the firm and to think long-term about how the firm might take advantage of opportunities and how the firm might avoid potential threats [Miller and Waller, 2003].

The benefits of SP tend to cluster around: a) expanded mutual understanding of potential environmental discontinuities, b) greater teammanship as a result of the process and developing a common language, and c) increased nimbleness of the firm that already has articulated contingent plans. In short, the SP process brings two major benefits germane to this discussion. First it helps in identifying the long-term uncertainties and risks that impact on the firm as a whole. Second it assists the executives in defining their alternatives, i.e., increasing their flexibility in responding to uncertainties. And, in so doing SP contributes to the firm’s ability to survive in hostile conditions and to position itself to more proactively exploit munificent environments.

In other words, SP contributes to strategic understanding of long-term exogenous variables and the design of contingent strategies or options. SP offers organizations the opportunity to envision the future and prepare contingency plans to address the uncertainties. It helps to challenge existing “maps of future possibilities, to explore what might possibly happen, and to prepare contingency plans. In short, it prepares organizations for possibilities [More, 2003]. The process represents a very qualitative real options approach to long-term strategy design.

Detractors point to the “blue sky” thinking that can result from SP --- contingency plans with dubious applications in a too distant future --- while the company’s shareholders clamor for bottom-line results, dividends and market share growth.

QUANTIFYING FLEXIBILITY USING REAL OPTIONS ANALYSIS (ROA)

Another technique, ROA, has increasingly been found valuable in contributing to more rigorous examination of strategic and operational decisions where outcomes are path dependent. Copeland and Antikarov [2001] argue that “In ten years, real options will replace NPV as the central paradigm for investment decisions.” The use of ROA as a decision making process is gaining acceptance. Finance practitioners and theorists have developed real options analysis as a means to value decisions made under conditions of uncertainty. In general, ROA can be applied to decisions where the investment can be staged so that the incremental investments are predicated on outcomes from the prior stage, where the initial investment can be small, where the firm is not locked into making the future investments, and conditions are uncertain. The assumptions underlying the theory may significantly limit the application of ROA as a means of quantifying investment outcomes.

WHAT IS ROA?

Real options analysis (ROA) is financial options theory applied to business decisions. Indeed, the Black-Scholes approach has migrated in recent years from application to stock options to applications to real options analysis, i.e., the valuation of strategic and operational investment alternatives. A great deal can
be gained by developing an understanding of such decisions through the ROA perspective. The theory recognizes that there is value in companies making limited initial investments that permit them to retain flexibility to take future action and possibly incur a gain [Kroll, 1998]. One way to think about the connection between financial options theory and ROA is that a financial call option gives the right, but not the obligation, to buy an asset at a predetermined price on or before a given date. The same applies in strategic decisions that can be multi-staged. At each stage the decision maker can make an investment in order to obtain the ability, but not the obligation, to make the decision to invest at the next stage.

Exhibit 1 below summarizes the analogous characteristics of stock options and strategic investments viewed from an ROA perspective. Exhibit 2 summarizes ROA alternatives and aspects of this approach.

### EXHIBIT 1
SUMMARY OF THE ANALOGOUS CHARACTERISTICS OF STOCK OPTIONS AND STRATEGIC INVESTMENT DECISIONS

<table>
<thead>
<tr>
<th>Financial Options</th>
<th>Real Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>The financial option aspect on the left is analogous to the characteristics of business investment decisions on the right.</td>
<td></td>
</tr>
<tr>
<td>Call option on a stock</td>
<td>Future investment decision</td>
</tr>
<tr>
<td>Current value of the stock</td>
<td>Expected present value of future cash flows</td>
</tr>
<tr>
<td>Strike price</td>
<td>Expected (future) investment cost</td>
</tr>
<tr>
<td>Time to maturity of the option</td>
<td>Time until the investment opportunity no longer exists</td>
</tr>
<tr>
<td>Volatility</td>
<td>Variability in the project’s returns</td>
</tr>
<tr>
<td>Dividend on a stock (i.e., the values foregone by the option holder in avoiding exercising the option right)</td>
<td>Cost of keeping the investment opportunity alive (e.g., values paid by the option holder to avoid making the full investment)</td>
</tr>
<tr>
<td>Risk-free interest rate</td>
<td>Risk free interest rate</td>
</tr>
</tbody>
</table>


### EXHIBIT 2
REAL OPTIONS ALTERNATIVES AND CHARACTERISTICS

<table>
<thead>
<tr>
<th>ROA Alternatives</th>
<th>ROA Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Investment timing options</td>
<td>• Real options exist when managers can influence the size and riskiness of a project’s cash flows by taking different actions during the project’s life.</td>
</tr>
<tr>
<td>• Abandonment/shutdown options</td>
<td>• Real option analysis incorporates typical NPV budgeting analysis with an analysis for opportunities resulting from managers’ decisions.</td>
</tr>
<tr>
<td>• Growth/expansion options</td>
<td></td>
</tr>
<tr>
<td>• Flexibility option</td>
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Coined by Stewart Myers of MIT’s Sloan school, the term real options is based on the principle that there is value to waiting for more information when faced with a series of linked investments, and that this value is not reflected in the standard discounted cash flow models used for capital investment decisions, such as payback, net present value, or internal rate of return [Reary, 2001]. The concept is an extension of option theory, which underlies the securities market transactions described above. However, in real options, the underlying asset is not a security, but rather an investment in an asset or a business opportunity, i.e., investment in a “real” asset. Many strategic investments have characteristics of securities...
options decisions, i.e., an investment made today gives the decision-maker the flexibility to make a future decision (e.g., make additional investment, reduce investment, or abandon the project). In many instances more information is acquired during the interim time that gives the decision-makers a clearer picture for assessing whether the future outcomes have positive value or not.

A major link between options theory as applied in the securities market and strategic investment opportunities for companies is that investment decisions are often modular and can be deferred. In short, strategic investments often come in the form of embedded options, that is, a series of options within the same decision stream. When strategic decisions are modular, or can be treated with modularity, the decision-maker has flexibility and this flexibility itself has value.

In many strategic decisions, there are several options embedded. Maximizing the value of the opportunity involves making the decisions to invest at the right time. A strategic decision-maker has the flexibility to buy, sell, or exercise options now or at some time in the future. Real options analysis can assist strategic decision-makers by providing analyses leading to decisions and, importantly, by shedding greater light on underlying factors in the opportunity itself as part of the process of undertaking the analysis. How do real options provide answer to managerial issues? As one writer in this field puts it, “First, real options provide a strategic answer as they force the manager to set up an opportunity register (i.e., identify a set of investment alternatives). Second, the pricing of these options will help the manager to quantify the opportunities attached to each project. Third, the determination of the real options’ price will indicate to the manager the optimal investment timing for the project” [Botteron, 2001].

Rather than viewing a particular decision as a series of projected cash flows to be discounted, the project’s value can be viewed as a “portfolio of options” [Botteron, 2001]. This view is particularly valuable for strategic decisions where the investments will be made in multiple stages, for example, investments such as R&D, purchase of natural resources, entry into a new market, and diversification including purchase or development of companies. Thus, Botteron argues, “The advantage of real options used in a multistage valuation is the ability to take into account future strategic decisions. These types of investments are analogous to compound options: each stage completed gives the firm an option to complete the next stage” [Botteron, 2001].

For example, in the pharmaceutical industry the decision to abandon or further invest in an R&D project is often associated with outcomes of the various drug-testing stages.

ROA is relatively new, an advanced technique that links strategy and finance. Compared to traditional tools such as NPV, ROA provides management with improved facility for dealing with uncertainty and thus helping managers solve complex investment problems. Real options analysis draws strategic decision-makers into a process designed to enhance their insights into issues such as:

- Timing of their investments
- Relative value of multiple-staged investments
- Identification of risk factors and ways of managing them
- Flexibility, i.e., what management can do to maximize the value of strategic investments [Botteron, 2001].

Future risks include factors such as changes in consumer tastes, regulations, government approvals (for example of new drug applications), currency exchange rates, or commodity prices, as well as technological breakthroughs --- all these factors, and more, can make significant differences in strategic choices.

The choice to invest in full stream production of a controversial new product may be linked to the results of test marketing. However, test marketing involves investment in: a) development of the concept, b) prototypes, c) sufficient inventory for test marketing, d) marketing analysis, and so on. Real options analysis encourages strategic decision-makers to more clearly map the stages in the investments that will need to be made, provided the results from each prior stage signal a “green light” for the next one, i.e., a series of embedded options. Further, at each stage the strategic decision-makers can choose to invest, wait, or abandon the activity. The investment at each stage is an investment in another option. That is, at the end of each stage, the decision maker can decide to exercise (or not exercise) the option to make the additional investment to continue with the strategic alternative.
AN APPLICATION OF ROA FOR THE NATIONALIGNITION FACILITY

In the 1990s the United States signed a test ban treaty. The test ban no longer allowed the underground testing of missiles. It also made it difficult to do nuclear research without testing. The solution to the problem was to build a nuclear explosion laboratory, which essentially is a lab where you create what occurs during a nuclear explosion in a controlled lab situation. The National Ignition Facility is such a place.

To test nuclear devices in a controlled laboratory setting, the National Ignition Facility (NIF) send a total of 192 high-powered lasers down bays. The lasers turn on high quality mirrors and aim at a target chamber. In the chamber is a piece of nuclear material about the size of a grain of rice. When the energy from the lasers hits the nuclear material, the same reaction occurs inside the little rice grain size material as happens in a nuclear weapon. In order for this process to work and for it to accurately simulate a nuclear explosion, the scientists described six major systems required that had not been invented or developed when the scientists received approval to build the National Ignitions Facility. There was a great deal of uncertainty in the project.

Development of the lasers became a critical component of the overall project. Previous lasers were small and could be produced in batch form. This project scaled up the size of the lasers to about 10 times that of the largest existing laser. Since the project required so much laser glass and the glass was needed quickly, NIF suppliers could no longer use the existing production processes for making laser glass. They had to develop a new method using a new production technology to make a laser glass. None of the existing glass companies were interested or able to fund the development of this new technology since there was a lot of uncertainty about whether one could actually develop this process.

The scientists considered a range of possibilities and narrowed it down to two options: to pay for the development of this process by one glass vendor or fund two vendors working in parallel stage development. Each of the stage developments would have a built in option to abandon if development was not progressing as expected.

For this scenario, the cost of the option are the $12 million needed to hire the second developer. The option value is trickier. The scientists did not doubt that at least one of the two developers would successfully produce the laser glass needed for the project. They believed the option created the difference between whether the project succeeded or potentially died. It is assumed, therefore, that survival or success versus failure is worth at least one-half of the value of the project, or 50% of $2.5 billion dollars minus the cost of the option. The suggested option value was approximately $1.13 billion.

In 1997, NIF picked strategy two, parallel funding to two companies in stages, with three stages of development and the option to abandon at each stage. By early 1999, both companies demonstrated that glass was coming out of the production processes developed. Both firms were able to demonstrate feasibility and that they could produce the glass at the rate NIF needed it to be produced. NIF decided, because uncertainty remained, to extend funding to both firms. In March and June of 2000, both firms were also able to demonstrate that they could meet the quality requirements. With two successful production processes, NIF decided to contract to produce the glass from both companies, essentially to maintain flexibility down stream.

A firm like NIFA can be assisted through valuation and designing their project optionality. This multiplicity of uncertainties and of options should be included in one strategy to capture all of the what-ifs in a project. Realistic behaviors need to be captured in practice. Alternative modeling approaches are also needed. Existing models can be expanded and enriched and combined with other modeling methodologies that may help capture some of these uncertainties. Looking at options from a managerial perspective may require to think about some expansions and different kinds of modeling methodologies. Then, ROA could be used successfully in finance, management and strategy.

WHERE HAS ROA BEEN USED?

Applications of ROA have appeared in industry, in the academic research literature, and in teaching.

Applications in Industry

The relative advantages demonstrated in ROA applications more clearly capture strategic aspects of the decisions that management confronts. ROA advantages have led to increasing application of the
approach. The example of the pharmaceutical industry was given above. For what kinds of decisions do experts use ROA? Both McKinsey and KPMG have groups that specialize in the use of ROA. KPMG, for example, has helped companies apply ROA to:

- R&D choices, especially in the early stages
- Mergers and acquisitions/alliances
- Management of patents, licenses, and brands

In addition to pharmaceutical firms mentioned above, to date the technique has been used to evaluate investments in strategic opportunities in a variety of firms including mining, petroleum, electric power companies, television programming [Baghin, 2000], and hi tech ventures.

Options theory has been found to have value when managers are confronting a strategic investment opportunity that has a great deal of uncertainty [Coy, 1999; Alleman, 1999]. However, when using real options, managers must have the ability to react to the uncertainty and alter the planned activity [Economist, 1999]. Under conditions of uncertainty traditional NPV analysis undervalues the project. ROA allows managers to incorporate the value of flexibility to adapt to changing environments.

Within companies where ROA is being used, it is finding broader and broader uses [Herath and Park, 1999]. Indeed, options models are becoming mainstream tools for financial practitioners around the world [Merton, 1988].

The academic research literature

ROA concepts have been applied in a widening variety of situations noted in the literature including:

- Toeholds pursued by minority shareholders
- Small acquisitions made in order to enter new technology or business areas
- Capital investment decisions
- Valuation of R&D and technology
- Development and introduction of new products
- Understanding environment, ownership, and performance relationships
- Capital budgeting
- Real asset investments
- Natural resources investments
- Valuation of government subsidies
- Various kinds of investment alternatives in the electric utility industry including mergers and acquisitions
- New venture startups
- Pursuit of maximizing value derived from entrepreneurship activities
- Analysis of the value of decision support systems [Leggio, Bodde, and Taylor, 2006]

Options theory and, more recently ROA, have received attention in economics, finance, and accounting classrooms for some time. Indeed, finance specialty courses focusing on risk management and ROA are increasing. However, only recently has the concept begun to be applied in strategic management classrooms. A review of leading U.S. strategic management texts yields at most a few paragraphs dealing with options and only cursory mention of ROA. The first two strategic management texts to devote more than a few sentences to one or two paragraphs to ROA appeared only recently.¹ To date no strategic management cases have been known to use ROA as an analysis technique in the Instructors Manual (or Teaching Note), although a small body of cases in corporate finance has begun to emerge.² Thus, there is considerable opportunity to extend the concepts into the Strategic Management area and perhaps into other disciplines such as Strategic Marketing and Human Resources Management.

ROA CAVEATS

Use of options pricing theory was revolutionary for financial markets --- ROA is proving to be as much of a stretch for strategic decision-makers. Experts expect that “the application of real options thinking to corporate strategy to be an active area of inquiry over the next few years” [Amram and Kulatikaka, 1999]. As the above discussion suggests, the ROA approach offers significant advantages for decision-makers and researchers.
There are caveats, however. For example, measuring the volatility can be a challenge with real options. How does one actually develop a measure of volatility? There are no easy answers. The critical step is to examine the primary sources of uncertainty. Indeed, this step is of critical value in developing a better understanding of the venture. Where there is prior experience, for example, with drilling of oil wells or pricing of commodities, the investor may have defensible data. For many strategic decisions there is little prior experience and thus no reliable historical data to provide guidance. One approach is to apply simulation analysis to the present value of the underlying asset to estimate the cumulative effect of the many uncertain variables. Another solution used in practice is to estimate volatility on the basis of the performance of a selected portfolio of comparable stocks, under the assumption that the volatility of this portfolio is reflective of the volatility of the opportunity being explored. “Finally one could turn the question around as follows: How large would volatility need to be in order for the project to generate shareholder value? Sometimes it is easier to assure oneself that one’s volatility is at least some threshold level rather than to estimate it precisely.” [Hevert, 2001]

Although increasingly used in making decisions within companies, ROA has not yet accumulated a history of its use like, for example, the traditional approaches of NPV or capital budgeting. Management judgment suggests that the process of using ROA in strategic decision-making indeed has value. However, empirical testing of management’s judgment whether better decisions have been made using ROA, as contrasted to what would have been made using NPV or other decision techniques, has yet to be conducted. Developing decision-makers’ understanding of the approach remains the major obstacle. Understanding and measuring volatility also remains an obstacle. NPV approaches simply do not appropriately value highly uncertain, actively managed projects. Strategic decision-makers have been in search of better approaches. Learning option valuation approaches takes significant organizational commitment, but ROA is well within the capabilities of motivated managers.

COMPARING SP AND ROA

In the last decade, finance practitioners and researchers have developed real option analysis as a way to value investments under uncertainty. SP and ROA have complementary strengths and weaknesses as tools for managers making strategic investment decisions under uncertainty. Ideally these two approaches are combined in an integrated enterprise risk management (i.e., ERM) process. This process involves scenario development, exposure identification, formulated risk management responses, and implementation steps. A corporate-level perspective on managing risk that takes into consideration the full range of exposures across a firm’s portfolio of businesses as well as its operations is advocated. Most of the ROA literature has a predominant emphasis on quantitative analysis. However, this paper argues that there is significant value in the qualitative assessment of real options. A comparison of the two approaches --- SP and ROA --- is facilitated through the application of the KUU framework.

WHAT IS KUU?

We turn our attention to a new notion --- KUU (Known, Unknown, and Unknowable) and consider the two processes, SP and ROA, within its framework. (See Exhibit 3). The three components of the framework are understood as follows:

What do is known --- what is certain? Either the issue is short term (but by definition does not apply to Scenario Planning) or it has been stable in its performance and there is no expectation it will change.

What is Unknown? Certainly longer-term states of unstable factors are less predictable and thus the predictability of their future states is less certain.

Unknowable? What is just not seen as impacting on the system? The word system was chosen very carefully here. Often the factors that are unknowable are: a) outside the system as defined and thus they are unexpected when they impact on the system because they simply were not on the radar screen or b) so unpredictable that one simply does not know where the outcome might be --- one can identify the factor, one just can’t identify the plausible states.

In using the various programs and processes for managing risk and uncertainty, executives are responsible for moving the Unknown to the Known and the Unknowable as least to the Unknown.
HOW CAN ONE APPLY THE KUU CONCEPT?

SP incorporates these notions implicitly and explicitly. SP helps to understand the sources of uncertainty and think through the actions to reduce the risks of taking inappropriate action. SP is not as concerned with the Known --- if a factor is known it is unlikely to have a range of possibilities that one would assume are equally probable (i.e., for the purposes of discussion).

The Unknown is where Scenario Planning focuses --- on factors that have a range of possibilities and, again, for the purposes of the process assumed to be reasonably equally likely or probable, i.e., if one thinks of outcomes as a continuum of some nature, the executives involved in the process have chosen four nodes on a distribution assumed to have an equal distribution of probability over the range being considered.

What about the Unknowable? --- Obviously, “simply” by choosing the factors on the axes, the executives are judging the factor/set of factors to be more highly uncertain and also critical (i.e., important to survival). SP, adeptly facilitated, can stretch the imagination as much as humanly possible to consider what other factors, perhaps those currently unknowable that might have significant effect.

What about ROA? It is much the same as SP in terms of understanding the outcomes of decisions taken at each stage of the analysis, i.e., the time modularized decision. The process is less concerned with the known, and rather works explicitly with the unknown. The facilitated ROA process pushes to include what might otherwise be unknowable into at least the unknown.

Obviously by choice of current business model executives have implicitly made the assessment that a specific scenario is most likely (--- a “no-no” for the SP process as strictly defined). Of course, the executive team strives to formulate a “robust strategy”, i.e., one that ensures the company’s survival regardless of which scenario occurs.

The Strategic Management domain since its inception has focused on the executive as the “hero” assisted by analytic techniques. Some of these techniques, such as SP, are more qualitative in nature and rely on experience, judgment, and intuition. Some are more quantitative techniques such as ROA. The quantitative techniques are reinforcing of and supportive of SP. In some sense SP establishes the long-term hypotheses about the future against which executive observations of U (unknown) and U (knowable) signposts/milestones and strategic and operational choices are tests of those hypotheses while ROA establishes shorter-term hypotheses used to ascertain whether the Ks and Us continue to hold.

Thus, overall, Strategic Management and Finance are both about management of uncertainty, mitigating risk, and enhancing profitability in the short run and survivability in the long run. One can see the comparabilities in the techniques and, increasingly, in the processes. The authors remain convinced that by dialogues across the Strategic Management - Finance boundaries one can provide each “side” a more effective bundle of skills, tools, and processes.

EXHIBIT 3
RELATING KUU AND SP/SB/ERM/ROA/SA

<table>
<thead>
<tr>
<th>Technique /Process</th>
<th>Relationship to KUU</th>
<th>Lo</th>
<th>Uncertainty</th>
<th>Hi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario Planning (SP)</td>
<td>SP focuses on the longer-term futures where there is greater uncertainty and therefore higher risk (e.g., regulatory change; world political conditions). While SP deals with the knowns as a foundation, its emphasis is on the unknowns. Through pushing the boundaries using dialogue and consensus building, SP establishes plausible descriptions of the Unknowns and, potentially, the Unknowable.</td>
<td>X</td>
<td>XX</td>
<td>XX</td>
</tr>
</tbody>
</table>
Real Options Analysis (ROA)

ROA assumes future flexibility exogenous to the decision-makers (See, for example, Daniel A. Levinthal (Wharton), “What is not a Real Option: Considering Boundaries for the Application of Real Options to Business Strategy,” Academy of Management Review, January 2004). Thus, it necessarily deals with the knowns and the unknowns, i.e., Monte Carlo simulation of expectations. It would seem that ROA has more difficulty with the unknowables since (by definition?) unknowables may be subject to qualitative identification, but not quantification.

Application to KUU: X = applies somewhat; XX = applies moderately; XXX = applies strongly; ? = not sure

### CONCLUSIONS

Certainly new ideas don’t arrive fully developed in organizations. Incorporation of the concepts presented in this paper will require consideration by multiple levels in organizations, not just the dominant coalition. Steps include gaining the advocacy of senior executives, keeping the language simple, and breaking a new concept or process into “Trojan mice” [Davenport and Prusak, 2003].

ROA has been developed during the 1990s and provides complementary strengths and weaknesses as compared to SP as managers make strategic investment decisions under uncertainty. In an integrated risk management approach these two techniques can be combined. The process involves scenario development, exposure identification, formulating risk management responses, and implementation steps. The discussion in this paper encourages a corporate-level perspective incorporating consideration of the range of exposure across a firm’s portfolio of businesses.

How do these strategic and finance techniques, methodologies, processes, and programs relate to the KUU framework? The critical contingencies are the degrees of the uncertainties and the expectation as to whether, over time, current uncertainties will or can become certainty. From a business perspective one might invoke “good old SWOTs” (strengths, weaknesses, opportunities, and threats) and consider that SP and ROA are ways of examining and designing responses to OTs, i.e., those factors external to the firm.

The commonalities between SP and ROA are worthy of consideration. They include commonality of objectives, overlaps, and interconnections [Taylor, Leggio, Coates, and Dowd, 2002; Taylor and Leggio, 2003].

*They focus on the same basic objectives.* The two approaches have the same end goal in mind --- future viability of the firm. SP is concerned with long-term future unknowns while SA is concerned with identification and quantification and emphasizes profitability and firm value, generally a shorter-term perspective.

*There are tremendous overlaps between SP and ROA.* SP is essentially going through a process of examining the plausible states of critical OTs and then figuring out what might be the most appropriate action to take, i.e., how to deploy Ss (or core competences) and mitigate Ws, i.e., what changes in strategy should take place. That’s a very simplistic description of a process that has undergone 30 or more years of development. One of its most heralded stories, as noted earlier, is enabling Shell to respond more nimbly to the 1973-74 Oil Crisis than competitors.

SP, simplistically thinking, starts with an inventory of the knowns and then moves on to the future outcomes, or plausible states that the environment can take. SP is usually thought of in terms of a process for identifying longer-term plausible future states and is usually coupled with contingency planning, i.e., what should be done if that future state occurs and what is our current best alternative? Thus SP involves a process of which an outcome is generating strategic alternatives that are possible for addressing alternative futures. Going through the process of *dialogue* to gain agreement on the descriptions of those plausible long-term futures followed by discussion of the appropriate action to meet the broadest challenge of those futures is the most critical aspect of the process.
It is the *discussion* and the *arrival at consensus* that are critical --- in short the participants involved in the process come to a better common understanding of the range of the future situations that might develop. Depending on how the process is structured, the participants might also go the extra step of developing a better understanding of the appropriate response to each scenario. In short, the process yields contingency plans. SP provides the nodes on the distribution of the outcomes. It is a categorical scale to be sure.

SP is a *process*, a process that permits executives to work out a common understanding of the *possible* interactive effects of at least two factors or sets of factors in the environment. Once the players in the process have come to a common understanding of four quadrants or scenarios, it is more likely that that same set of players can come to concurrence as to what to do should that scenario begin to happen. Note this is about *possibilities* not *probability, plausibility* not *guessimates* of whether the scenario might happen. Stories are told about executives who have gone through a SP process together and then meeting in the hall and saying things like, “Well it looks more likely that ‘The Pits’ is where things are going …have you been preparing….?” It looks simple, doesn’t it? It’s not --- gaining consensus is only achieved through a carefully facilitated *process* --- indeed most observe that the process is at least as valuable as the outcome. Similarly the ROA encourages broadened participation in the dialogue and discussion as part of a process of coming to a common understanding of the possible outcomes for the decision under consideration.

**WHAT ARE THE INTERCONNECTIONS?**

The discussions within the SP and ROA processes especially enable executives to establish a range of combinations of possible future states and possible actions. In short, the executives are going through a form of a Total Enterprise Risk Management process. At the very least they have agreed ipso facto on the alternative scenarios and it is possible that they have identified the actions that would be appropriate given specific scenarios. As an extra stage, they might then concur on “leading indicators” that signal whether a scenario might possibly be occurring. The contingency plans are better understood as alternative actions. In short, the firm’s executives, at least, have built a broad-based understanding of their environment and the way that their company should be positioned to appropriately address that environment to increase its chances of survival. Another way of thinking about it is that the executives going through the process have used a qualitative process of truncating their loss alternatives, i.e., an outcome at which ROA is aimed.

It appears that the fields of Strategic Management and Finance have developed tools and processes that have commonalities. The tools discussed in this paper are among those that assist executives in identifying and managing uncertainties, mitigating risks, and exploiting opportunities. The biggest problem in crossing the borders between the disciplines is that for a long time academics have been trying to quantify strategy factors. That is appropriate. As Finance and Strategy come together, the finance perspective especially emphasizes quantifying inputs and outcomes. However, instead of trying to force quantification of strategic factors, one should be taking more of a qualitative approach with the financial tools and concepts. The intent thus is to extend the boundaries of K (i.e., what we know), U (i.e., what one does not know), and U (what one currently can’t know). As well-known psychologist, Eric Fromm, put it, “the quest for certainty blocks the search for meaning. Uncertainty is the very condition to impel man to unfold his powers” [Fromm, 1999]. In Strategic Management and Finance, one needs to mitigate concerns for differences and try to pull things together to integrate the two fields in theory, in research, and in practice so that one can expand understanding and in the process become more successful at mitigating negative outcomes in the short run, help organizations profitably pursue opportunities in the medium term, and seek appropriate survival alternatives in the long run.

**ENDNOTES**

2. See, for example, the work of Robert Bruner at the Darden School at the University of Virginia (http://faculty.darden.edu/brunerb/) including the recently completed case “Enron: 1986-2001” by Samuel Bodily and Robert Bruner.

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